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ABSTRACT

This document contains the three volumes of the technical report for development of the prototype of the Occupational Information Network (O*NET), which is intended to replace the "Dictionary of Occupational Titles." "General Introduction" (Norman G. Peterson) presents an overview of O*NET's purpose, content, and structure. "Research Method: Development and Field Testing of the Content Model" (Norman G. Peterson, Michael D. Mumford, Kerry Y. Levin, Jim Green, Joseph Waksberg) details the methodology used to assess the meaningfulness and usefulness of the O*NET system. The remaining four papers in volume 1 describe the results of the analysis of the data for the following O*NET domains: skills, knowledges, occupational preparation, and generalized work activities. The papers are as follows: "Basic and Cross-Functional Skills: Evidence for the Reliability and Validity of the Measures" (Michael D. Mumford, Norman G. Peterson, Ruth A. Childs); "Knowledges: Evidence for the Reliability and Validity of the Measures" (David P. Costanza, Edwin A. Fleishman, Joanne C. Marshall-Miles); "Education, Training, Experience, and Licensure/Certification: Evidence for the Reliability and Validity of Measures" (Lance E. Anderson); and "Generalized Work Activities: Evidence for the Reliability and Validity of Measures" (Walter C. Borman, P. Richard Jeanneret, U. Christean Kubisiak,

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Mary Ann Hanson). Five papers contain substantial bibliographies. The five papers in volume 2 describe the results of the analysis of the data for the following O*NET domains: work context, organizational context, abilities, occupational values, and work styles. The papers are as follows: "Work Context: Evidence for the Reliability and Validity of the Measures" (Mark H. Strong, P. Richard Jeanneret, S. Morton McPhail, Barry R. Blakely); "Organizational Context: Evidence for the Reliability and Validity of the Measures" (Sharon Arad, Mary Ann Hanson, Robert J. Schneider); "Abilities: Evidence for the Reliability and Validity of the Measures" (Edwin A. Fleishman, David P. Costanza, Joanne C. Marshall-Miles); "Occupational Interests and Values: Evidence for the Reliability and Validity of the Occupational Interest Codes and the Values Measures" (Christopher E. Sager), and "Work Style Descriptors: Evidence for the Reliability and Validity of Measures" (Walter C. Borman, U. Christean Kubisiak). Four papers contain substantial bibiographies. Papers in volume 3 cover topics that cut across the O*NET domains, including possible covariates of O*NET rating data, cross-domain analyses, cluster analyses of occupations, use of O*NET data to describe occupations, and analyses and methods of collecting occupation-specific information. The papers are as follows: "Occupational Descriptor Covariates: Possible Sources of Variance in O*NET Ratings" (Ruth A. Childs, Norman G. Peterson, Michael D. Mumford); "Cross-Domain Analysis Results" (Mary Ann Hanson, Walter C. Borman, U. Christean Kubisiak, Christopher E. Sager); "Occupational Classification: Using Basic and Cross-Functional Skills and Generalized Work Activities to Create Job Families" (Dwayne G. Norris, Wayne A. Baughman, Ashley E. Cooke, Norman G. Peterson, Michael D. Mumford); "Issues in O*NET Applications" (Walter C. Borman, Mary Ann Hanson, U. Christean Kubisiak); and "Occupation-Specific Descriptors: Approaches, Procedures, and Findings" (Michael D. Mumford, Christopher E. Sager, Wayne A. Baughman, Ruth A. Childs); and "Conclusions and Recommendations" (Norman G. Peterson). The computer-assisted telephone interview protocol for organizational representatives and other data collection materials are appended. One paper contains a substantial bibliography. (MN)

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O*NET Final Technical Report

Volume I
Volume II
Volume III

Submitted by

Norman G. Peterson

Michael D. Mumford

Walter C. Borman

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Sponsored by

Utah Department of Workforce Services

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September 1997

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O*NET Final Technical Report

The Occupational Information Network

TM

Volume I

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Sponsored by: Utah Department of Workforce Services
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September 1997

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Notice

The American Institutes for Research and its subcontractors, Personnel Decisions Research Institutes, Inc., Management Research Institute, Inc., Jeanneret & Associates, Inc., and Westat, Inc., performed the work described herein under Contract Number 94-542, administered by the Utah Department of Employment Security, on behalf of the U.S. Department of Labor.

Under this contract, the American Institutes for Research and its subcontractors developed an operational prototype for an occupational data collection, analysis, and dissemination system--the Occupational Information Network or O*NET--to replace the Department of Labor's *Dictionary of Occupational Titles*. This report, *O*NET Final Technical Report*, submitted by the American Institutes for Research as a major deliverable under this contract, describes the empirical evidence provided by the preliminary data collection effort for the meaningfulness of the prototype system. An earlier report, *Development of Prototype Occupational Information Network (O*NET) Content Model*, described the development of the model underlying the O*NET and the design of the questionnaires used to collect the occupational information. A separate report, *O*NET: An Information System for the Workplace. Designing an Electronic Infrastructure* (Rose, Hesse, Silver, & Dumas, 1996), describes the development of the electronic database and provides technical documentation for the database.

The Holland Occupational Codes and explanatory text included in Chapter 10 of this document are adapted and reproduced by special permission of the Publisher, Psychological Assessment Resources, Inc., Odessa, FL 33556, from the *Dictionary of Holland Occupational Codes, Second Edition* by Gary D. Gottfredson, Ph.D., and John L. Holland, Ph.D., Copyright, 1982, 1989. Further reproduction for any purpose or by any means is prohibited without the prior written permission of the Publisher.

Please note that the analysis results tables in Chapters 3 through 11 are numbered uniformly across chapters. Because some analyses are not appropriate for every domain, some domains are missing certain table numbers. This is intentional. Please refer to chapter 2 and, particularly, Figure 2-17 for a listing of what tables should appear in each chapter.

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Barbara Smith, *State of Utah Occupational Analysis Field Center,* Contract Monitor

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Chapter 1

General Introduction

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American Institutes for Research

This is the final technical report for the development of the prototype of the Occupational Information Network, or O*NET. O*NET is intended to be the replacement of the Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1991). This project has its origins in the report of the Secretary of Labor's Advisory Panel on the DOT (APDOT; U.S. Department of Labor, 1993). The findings of that committee led directly to this effort. Among the recommendations of APDOT, perhaps most seminal were the general recommendations that the DOT replacement be an electronic database, rather than a book, and that it contain a comprehensive set of occupational information that would meet the requirements of a diverse set of informational consumers. More specifically, the APDOT outlined some of the types of occupational descriptors that might be used in the DOT replacement, recommended the use of

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survey methodology, and called for frequent updating of the information in the occupational database.

Much of the initial effort of this project was directed toward devising a general approach for organizing occupational description to accomplish these ends. The results of those efforts are contained in the "content model" report (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1995). Figure 1-1 shows the O*NET content model as described in that report. We will not attempt to duplicate that report here, but several points about the model bear mention.

First, there are several taxonomic domains. These can be thought of as multiple "windows" for viewing an occupation. Thus, an experienced worker with a long work history might be more interested in cross-functional skills required for an occupation, while a recent high-school graduate might be more interested in abilities or basic skills--since the recent graduate will have had less time and fewer experiences to develop such skills. Vocational counselors will be more interested in the interests' and values' profiles for an occupation, while educators might be more interested in the required knowledges.

The use of multiple windows for diverse users requires the development of relatively complete taxonomies within each window. Thus, users do not have to access many windows or domains to obtain a complete picture, for them, of an occupation, when their interests are most likely to be restricted to one or a few domains.. On the other hand, some descriptors within a domain will no doubt appear to be and may, empirically, turn out to be highly related to some descriptors in another domain--because of the desire for within-domain completeness.

Each domain of descriptors has been developed to apply across occupations. That is, the level of detail and definition was intended to allow the sensible use of the descriptors across all occupations, but still, when used collectively, be useful for clear discriminations between

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occupations. The scales accompanying each occupational descriptor (e.g., level of complexity or importance) were developed to allow quantitative descriptions of and discriminations between occupations.

Partially apparent in Figure 1-1 is the hierarchical nature of the O*NET system. Note that abilities, occupational values and interests, and work styles are grouped under worker characteristics, while generalized work activities, work context, and organizational context are grouped under occupational requirements. This descending hierarchy continues to several more levels, as described in the content model report and in later chapters in this report. Use of hierarchies in this manner allows easier access and understanding of the large numbers of variables in the content model; each user can access the information at the appropriate level. However, this incurs the cost of examining the appropriateness and limits of aggregating quantitative data up from the most basic level. In the prototype project, all data were collected at the lowest levels of these hierarchies and initial investigations of data aggregation were conducted.

Also somewhat implicit in Figure 1-1 is the relational nature of the O*NET system. In a relatively mundane, but important, sense, this refers to the fact that all the occupational descriptor data are ultimately housed in an electronic, relational database with the various data fields linked by a common occupational code. In a larger sense, it refers to the notion that all the various domains are conceptually and theoretically linked, as outlined in the content model report, and are susceptible to being empirically linked through analyses of the quantitative data. We have taken the first steps toward these empirical investigations in this report.

Perhaps most importantly, but not apparent in the figure, is the notion that the O*NET provides a common language for describing and thinking about occupations. The actual

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definitions and rating scales that accompany each descriptor provide the basic elements of this language, the words. The theoretical and empirical relationships between the descriptors within each domain and across the domains begin to provide a sort of grammar for the occupational universe--the ways in which the words fit together to provide information about occupations. Accompanying this notion is the very real point that language is not static, but constantly evolving--although not at a rate that obviates the usefulness of the language.

The remainder of this report describes the initial attempt to make operational the O*NET content model--that is, to identify occupations upon which to collect O*NET information in a systematic way and to analyze that data to discover its reliability, its internal structure, its ability to differentiate and to cluster occupations, and its usefulness for describing occupations. Chapter 2 describes the research methodology, including sampling data collection procedures, and the general analytic methods employed. The next nine chapters describe the results of the analyses of the data for each O*NET domain: skills, knowledges, occupational preparation, generalized work activities, work context, organizational context, abilities, occupational values, and work styles. Chapters 12 through 16 cover topics that cut across the domains, including possible covariates of O*NET rating data, cross-domain analyses, cluster analyses of occupations, use of O*NET data to describe occupations, and analyses and methods of collecting occupation-specific information. The final chapter presents some general conclusions and recommendations for future research and development.

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U.S. Department of Labor (1993). The new DOT: A database of occupational titles for the twenty-first century. Washington, DC: Author.

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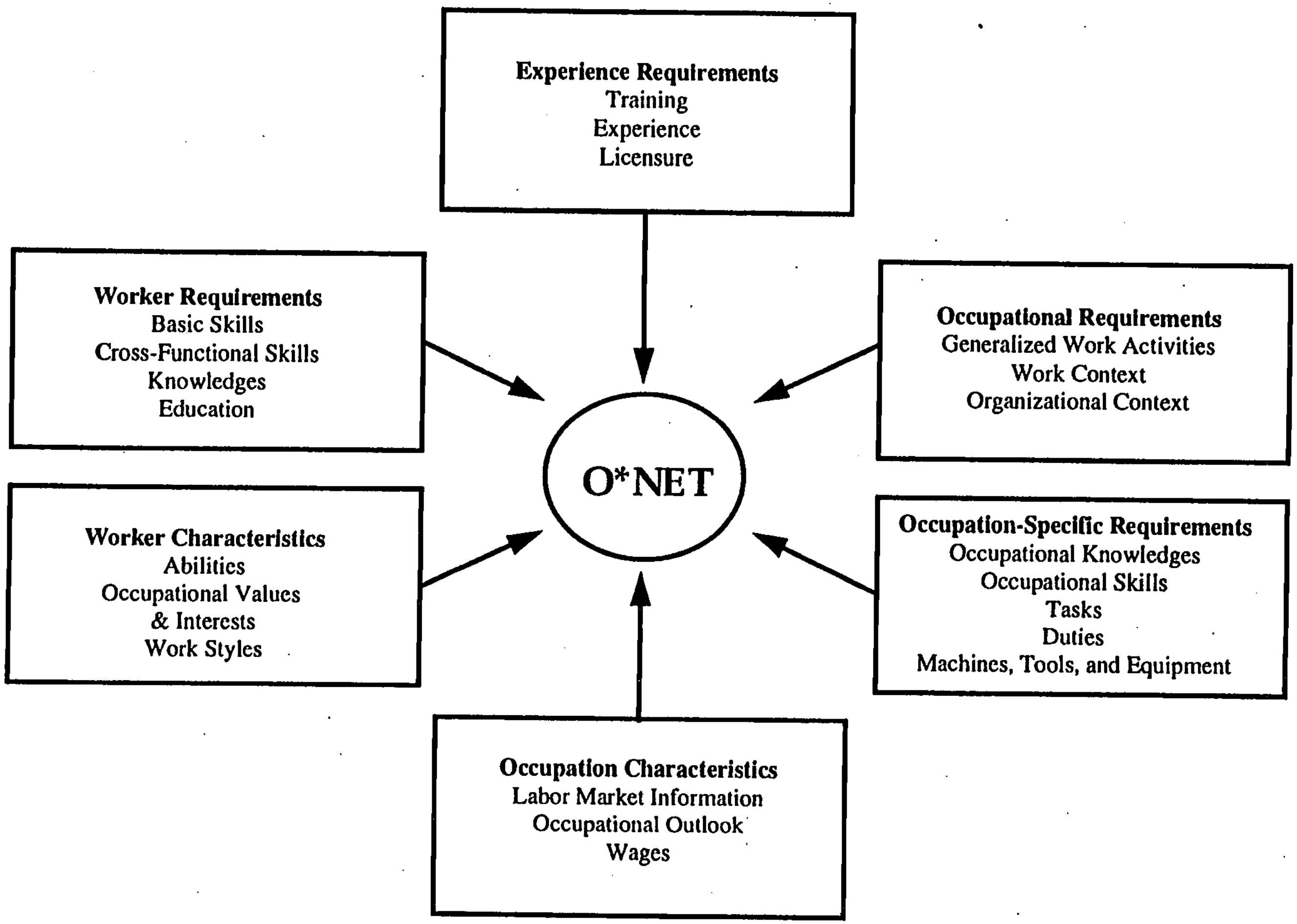
Figure I-1
O*NET Content Model



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Chapter 2

Research Method:

Development and Field Testing of the Content Model

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Introduction and Background

Our objective in developing the taxonomies of cross-occupation descriptions which form the content model was to provide a basis for measuring the similarities and differences observed among occupations. A variety of procedures might be used to describe occupations with respect to their status on these variables. One might, for example, develop an objective, formal test intended to assess workers' expressions of each characteristic. Alternatively, one might ask occupational analysts to observe worker performance and then rate the extent to which each variable was required for effective performance.

In fact, ratings represent the technique most commonly used to obtain descriptions of occupation characteristics. To obtain these ratings, definitions of the variables of interest are presented to people familiar with the occupation. Judges are then asked to describe how the variables manifest themselves in job performance, using rating scales which examine different ways the variables might be expressed. For example, one might ask judges to describe how frequently an activity is performed and how important it is to job performance.

This widespread use of ratings in the description of occupation characteristics is attributable to three characteristics of the approach. First, ratings allow a great deal of descriptive information to be collected at a relatively low cost. Second, ratings allow us to draw on the expertise of the people doing the work in assessing occupational requirements. Third, because a variety of different types of rating scales might be developed, it is possible to look at the different ways a given descriptor variable manifests itself on people's jobs.

This final comment brings to the fore a new question: exactly what type of rating scales should be used in describing occupations? A variety of different types of rating scales have been developed. Fleishman's (1982) ability requirement ratings, for example, are based on behaviorally anchored scales examining the level of the ability required for task performance. A number of other scales for describing ability requirements have been suggested, such as the importance of the ability in accounting for observed performance differences or, alternatively, its impact on performance under emergency conditions (P. D. Sackett, personal communication, 1993).

As Messick (1995) points out, selection of a particular rating scale should be based on the nature of the variable at hand and the type of inferences to be drawn. Thus, Work Context variables (e.g., Noise) might be assessed in terms of frequency or intensity. Frequency and intensity scales, however, would not be appropriate for assessing skills and abilities. Thus, in developing the O*NET system, different types of rating scales were used to assess the variables included in different taxonomies (Mumford, Weeks, Harding, & Fleishman, 1987). The types of rating scales to be applied were selected based on: (1) the key manifestations of the variable on people's jobs, (2) the feasibility of applying the scale across occupations, (3) the usefulness of the descriptive information provided, (4) the appropriateness of the scale for observational ratings, and (5) the available evidence bearing on the reliability and validity of the resulting descriptive information (Friedman & Harvey, 1986; Harvey & Lozada-Larsen, 1988).

Although rating scales were necessarily specific to the particular types of variables under consideration, certain general characteristics of these rating scales should be noted. To begin, in most cases, multiple types of ratings were obtained for a given set of variables. Multiple ratings were obtained primarily because a number of questions might be asked about the variables included in a taxonomy (Cornelius, Carron, & Collins, 1979; Cornelius, Hakel, & Sackett, 1979). Use of multiple ratings, however, also offered some advantages by forcing people to carefully consider the questions being asked and to distinguish among constructs--a feature of multiple rating tasks that contributes to the reliability and validity of the resulting descriptive information (McCormick, 1964). Second, in all cases where level ratings were applicable--abilities and skills, for example--level ratings were obtained, based on their demonstrated reliability (Fleishman & Quaintance, 1984; Fleishman & Mumford, 1988) and the merits of level ratings in addressing questions about job demands. In accordance with the procedures recommended by Fleishman and Mumford (1988), these level ratings were obtained using seven-point behaviorally anchored rating scales. These anchors were developed using standard judgmental scaling procedures (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1995; Childs & Whetzel, 1995). Most other ratings, however, were obtained on standard four- or seven-point Likert Scales. In this regard, however, it is important to note that, whenever possible, an attempt was made to develop anchors that could be scaled on an absolute rather than a relative continuum. Absolute scales ("How much time do you spend on this activity?") were used rather than relative scales ("Do you spend more time on this activity as compared to other activities?") in order to facilitate cross-occupation comparisons (Harvey, 1990).

In developing these rating scales, a number of other steps were taken to help insure the reliability and validity of the resulting descriptive information. First, all rating scales were constructed using operational, rather than technical, definitions written to clearly convey the nature of the variables, eliminate jargon, and minimize reading difficulty. Second, these operational definitions of the variables, along with the associated rating scales, were administered to some 250 people, working on jobs ranging from construction worker to college professor (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1995). In this pilot study, after respondents had used these rating scales to describe their jobs, they were interviewed one or more times. Respondents' comments were used to identify any ambiguities in rating instructions, variable labels, operational definitions, and rating scale anchors. Finally, several experienced occupational analysts were asked to review the rating instructions, variable labels, operational definitions, and rating scale anchors for clarity, readability, and appropriateness for use in describing people's jobs. The revisions resulting from workers' and analysts' comments resulted in revised scales and rating procedures that could be expected to yield adequate reliability and validity, while casting scales in a common language framework intended to facilitate communication and minimize the burden placed on raters.

Figure 2-1 presents the rating scales developed for one Skill and one Generalized Work Activity. The instructions accompanying these rating scales are illustrated in Figure 2-2, which presents the instructions developed for the skills questionnaire. These rating scales typify the basic instruments used to assess similarities and differences among occupations with respect to the cross-occupation descriptors.

In developing these measures, it was necessary to address two other procedural issues: (1) what source would be used to obtain ratings and (2) what data collection formats would be used to gather these ratings? When occupation characteristics are to be described using judgmental techniques, such as ratings, it is necessary to obtain descriptive information from people who have the expertise needed to provide accurate, meaningful assessments of occupational requirements (Cornelius, Denisi, & Blencoe, 1984). Broadly speaking, three types of raters are available who have the background needed to provide adequate assessments of occupation characteristics: (1) workers, or incumbents, (2) supervisors, and (3) occupational analysts. Occupational analysts' ratings are often seen as the best source of descriptive ratings, in part because analysts are viewed as more objective, and also because analysts are seen as having a better understanding of how the occupation at hand compares to other occupations (Henderson, 1988).

On the other hand, a variety of available evidence indicates that analysts may not necessarily yield superior descriptions, at least under conditions where there is no overt motive for faking. In one study along these lines, Fleishman and Mumford (1988) examined the degree of agreement observed on ability requirement ratings obtained from incumbents, supervisors, and occupational analysts. They found that in the kind of high ability populations examined in this study, all three types of raters provided virtually identical descriptions of ability requirements.

The results obtained in the Fleishman and Mumford (1988) study are by no means unique. Peterson, Owens-Kuntz, Hoffman, Arabian, and Whetzel (1990) had soldiers, their supervisors, and occupational analysts assess the knowledge, skill, ability, and work style requirements of a sample of army jobs. Again, it was found that these three types of judges displayed substantial agreement.

Taken as a whole, these studies suggest that occupation descriptions might be obtained from any of these three types of judges. Incumbents, however, seemed best able to provide information across all descriptor domains, especially complex, difficult-to-observe occupation characteristics, such as work styles and organizational context variables. Large samples of knowledgeable incumbents are available, which should contribute to the reliability of the resulting descriptive system. This same consideration, of course, recommends the use of incumbents', as opposed to supervisors', ratings since it generally is easier to obtain sizable samples of incumbents.

Although these considerations recommend the use of incumbents' ratings, one further point should be borne in mind. Incumbents' ratings essentially base description on the smallest possible unit of analysis--the positions of individual workers. By basing description on these discrete units, without the imposition of an up front structure, it becomes possible to formulate a more flexible occupational information system than would be the case if analysts' or supervisors' ratings were used. Regarding type of rater, we were able to take advantage of a related Department of Labor project to convert the Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1991) information to O*NET information. In this effort, occupational analysts used DOT task information about occupations to rate occupations on O*NET descriptor scales. This allowed the possibility of comparing the two kinds of ratings.

Not only can ratings be obtained from a number of different types of judges, ratings might be obtained using a number of different data collection techniques. The most common procedure used to collect ratings is the traditional paper-and-pencil measure. Paper-and-pencil questionnaires represent a flexible data collection technique that minimizes costs while ensuring that the measures can be applied across a wide range of job settings. Nonetheless, a number of other techniques are available. For example, computer assisted telephone interview (CATI) or survey "fax back" techniques might at some time represent viable alternatives to traditional paper-and-pencil surveys. Rating questionnaires might also be administered using computer assisted data collection techniques, such as DOS- or Windows-based administration of the paper-and-pencil surveys or use of the World Wide Web as a basis for survey administration. Computer assisted survey administration, of course, reduces data coding costs, while opening up the possibility of applying new types of unobtrusive measures during data collection. On the other hand, however, these techniques cannot readily be applied on many lower level jobs lacking easy access to the requisite technology.

Based on the flexibility of paper-and-pencil techniques, and the need to cover a wide range of occupations, the paper-and-pencil approach was the primary method used in administering the rating scales developed in the present effort. However, the feasibility of using computer-administered versions of the paper-and-pencil surveys was assessed in a sample of ten occupations where incumbents were likely to have access to the requisite technology.

These rating scales were also developed for possible administration over the World Wide Web. However, web-based administration, because it prohibits systematic sampling, was considered a purely exploratory technique.

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Assessing Internal and External Validity

No matter how careful the procedures used in scale development, these procedures cannot provide empirical evidence for the meaningfulness of the occupation descriptions obtained from the O*NET cross-occupation descriptors. Accordingly, there is a need for evidence indicating that meaningful inferences about the characteristics of people's jobs can be obtained from those measures. Fleishman and Mumford (1991) proposed a set of tests that might be used to accrue evidence for the meaningfulness of the descriptive data provided by job analysis measures, drawing a distinction between two basic types of evidence. They argue that evidence bearing on the meaningfulness of cross-occupation taxonomies may be obtained by considering internal or external validity evidence.

Essentially, internal validity examines the relationships embedded in the taxonomy as a basis for drawing inferences with regard to its meaningfulness. For example, one might examine the degree of agreement observed among judges in describing an occupation or set of occupations (Cronbach, 1990; Fleishman & Mumford, 1991). Alternatively, one might use techniques such as confirmatory factor analysis to assess whether the variables included in the taxonomy evidence a meaningful pattern of relationships. Although those various internal validity indicators provide some important evidence for the meaningfulness of a descriptive system, it is important to bear in mind that, ultimately, these taxonomies--and the resulting measures--are intended to describe the similarities and differences among occupations. Thus, an essential piece of evidence that must be provided in evaluating any taxonomy used to describe people's jobs is whether the resulting descriptive system, in fact, provides meaningful discrimination of occupations.

The kind of internal validity tests described above examine inferences drawn from within a particular descriptive system--for example, the consistency and reliability of descriptors within a particular domain, and the intuitive sensibility of the empirical relationships of descriptors within a domain. External validity assessments attempt to establish whether inferences about occupations divined from a given set of descriptors, in fact, can be supported by considering relationships that go beyond, or were not considered, in initial development of the classification. For example, some evidence for the skills taxonomy might be provided by showing that occupations held to require problem solving skills also tend to involve similar generalized work activities, a separate O*NET taxonomic domain. In accruing external validation evidence for the meaningfulness of a taxonomy, a variety of different types of tests of this nature might be conducted (Messick, 1989, 1995).

These introductory remarks set the stage for the detailed consideration of the analyses of the data collected using the O*NET occupational analysis instruments on a sample of occupations. The remainder of this chapter describes the sampling methods, data collection procedures, obtained response rates and associated issues, and the general analyses that were conducted to evaluate the internal and external validity of the O*NET system.

Sampling

In order to facilitate assessment of internal or external validity, data describing people's jobs with respect to the relevant descriptors is required. One cannot draw general conclusions about the meaningfulness of the resulting information unless data have been obtained from an adequate, reasonably representative sample of occupations. Accordingly, substantial effort was devoted to obtaining a representative sample of occupations for use in assessing the O*NET descriptive system, employing a multi-stage sampling design. The following section details each

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of the three sampling stages--Selecting Occupations, Identifying Establishments, and Selecting Incumbents--for both the baseline and feasibility studies, and explores some of the caveats applicable at each stage of the sampling design. Figure 2-3 depicts these three major stages of sampling for the baseline and feasibility studies.

Selecting Occupations

The framework used for sampling occupations was based on the 1984 Occupational Employment Statistics (OES) classification, which describes occupations in terms of a six-digit code. The first two digits of this six-digit system describe the job family, while the third digit identifies occupations within this job family. The occupational sampling frame for the baseline study was created by merging the 1991, 1992, and 1993 Occupational Employment Statistics (OES) data files with the job family codes from the National Crosswalk Service Center's (NCSC) data file. The merged OES data files provided a file of occupational data with multiple records by year for a given occupation. One record was created for each unique five-digit occupation code by collapsing multiple occurrences of a given occupation code and cumulating total employment.

The OES and NCSC file merge was largely successful, with only 14 NCSC occupations not receiving OES codes. The NCSC file then provided additional codes for 10 of the non-matching OES occupations. These four unmatched occupations were removed from the sampling frame. Their occupation codes, titles, and total employment are as follows:

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Occupation Code	Occupation Title	Total Employment
22514	Drafters	286,920
79014	Gardeners and groundskeepers	127,660
87705	Pile driving operators	1,400
93951	Engraving & printing workers, hand	3,850

One further restriction applies to the occupation sampling frame. Occupations unique to Federal government entities are not represented in the occupation sampling frame. Therefore, employment counts for those occupations underestimate the total United States employment counts by the number of Federal employees in those occupations. (An OES supplement includes data on Federal government entities, but this data set excludes 19 large Federal entities and, therefore, we considered this supplemental data set insufficient for use in the occupation sampling frame.)

The resulting sampling frame is presented in Figure 2-4. This figure provides counts of occupations, total employment, and sample size by two- and three-digit job family code. Each cell of the figure provides information for a particular three-digit job family. These cells represent areas of analytic interest and were therefore used as strata for the sample of occupations. Cells with fewer than two hundred thousand employees were excluded from the sample design (i.e., they were assigned sample sizes of zero). There was no information in the OES files for some job families (e.g., job family "104") and a small amount of employment was reported for three-digit job family codes that did not appear in the original job family matrix provided to us. Both types of cells were excluded from the sample design.

There are several reasons for the selection of a probability sample of occupations, using probability proportionate to size. A major reason for using probability sampling was to have an objective method of picking the occupations to study, thereby avoiding conscious or unconscious biases in selection choices. This type of sampling tends to result in the selection of larger occupations (in terms of number of employees), thereby permitting wide coverage of the work force with relatively few jobs. Additionally, when probability proportionate to size is used for the first stage of selection and a constant number of employees are chosen per occupation, the sample produces close to equal probabilities of choosing employees. This was a desirable property of the sample, even though no national estimates are planned. Therefore, we allocated 70 occupations across the 14 columns of the job family matrix with the probability proportional to the column total employment. This simply means that occupations with larger employment totals received a larger number of job families to sample. Adjustments were made to the column sample sizes so that at least one occupation could be selected within each cell. For example, we allocated two occupations to job family column "10" to ensure selection of one occupation each in rows "101" and "102" instead of the 0.65 total occupations warranted under strictly proportional allocation. We allocated the resulting column sample sizes across cells in a similar manner. The final sample size for each cell is given by the last entry in each table cell. A sampling macro was then used to select the specified number of occupations within each cell with probability proportional to total employment. The 70 occupations selected in this manner represent approximately 45% of the workforce, consistent with our goal in employing probability sampling.

Since employer demands are placing greater emphasis on computer and technical skills, there was a need to ensure that the prototype included occupations considered to be highly technological in nature. A limitation of the OES sampling frame is that it taps occupations proportional to the amount of current employment and does not necessarily include emerging or highly technological occupations. Thus, it was necessary to adopt an additional sampling technique in order to include the emerging, technological occupations.

A literature review suggested that highly technological occupations are prevalent in many high performance organizations (Arad, Schneider, & Hanson, 1995). These organizations emphasize the importance of innovation and technology in the workplace. Employment within high performance organizations tends to set industry standards and the organizations are often used as benchmarks for job and market trends. Thus, high performance workplaces seemed a logical place to find the types of occupations absent from the sample selected using traditional statistical techniques.

The literature review indicated that many high performance organizations were concentrated within a few industries. Thus, we chose the most commonly represented industries in the literature and used the concatenated OES data files from those industries to select additional occupations. Occupations considered for selection were those that were commonly found within high performance industries and were technological in nature. Ten occupations that met those criteria were chosen to supplement the original sample of 70 occupations.

Taken together, the sample of occupations used for initial development of the O*NET system consisted of 80 unique occupations--70 of which were selected proportional to current employment size using the OES sampling technique, and 10 of which were selected from industries frequently represented in the high performance literature. Figure 2-5 provides two- or three digit job family code, occupation code, occupation title, and total employment of the 80 occupations selected for inclusion in the baseline study.

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Selecting Organizations

Once the 80 occupations were approved, a list of establishments that were likely to employ people in those occupations was obtained. Dun and Bradstreet (D&B) maintains complete and up-to-date files of all establishments in the United States and provides names, addresses, and phone numbers to customers. These data files were used to identify establishments--business units--likely to employ people on the targeted jobs.

In communicating project requirements to D&B, the assumption was that four standard industrial classification (SICs) were sufficient to represent each occupation. Thus, a total of three hundred and twenty SICs were initially requested (4 SICs x 80 occupations); however, because some occupations mapped to fewer than four SICs in D&B's files, only 143 SICs were actually selected. These SICs were chosen on the basis of having a high probability of employing people in the 80 occupations of interest.

D&B was instructed to randomly select a sample of 2,160 establishments from their file. They were asked to stratify the sample across the 143 three-digit SICs. D&B stratified the sample across the following four employment size classes: (a) 5 to 24 employees, (b) 25 to 99 employees, (c) 100 to 499 employees, and (d) 500 or more employees. Establishments that employed fewer than five people were excluded, as they were not expected to yield enough employees in each sampled occupation.

Once the sample was returned from D&B, it was partitioned into a baseline sample ($\underline{n}$ = 1,240 establishments) and a reserve sample ($\underline{n}$ = 720 establishments). The reserve sample was used only when employer cooperation was less than anticipated.

For roughly 20 occupations, these procedures failed to provide the requisite number of establishments needed to obtain the targeted sample size. In some cases, the problem was due to

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the need for greater specificity in sampling occupations (e.g., photographers). In other cases, it was attributed to the number of people employed on the job at a given establishment (e.g., butchers). Accordingly, a two-phase plan was developed to address these problems. The first phase involved extending the number of establishments sampled by an additional 400, but using more specific SIC codes. The second phase involved identifying the remaining occupations where a sufficient number of potential participants had not been identified and then identifying people employed on these jobs, using alternative sources for identifying workers, such as trade associations, unions, and public announcements of the project.

Selecting Incumbents

Screening

Once establishments employing people in the targeted occupations had been identified, attempts were made to contact each of those establishments, solicit their cooperation, and obtain a sample of incumbents, people currently working on the targeted job. Due to the dynamic nature of businesses, the D&B sample contained a certain amount of out-of-date or missing information. Additionally, response rates improve when researchers can identify, by name, the appropriate respondent prior to an initial contact. For these reasons, telephone interviewers contacted sample establishments prior to negotiating study participation. Interviewers called each company in the sample to confirm the name, address, and size of the organization, and to obtain the name and title of the appropriate person to send an advance letter explaining the study. (These points-of contact were generally human resource personnel.) The screening interview was designed to be answered by a receptionist and took about 5 minutes to administer. The three day screening resulted in a sample of 1,055 establishments. One hundred and ten of the original sample were

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ineligible to participate, as they employed fewer than five people. One hundred and seventy-five establishments were out of business, duplicates, or not locatable, and/or refused to participate.

Establishments qualified to participate in the study were mailed an advance letter. The advance letter described the purpose of the study, discussed how they could help, and provided a fact sheet about the O*NET project which was used to support the solicitation for study participation. Copies of the data collection materials are contained in Appendix B of this report.

Negotiation and Incumbent Selection

Perhaps the most important aspect of the data collection effort involved negotiating study participation with the employer sample in the baseline and feasibility (diskette-by-mail) studies. Success in negotiating is necessary to ensure study participation and endorsement by employers. Once employers agree to participate, they are asked to provide organizational data and coordinate the collection of occupational information from their employees. Negotiations are also necessary to confirm the existence of the occupations that are expected to be present in each establishment, and the number of persons employed in each. The numbers gathered during negotiations are used to sample employees in each occupation across all participating establishments. A script was used in negotiating study participation with organizations.

Due to the complexity of these negotiations and the high level of expertise needed, Occupational Analysis Field Center (OAFC) staff took primary responsibility for this activity. The OAFC analysts were provided with training in negotiation procedures. The negotiation involved contacting point-of-contact personnel (POCs) at each sampled establishments by telephone and providing information about the study, gaining agreement to participate, and making appointments for later interviews. Prior to negotiation, a list of occupations likely to be present within each sampled establishment was generated based upon matching the establishment with its major SIC. No more than 10 occupations were assigned to an establishment. During the negotiation, POCs were asked to confirm that these occupations were present in the organization and provide the number of incumbents (employees) in each of those occupations. Following negotiations, all of the information about the number of incumbents within an occupation received from these organizational representatives was then entered into an employee sampling database.

Finally, the number of employees to sample per occupation within an establishment was generated based upon targeted sample sizes. Sampling rates were based upon overall employment within the occupation studied. For example, occupations like secretaries yielded large numbers of employees in the sampling database. These large numbers led to low sampling rates. Low sampling rates mean that the sample of secretaries was spread across many establishments, with any one establishment only asked for a small number of employees in that occupation.

On the other hand, a different outcome occurred for occupations such as librarians, which yielded smaller counts of employees in the sampling database. Occupations like this resulted in higher sampling rates. This means that the sample of librarians, in this example, was spread across fewer establishments, thereby requiring more employees to be sampled within each establishment.

<u>Organizational Representative Interview</u>

Following the negotiation phase, the organizational representatives (POCs) of organizations that agreed to participate were contacted again to complete a 40- to 45-minute computer assisted telephone interview (CATI) designed to be conducted with the POC. The protocol for the CATI is contained in Appendix A to this report.

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Since the organizational representative interview was originally developed for paper-and pencil administration, it was necessary to revise it for CATI administration. A team of industrial psychologists worked together to shorten questions and simplify them as much as possible without destroying meaning. The revised measure was pilot tested, via telephone, on three volunteer respondents. The respondents were human resource representatives with responsibilities similar to those of eventual study respondents. Respondents agreed in advance to participate in the pilot interview, but were not given any information about the types of questions they would be asked.

The pilot test revealed that the instrument was too long overall when used in interview form. Furthermore, some question stems were too long as were some of the response choice alternatives. Therefore, many of the examples and definitions from the body of the questionnaire were eliminated. Care was taken to leave examples and definitions intact if their elimination would alter the construct being measured. The examples and definitions that were removed were transferred into a Question-by-Question Specification Guide. This guide was available to interviewers so that they could answer any questions respondents may have in a standardized manner. In addition, several questions were dropped because they duplicated information ascertained elsewhere. Following revisions, the interview time was reduced from 65 to 40 minutes. Following these revisions, the organizational representative interview was programmed using Cheshire, Westat's proprietary CATI system.

At the conclusion of the organizational survey interview, the POC was told which occupation(s) at his/her establishment were recommended for sampling, and the number of incumbents needed in each occupation. During this discussion, the POC's responsibilities in

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collecting job analysis questionnaires from his or her organization's employees was reiterated. Interviews with POCs occurred from October 1995 through January 1996.

Following completion of the CATI interview, the POC was sent a package containing: (a) a letter thanking the POC for participating, (b) instructions for implementing the project, (c) a list containing the number of incumbents needed to complete job analysis questionnaires in each of the selected occupations, (d) job analysis questionnaire packets--one for each incumbent, and (e) materials that could be distributed to explain the study to managers and incumbents.

The POC was asked to randomly select incumbents in the designated occupations from among those who had been employed on the job for six months or more, and to coordinate the distribution and collection of job analysis questionnaires from participating incumbents.

The selected incumbents received, from the POCs, a packet containing: (a) a letter introducing the study, (b) instructions for completing questionnaires, (c) supporting materials and information, (d) a background information questionnaire, (e) an occupation-specific task questionnaire, and (f) two to four general across-occupation questionnaires.

Incumbents were asked to complete the questionnaires at work and return them in a sealed envelope to the POC. The POC then forwarded these packets for processing. Follow-up telephone calls were conducted to prompt non-responding employers. The purpose of the follow-up was to answer POC questions and to encourage study participation. An interview form was used in carrying out the telephone follow up calls. One follow-up phone call was made approximately every two weeks for the following six weeks after the POC had received his or her package of questionnaires.

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Data Collection Procedures

Measure Administration

To this point we have examined sampling procedures. Although this background is needed to understand the nature of the sample, it does not provide information about how the measures were administered to sample members.

The sampling procedures used in initial development of the O*NET occupational information system were designed to provide 30 incumbents on each measure for a given job. This targeted cell size was selected based on two considerations. First, samples of 20 to 30 individuals typically yield stable means and standard deviations (Winer, 1971)--a point of some importance if these measures are to be used in describing people's jobs. Second, prior research by Fleishman and his colleagues (e.g., Fleishman & Mumford, 1988; Fleishman & Quaintance, 1984) and others (e.g., Hunter, 1980) indicates that 15 to 30 incumbents are typically sufficient to obtain adequate interrater agreement coefficients, given the type of measures being used to describe people's jobs.

To obtain 30 incumbents' assessments of their jobs on each measure, however, it was necessary to use sampling procedures that provided roughly 100 incumbents for each of the targeted occupations. The need for such a large number of incumbents was based on the structure of the content model and its implications for data collection. More specifically, the content model included a number of different descriptor domains (e.g., skills and knowledges). Furthermore, within any given domain--skills, for example--it was expected that a relatively large number of descriptors would be required, roughly 30 or 40. Because organizations could not be expected to provide more than 90 minutes of an incumbent's time, not all measures could be administered to all incumbents.

To minimize testing time and ensure that the relationships among measures could be examined, we used a rotation design in administering the rating scales. In this rotation design, the measures developed for a given description domain--skills, for example--were treated as a distinct questionnaire. The questionnaires were grouped into packets, where each packet contained 2 or 3 distinct questionnaires, accompanied by background material and a short task inventory, and took 60 to 90 minutes to complete. In all, 15 different packets were assembled. These packets were rotated across five administration sets, such that each questionnaire was paired at least once with every other questionnaire. Figure 2-6 presents this rotation design, noting both the time needed to complete each questionnaire and the time needed to complete all questionnaires included in the packet.

This design required 100 incumbents on each job in order to obtain 33 incumbents who responded to each questionnaire and a smaller number (minimum = 6) of incumbents who responded to any given pair of questionnaires. Accordingly, this design required 8,000 incumbents overall across the 80 occupations considered in development of the O*NET content model. An additional 1,000 incumbents were required as part of the methods feasibility study, to be given computer-administered versions of the questionnaires.

With regard to this design, four other points should be mentioned. First, questionnaires were rotated across packets to minimize potential order and priming effects (Morgeson & Campion, 1996). However, within a questionnaire, order was fixed to maintain the structure of the taxonomies and reduce burdens placed on the incumbents. Second, all packets began with an introduction describing the study, stressing that the data were being gathered as part of a national research study. Third, following this introductory material, all incumbents were asked to complete a short background information form, where they were asked to indicate age, sex, educational level, and years of experience. Fourth, once they had completed the various questionnaires included in their packet, all incumbents were asked to rate the frequency with which they performed and the importance of certain tasks on their jobs, identified by occupational analysts using available DOT data for the targeted occupations.

Due to the nature of this design and the measures in use, separate instructions were formulated for each questionnaire. Incumbents were asked to read these instructions before starting work on a questionnaire. These instructions, although they necessarily differed across questionnaires, followed a common format. They began by describing the general nature of the rating task, asking incumbents to describe their current job using the provided rating scales. Next they described in some detail the nature of each rating scale, carefully distinguishing between different ratings (e.g., level and importance) being collected for the variables included in a given questionnaire. Finally, an example of the ratings was provided. Figure 2-2 provides an illustration of these instructions, in this case, the instructions accompanying the skills questionnaire.

Comparative Studies

Methods Comparison Study

To examine the feasibility of collecting descriptive information on content model variables using other, alternative data collection techniques, a method comparison study was conducted. The alternative data collection methods used in this comparison included mail-out of diskettes containing computer-administered versions of the questionnaires.

To conduct this methods comparison study, 10 occupations in which workers were likely to have access to personal computers (e.g., chemical engineers) were selected from among those

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included in the baseline study. For each occupation, 70 incumbents were asked to complete the questionnaires using a DOS-based version of the questionnaires.

In all, 200 establishments were needed to complete this portion of the study. The selected establishments, from which the sample members were drawn, did not overlap with the establishments in the baseline paper-and-pencil study. The screening administration procedures were the same as those used in the baseline study, with the addition of one question. This question asked which computer operating system the company used (e.g., DOS, OS/2, Unix). Of the 200 companies initially included in the feasibility study, 177 (89%) remained eligible for the study based upon the results of screening. Of those companies which became ineligible, several had fewer than 5 employees and 12 others were out of business or not locatable. The advance letter was sent at the same time as the baseline study, and negotiations resulted in 150 participating companies. Following negotiations, the POC within each organization was asked to complete a CATI questionnaire on organization- and location-specific information. The POCs were asked to distribute and collect diskettes from employees in each of the selected occupations. The mail-out of the diskettes began in late November and continued through January of 1996.

Specific procedural differences between the baseline and feasibility studies are outlined below:

1. Screener. The screener asked a few additional questions about the type of computers and operating systems used in the workplace. These questions were designed to determine which organizations would be eligible to participate in the method feasibility study.

2. Advance Letter. None.

3. Negotiations. None.

4. Organizational Representative Interview. Text concerning the mode of data collection for employees differed. This text automatically appeared in the CATI system for cases in our method feasibility sample. POCs in this study were also asked about the types of computers used and the size and type of diskette drives available.

5. Mailout. Additional instructions for running the computer program were included in the employee letter for the feasibility study.

6. Follow-up. None.

Programming diskette-by-mail questionnaires using a DOS-based application.[1] The DOS version of the questionnaires was developed to mirror the format of the paper-and-pencil instrument as much as possible. However, the computer screen size allows only twenty-two lines of text at one time, while an average of sixty-six lines of text can appear on a printed page. This limitation was solved by keeping individual questions intact, but breaking question groups across several screens.

All nine questionnaires, the background information section, and occupation-specific sections were programmed onto one executable computer diskette. However, as in the baseline study, a modular design was also implemented. The computer program automatically identified which combination of the nine questionnaires modules and which occupation-specific task items was to be presented for each employee. This was determined by a unique employee identification

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[1] A Windows™ version of the diskette-by-mail questionnaire was completed in August of 1996. The decision to add a Windows-based computer program offers several advantages over the DOS-based program. This format provides a colorful layout and has more flexibility regarding font, size, and placement of objects and characters. Windows-based programs also afford more flexibility and design freedom than other software. Documentation of the DOS and Windows versions of the questionnaires is contained in the companion report, O*NET: An Information System for the Workplace. Designing an Electronic Infrastructure (Rose, Hesse, Silver, & Dumas, 1996).

number which was linked to the occupation and the questionnaire module as per the rotation design.

The DOS program was developed using the Clipper 5.2 programming language. The program was designed to run on an AT-level machine with DOS version 3.31 or higher with or without a color monitor. All employees received the program on 3-1/2" high density diskettes, unless they requested 5-1/4 inch diskettes. Some of the features of the DOS system include:

- Instructions at the beginning of the instrument and a "thank you" at the end;
- All questionnaire items;
- Pop-up windows to display descriptions of "HIGH" and "LOW" values for some questions;
- A file for storing respondent answers, reducing the need for editing and coding;
- Navigation keys to move backward and forward within the program;
- An exit/re-entry facility that allows respondents to return to a partially completed questionnaire; and
- Color for emphasis in distinguishing between the question text and the text associated with valid responses.

Rater Comparison Study

In addition to the method comparison study, a rater comparison study was also conducted. The intent of this study was to determine whether the descriptions obtained from incumbents, people working on the job, were similar to the descriptions that were obtained from occupational analysts. Occupational analysts providing these ratings were occupational analysts employed by the OAFCs and Industrial/Organizational psychology graduate students. The analysts rated 1,122 occupational units, where occupational units represented a taxonomy of jobs with a level of specificity in between the more general Occupational Employment Statistics (OES) taxonomy and the more specific Dictionary of Occupational Titles (DOT) taxonomy. Some of the OES categories are subdivided and many of the DOT categories are combined. The occupational analysts rated the following O*NET Content Model categories: basic and cross-functional skills, generalized work activities (GWAs), abilities, work context, and knowledges. It is important to note that, although most of the rating scales used by the occupational analysts were identical to those used by job incumbents, some were not. In particular, the scale used by occupational analysts to rate the frequency (in the generalized work activities and work contexts domains) differed from those used by job incumbents. The scales differed in two ways: (1) the scale used by the analysts had five scale points, while the scales used by the job incumbents varied from five to eight points, and (2) the scale anchors on the analysts' version did not reference particular time intervals--for example, one anchor on the analysts' scale was "sometimes," while a comparable anchor on the incumbents' scale was "more than once a month." In addition, analysts completed only a subset of the work context ratings, and did not rate job entry requirements for skills or job specialty requirements for knowledges.

For all 1,122 occupational units, each unit was rated by at least five raters independently to minimize the effects of rater error. During a rating cycle, each rater rated a set of 125 occupational units on one O*NET Content Model category for level, importance, and frequency, when applicable. The 80 occupations targeted in the initial O*NET data collection are a subset of the 1,122 occupational units.

Receipt Control

Since the study design is complex, an extensive receipt control system and information database was developed to track the many phases of data collection. The receipt control system generated mailing labels, respondent information sheets, individualized lists of occupations and employment within those occupations, and individualized text used in the CATI instrument. Three separate databases were constructed to include: the receipt control database: the sampling database, and the CATI database.

The receipt control database was the central repository of information. It was periodically updated with information from the other two databases, as well as files generated from the results of the screener, study negotiation, and mailout process.

The receipt control system was built around a database with a two tier file structure. File one contained establishment level information. File two contained respondent level information. The establishment level file structure contained the following information:

- An establishment ID that linked to the sampling database and the respondent level file;
- SIC;
- A variable to indicate if the organization belonged to the baseline sample, the feasibility sample or the reserve sample;
- The organization's name and address information from D&B, the screener and the negotiation;
- The POC's name and title from the screener;
- A list of likely occupations in each organization obtained from the sampling database;
- The list of occupations confirmed by the POC during negotiation;
- The number of incumbents in each occupation provided by the POC during negotiation;
- Time and date of the Organizational Representative CATI scheduled during negotiation;
- The number of employees sampled in each confirmed occupation, derived from the sampling database;

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- Result codes and fielding dates for each step in the data collection; and
- A trigger variable that signaled the next activity to be performed.

The respondent level file contained the questionnaire packet number, questionnaire type, and receipt control information.

The sampling database was used for sampling occupations within establishments and for identifying the number of employees who were sampled in each occupation at each establishment.

The purpose of the CATI database was to link the information gathered during the organizational representative interview to the receipt control database. This database directly stored sampling and receipt control information obtained during the interview.

Managing the Databases

Updated information was entered into the databases during all phases of the fielding period. During the entire fielding period a nightly program was run, which automatically applied files that were updated that day. Applied updates could set off switches, signaling other actions to be taken by the computer. This update process enabled many database management functions to take place automatically.

Response Rates

Due to the many stages of the study design, response rates are described below according to each of the steps in the study design. Results from the baseline study are presented first, followed by the response rate results for the feasibility study.

Baseline Study Response Rates

Initially, 1,240 establishments were screened for a POC. Of the 1,240 establishments, 1,054 (85%) were eligible to participate in the study (see Figure 2-7). As noted previously, those ineligible to participate included establishments that were out of business, duplicates in the data file, and those having fewer than 5 employees. The percentage of ineligible organizations obtained from the D&B file is typical of that found during the initial screening of organizations for an establishment survey.

Based upon this initial screening, 1,054 establishments were identified for negotiations. During this phase of the project, an additional 80 establishments (7%) indicated that they did not have employees in the jobs we were studying. During negotiations, 218 establishments (21%) refused to participate in the study for a variety of reasons including time constraints, no interest in the study, and company policy regarding no participation in outside studies. Overall, 756 establishments (72%) agreed during the negotiations to participate in all aspects of the study design.

The next stage of the study involved administration of the organizational interview. During this stage an additional 92 establishments (12%) refused to participate even though they had initially agreed during project negotiations. Organizational interviews were conducted with 661 organizational representatives, for a response rate of 88% at this stage.

The next stage of the project involved mailing a number of incumbent questionnaires to each POC for distribution within the establishment. Of the 661 POCs who completed the organizational interview, 181 returned at least one incumbent survey. This resulted in a response rate at the employer level of 27%. During the fielding of the incumbent survey, it became apparent early on that POCs were not returning questionnaires at the rate anticipated. In fact, once employers received the incumbent packages, an additional 174 establishments (26%) refused to participate.

Identifying Response Rate Problems in the Baseline Study

A number of actions were taken to identify reasons for the low incumbent response rates and to increase POC participation in the distribution and collection of incumbent questionnaires. First, follow-up calls were made to POCs who had agreed to participate, but whose incumbents did not return questionnaires. These calls were intended to encourage POCs to administer the surveys. Second, a systematic effort was made to encourage POCs to distribute incumbent questionnaires by making follow-up calls describing the importance of the study, its benefits, and the fact that the time to complete the survey for each incumbent was under an hour. Third, the initial fielding period was extended from 6 weeks to 3 months. Fourth, a reminder letter was prepared and faxed to the POC further encouraging participation following the final follow-up telephone call.

All of the attempts to increase participation described above did not significantly impact POCs' willingness to distribute questionnaires to incumbents. The high rate of refusal at this stage in the study was not anticipated because POCs were carefully informed at earlier stages about the time needed for incumbents to complete the questionnaires and the majority of POCs agreed to participate. Consequently, it appeared that the primary factor contributing to slow response rates was the POC's unwillingness to distribute incumbent questionnaires--a gatekeeper effect.

A careful examination of the baseline response rates support this contention. Results presented in Figure 2-7 (in "MAILOUT: EMPLOYEES (employees who have returned data)") show that participating establishments had an incumbent response rate of 60%, which was 44%

higher than the incumbent response rate obtained overall. This finding indicates that when employers actually distributed questionnaires to incumbents in their establishment, participation rates were quite satisfactory.

In order to gain a better understanding of this gatekeeper problem, phone calls were made to nonresponding establishments. The comments provided by POCs fall into the following categories:

- Excessive POC Burden. This perceived burden focused on the time required of POCs to sample incumbents in the selected occupations as well as the time needed to distribute and collect large numbers of surveys from incumbents (on average employers were asked to distribute questionnaires to 25 incumbents). In addition, many POCs who completed the telephone-administered organizational survey felt they had spent sufficient time on this effort (about one hour on the phone) and were unwilling to continue their participation.
- Time Required for the Incumbent. POCs expressed strong reservations regarding the time required of incumbents to complete the questionnaires. Those who refused to participate were unwilling to provide work time to complete a questionnaire taking 60-90 minutes. Many did not offer the incumbent the choice of completing the questionnaire at home.
- Short Fielding Period. Several POCs did not have the time to distribute the questionnaires over the designated period of data collection to incumbents. If the fielding period were extended, some said they would consider participating.
- No Incentive for Participation. Several POCs wanted more immediate "payback" for participation. Suggestions such as financial compensation and use of the O*NET database were among the most common incentives discussed.

- Questionnaire Difficulty. Some POCs felt the questionnaire was too difficult for incumbents to respond to without assistance. Language problems also occurred within certain occupations which made it impossible for the incumbent to complete the questionnaire.

Pilot test to improve response rates. Based on the above findings, a small pilot test, called Phase 2, was conducted incorporating the feedback received from POCs. A sample of 175 establishments were selected from the reserve sample for the pilot test. Two occupations likely present in these establishments were studied--general managers and secretaries. Specifically, the study design incorporated the following features designed to reduce the burden required from sampled establishments:

- Reduction in Time. The questionnaire modules were changed so that each incumbent received fewer questionnaires. This revision resulted in the time for completion changing from 60-90 minutes to 30 minutes.
- Fewer Incumbents Sampled within an Establishment. POCs were asked to administer no more than five questionnaires to incumbents.
- No Formal Sampling of Incumbents within Establishments. While procedures for selecting a representative sample of incumbents was described (e.g., range of experience, range of ability), POCs were not asked to follow formalized sampling procedures.
- Change in the Order of the Organizational Interview. The organizational interview was administered to some of the sample used in this pilot test. However, when the survey was administered, it was given at the end (rather than the beginning) of the data collection process. That is, POCs were first asked to distribute and collect incumbent

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questionnaires. Then, a small sample of the POCs were asked to participate in the organizational interview.

Results From the Pilot Test

Following screening, a total of 169 out of 175 establishments (97%) reached the negotiation phase (see Figure 2-8). A total of 11 establishments (17%) refused participation and 23 establishments (14%) were ineligible (e.g., did not have incumbents in the chosen occupations or they had fewer than 5 incumbents). At the employer stage, 65 employers (51%) responded by sending back incumbent surveys, 10 (7%) refused to participate, and 52 (39%) neither directly refused nor sent back surveys. Of the questionnaires mailed, the incumbent response rate was 41%. Finally, in establishments that returned any data at all, 85% of the selected incumbents returned packets.

A comparison of Figures 2-7 and 2-8 shows that the procedures used in this pilot test resulted in much higher incumbent response rates than those achieved in the baseline study. Reducing burden for employers appeared to impact on their willingness to distribute and collect questionnaires from incumbents. Clearly, the revised procedures implemented in this test should be incorporated into any future data collection.

Other Procedural Recommendations

In addition to some of the methods and procedures examined in the pilot test described above, other notable lessons were learned from the baseline data collection. First, the type of establishment sampling conducted relied on using broad standard industrial codes in the matching of establishments with occupations. This procedure made it difficult to identify a sufficient number of establishments employing individuals in smaller, less populous occupations (e.g., librarians) or occupations where many individuals are self-employed (e.g., musicians). This finding has two noteworthy implications. First, more detailed SIC matching should be used when initially drawing the sample of establishments; second, in the case of some occupations that are not typically found in establishments, it may be better to use trade association or guild listings of members as a basis for identifying individuals in particular occupations.

Feasibility Study Response Rates

As previously discussed, the feasibility study examined the possibility of using computer-based questionnaire administration in place of the more traditional paper and pencil method. The design of the feasibility study was similar to that of the baseline study, with the exception that the packet design used mirrored that of the pilot test. Consequently, in this study, incumbents received fewer questionnaires than in the baseline study, in order to reduce the time required for survey completion.

A total of 200 establishments were initially screened in the feasibility study. Of the 200 cases, 177 (89%) were identified as eligible to participate. Establishments were identified as ineligible primarily because they did not have computers or were out-of-business. Following negotiations, 98 establishments (55%) agreed to participate in the organizational interview and employee survey distribution and collection process. During negotiations, an additional 54 establishments (31%) were identified as ineligible to participate, either because they did not have DOS or Windows based PCs available, or because they did not have individuals employed in the occupations being studied. A total of 25 establishments (14%) refused to participate during negotiations. The organizational interview was successfully completed with 88 of the 98 establishments (90%) (8 more refusals occurred at this stage and 2 companies went out-of-business). At the employer stage, a total of 34 establishments (39%) returned at least one completed diskette and 54 (61%) neither refused overtly nor mailed back completed diskettes. At the incumbent stage, the response rate was 23%--a total of 247 completed diskettes were returned. Figure 2-9 displays the response rates for the feasibility study at all stages of data collection.

Identifying Response Rate Problems in the Feasibility Study

The response rates for the feasibility study were slightly higher than those obtained in the baseline study. However, as in the baseline study, several suggestions for improving the administration process were provided by POCs during nonresponse follow-up telephone calls. First, while the survey was reduced to approximately 30 minutes using the pilot test design, it often took much longer than that to complete the same questionnaire using the computer. The longer time for completion may in part be attributable to the loading and clean up time necessary for computer administration.

Employers' reported reasons for nonresponse were those reported in the baseline study. Specifically, many of the employers contacted reported that:

- The questionnaire was too long;
- They had already provided enough information by participating in the organizational interview;
- Participation in the study required too much administrative effort on their part; and
- Employee participation in the study would tie up group computers for too long during the work day.

Despite disappointing response rates, computer administration shows promise and should be considered for future data collection. Employers who did return diskettes often reported that incumbents found completing the questionnaire to be less tedious and more interesting than typical paper-and-pencil surveys.

Non-Response Analysis

Because the response rates in this study were low, it is possible that the survey results obtained are seriously biased. That is, the responding employees might include or exclude particular kinds of people or people employed in particular industries. If that were the case, appropriate caveats would need to be stated prior to any discussion of findings. In order to partially address the issue of bias, a nonresponse analysis was conducted.

Only selective evidence has been uncovered indicative of systematic survey response or nonresponse. The size of establishments, as measured by number of employees and job titles, is related to survey nonresponse as are some occupational codes. Additionally, a firm's final survey administration disposition is correlated with one of the questionnaire's series of questions--those measuring high performance human resources practices. Given the number of comparisons made in this analysis, however, these departures are considered instructive rather than pervasive.

The analyses presented here cannot directly address the issue of bias. The most these analyses can produce is indications of systematic nonresponse patterns. Some were uncovered. However, these indications are limited in number and scope. The findings from this analysis are summarized below.

Non-Response Analysis Procedures

A total of 1,240 cases were provided for the nonresponse analysis. Figure 2-10 summarizes the distribution of cases by their final survey disposition. The preponderance of nonrespondents and refusals underscores the need for examining establishment characteristics by disposition to determine whether systematic differences exist by category. For this analysis, cases found to be ineligible during any phase of the data collection effort were dropped, leaving a total of 1,054 cases to be analyzed.

The analysis proceeded in two stages. First, establishment characteristics known for all cases were examined. These included the SIC code of the establishments, the number of employees at the selected location, a status indicator (branch or HQ), and the state in which the establishment was located. Each of these items was supplied by D&B. The distribution of these characteristics across disposition categories was examined to determine whether systematic concentrations of particular firm types were occurring in particular disposition categories.

The second stage of the analysis examined survey results also arrayed by disposition status. Figure 2-11 displays the distribution of completed surveys by disposition status. This table shows that the majority of establishments did not respond at the mailout phase of the project.

Several variations of the analyses reported here were performed. For example, in the analysis of firm characteristics by disposition, one categorization of firms collapsed all firms associated with a completed questionnaire into a single category - completed questionnaire. The distribution of this category on establishment characteristics was then compared to the total sample and other dispositions. In addition, many data transformations and exploratory linear regressions and analyses of variance were also conducted in an attempt to uncover systematic patterns of nonresponse. None of these complementary analyses produced findings essentially different from those that are presented here in the form of tables and bar charts. We decided that results presented plainly were more valuable than those employing complex transformations or procedures when no fundamental alteration in results was obtained.

Establishment Characteristics by Survey Disposition

D&B provided establishment characteristics for firms selected in the sample. Among the characteristics provided were the geographic location of the firm (state), the number of employees working at the selected location, and a status indicator. Figure 2-12 displays the

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distribution of firms by geographic region and final disposition status. In this figure the percentage expressed is the percentage occupying a disposition status. For example, approximately 24% of all firms refusing at negotiation reside in the North Central U.S. while approximately 30% reside in the South. The sum of all percentages for a disposition equals 100%.

As will be seen in many of the figures presented in this nonresponse analysis, there is general parity in the percentage of firms in each disposition category within region and greater variation across regions. This pattern of within characteristic similarity and across region variation is the primary finding of the nonresponse analysis. Within geographic region, the percentages of firms in each final disposition are roughly the same, while greater systematic variation is observed between, for example, Northeast and the South.

Figure 2-13 presents final disposition by firm status (e.g., whether the firm exists at a single location, whether the location selected is the headquarters or a branch office). With one major exception, the distribution of firms within status by disposition are relatively similar. The exception to this generalization is in the distribution for headquarters. Here there are far greater numbers of mail refusals than any other disposition category. While between 20 and 25 percent of all other dispositions were realized at firm headquarters, over 35 percent of all mail refusals occurred at firm headquarters.

The distribution of dispositions by SIC category provides some distinctions in response and nonresponse patterns. Figure 2-14 displays final disposition by SIC categories. These categories were formed by collapsing similar codes into larger categories such as construction, mining, and transportation. The justice (justice, public order, and safety) and service (health, educational, and social services) categories distinguished themselves in the high percentage of mail completes they returned compared to the other disposition categories. Conversely, construction (building, heavy construction), food (food and kindred products), and service (hotels, personal, and business services) are distinguished by their relatively small percentage of mail completes compared with the other dispositions for their SIC categories. Survey response varied considerably within these five SIC categories.

Figure 2-15 presents average firm size (measured as number of employees) by disposition category. For the total sample, the average firm size was slightly over 300 employees. For most disposition categories firm size fluctuated about the sample average. The average size of firms providing a "mail refusal" to survey administration efforts was nearly twice the sample average. It appears that mail refusals were much more prevalent for larger firms.

Questionnaire Factor Scores by Final Survey Disposition

Following the examination of establishment characteristics by final disposition category, attention was turned to questionnaire responses. As shown in Figure 2-11, nearly one-half of returned questionnaires were associated with firms having a final disposition code of mail nonresponse. The purpose of this portion of the nonresponse analysis was to determine whether systematic differences existed in survey responses by final disposition category.

A prominent feature of the CATI organizational survey was the inclusion of questions designed to measure concepts related to organizational structure, human resource systems and management, and organizational values. Operationally, measurement of these concepts was accomplished through the development of 14 factor scales. Each scale was associated with multiple survey questions, and a scoring algorithm was used to compute factor scale scores.

Figure 2-16 presents average factor scores for each of the scales broken out by final disposition category. Average factor scores considered significantly different than those for the other dispositions in the row are displayed in boldface type. Only the scales measuring establishment size and high performance exhibited significant variation in average factor scores. (As the distribution of some factor scales are highly skewed, their distributions were "normalized" through logarithmic and power transformations. As the results of comparisons for the transformed scales reproduced those obtained in the original metric, we limit our discussion to the original metric.)

The establishment size factor is composed of questions concerning the respondent's firm's size. The questions used to construct this scale asked about the establishment's total number of employees, number of job titles, and number of specializations. Respondents from firms categorized as mail refusals scored between 70 and 80 percent higher on this factor than respondents in the other categories. Presumably, these are respondents from larger firms. This finding is very much in concert with the earlier finding that the firms in the category "mail refusal" were, on average, nearly twice as large as firms in the other final disposition categories.

The high performance human resource factor is composed of questions regarding the setting of goals. This constellation of questions asks about managerial and non-managerial goal setting and negotiation, and the communication of these goals. For this factor, the "mail complete" category differed from the other categories in that its average factor score was approximately 80% of the average observed for "mail nonresponse and refusal" dispositions. There does not appear to be an obvious link between this and earlier findings concerning establishment characteristics and final survey administration disposition.

The other 12 factors showed relatively small differences across the disposition categories.

<u>Non-Response Analysis Summary</u>

Although analyses such as these summarized here cannot definitively establish the presence or absence of nonresponse bias in survey findings, they can provide general indications of survey response coverage. Generally, it was established that, when categorized by final disposition, both establishment characteristics and questionnaire responses were more similar within categories than across. This observation is tempered by findings indicating that establishment size and occupational grouping do, in certain cases, impact on survey administration outcome. Larger establishments are more likely than others to terminate the survey process through "mail refusal," and certain occupational groupings display greater or lesser propensities to cooperate and provide completed surveys. Regarding high performance practices as measured via a telephone interview, goal-setting practices showed differences across disposition categories.

Viewed as an ensemble of findings, the nonresponse analyses provide some lesson learned. Administration of an establishment survey is difficult and some of the difficulty is a function of the establishments themselves. Obviously, establishment size, area of occupational focus (e.g., construction, service, or justice), and bureaucratic structure (as reflected in human resource practices) affect survey response differentially. When reviewing survey responses, few indications of bias were observed. Of the 14 scales evaluated and the 42 comparisons made, only 2 scales revealed significant differences in responses by disposition. It is less the case that bias has been discovered than some administrative difficulties with the procedures have been underscored. Bearing this in mind, several suggestions can be made for improving response rate. Most emphasized is the suggestion that future data collection should not be limited to a single design (e.g., stratified random sample). Rather, a mix of different approaches should be considered while also ensuring that the outcomes are systematic and can be generalized beyond a restricted sample. In addition, whatever the method employed, incentives should be considered both to employers and to employees. Some of the approaches to be considered include:

- Within the random sampling approach, more specific SIC codes should be used. More specificity (perhaps at the 6-digit level) should help in identifying establishments employing people in less populous occupations (e.g., instrumental musician, photographer) who work in establishment settings. However, other methods should be used to locate individuals whose occupations do not typically cluster in establishments. A sample could be drawn from lists such as those available through professional associations.
- Reducing establishment burden should be considered, pending examination of more occupations using this traditional sampling design with the reduced burden features (e.g., reduced questionnaires, fewer employees required within a company, no formal sampling).
- Another short-term action involves collecting data from establishments who have already expressed a willingness to support the development of the O*NET database. Several establishments have contacted Department of Labor personnel and expressed an interest in participating in the study and using the results obtained from O*NET. POCs could be identified at these establishments and participation solicited. Occupations within these "volunteer" establishments would then be determined, and the POCs would distribute employee questionnaires following the procedures previously described. However, a procedure for disseminating establishment-specific results or using the O*NET database would need further development.

- Opportunistic data would be collected by soliciting the cooperation of volunteer organizations. This would enable the formation of a consortium of large, diversified employers such as Bell Atlantic, General Electric, and Marriott. These companies employ people across a wide range of jobs and have the most to gain by the availability of descriptive information about jobs in these respective organizations. In addition, a random sampling approach might be used to collect data in jobs that employ large numbers of people.

Data Preparation

As a first step in ensuring data quality, all returned questionnaires returned were cleaned and coded prior to data entry. Upon receipt of incumbent packets, identification numbers were entered into a receipt control system which kept track of which questionnaires were completed by each incumbent. As the mail arrived, it was opened and each form was checked to make sure it had at least some responses. A form number was written at the top of the questionnaire to aid in data entry. Refusals were also entered into the receipt control system. If a company returned all of the incumbent packets blank or indicated a refusal by telephone, this information was entered into the database by company name. Following this step, questionnaires were then sorted by form type and coded.

Codebook Verification

Codebooks were produced for each data collection instrument. The codebook assigns a unique variable name to each piece of data collected, identifies the column(s) in which the data are stored, and defines valid responses allowed for each question. Each instrument was examined page by page to ensure that the data would be keypunched correctly. Responses are checked for such problems as: X's marked in any place other than over a valid response number, non-valid or out-of-range responses, respondents marking more than one answer when only one should be marked, and missed/improperly skipped items.

Additionally, some of the questionnaires required coding of respondent answers. For example, in the occupation-specific questionnaires, the number of written added tasks was entered at the end of the task list. If no additional tasks were added by the respondent, a 0 was entered. Similarly, if there was more than one response to the highest level of education on the background questionnaire, the highest level marked was the response coded. For example, if Bachelor's Degree and Master's Degree were both marked, the Master's Degree was chosen by the coder as the correct response. Finally, if an "other specified" response was written in the sources for recruitment for current job, the responses were typed into a separate log.

Data Processing

Once the coding was completed, the questionnaires were sent to data entry for keypunching. All questionnaires were key punched and verified by experienced data entry operators. Once the data were keyed, various edit checks were run. First, the data were checked to ensure responses were within valid ranges, proper skip patterns were followed, and there were no missed or improperly skipped items. When errors were noted by the edit check program, each case was examined and corrections were made by updating the data file with the correct information.

Following these edits, data quality checks were made and rules for inclusion of data were invoked. These checks occurred within each domain or questionnaire (e.g., within the skills, within generalized work activities). If a data quality check detected unusable data within one domain, it had no effect on the checks in another domain.

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If a respondent had more than 10 percent missing data within any domain, the entire case (i.e., all of the respondent's responses for that questionnaire) was deleted. If a respondent had fewer than 10 percent missing responses, but had some missing responses, then the mean descriptor value for that occupation was substituted for the missing response.

An occupation was retained for analyses if four or more respondents had provided data surviving these data processing and quality checks. Although our goal was to obtain 30 respondents for each domain for each questionnaire, four respondents was sufficient to carry out investigative analyses for evaluative purposes.

When these rules were invoked, there were 29 occupations that had at least four respondents across all the O*NET content domains. These occupations are listed in Chapter 13, which describes the cross-domain analyses. There were somewhat larger numbers of occupations available within each domain, where the requirement was only for four respondents of the relevant questionnaire, not across all questionnaires; those occupations are displayed in the chapters that describe their respective analyses.

General Analyses

The initial O*NET data collection effort was not intended to provide a comprehensive description of all jobs in the United States economy. Instead, it was part of a prototyping effort intended to provide evidence bearing on the meaningfulness of the descriptive information provided by these measures. Thus, as stated in the beginning of this chapter, our intent in conducting analyses of these data was to evaluate the initial evidence for the internal and external validity of the resulting descriptive system.

The nature of the measures used in any particular domain sometimes dictated unique kinds of analyses. In all cases, however, the basic questions of concern in deciding whether these

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measures, in fact, appeared to yield meaningful inferences dictated a relatively straightforward set of core analyses carried out within each domain.

The within-domain analyses can be classified into seven basic types of analyses. These are generally described here; details specific to a domain are covered in their respective chapters.

Descriptive Statistics

Means and standard deviations of occupational means for the various scales within each domain are provided to give a general impression of the overall centrality and variance of the descriptors within our sample of occupations.

Reliability

By reliability we primarily mean interrater agreement. No rate-rerate data were collected. We computed interrater agreement coefficients for each descriptor measure, using standard intraclass coefficients (Shrout & Fleiss, 1979). Such coefficients were computed for the level, importance, frequency or other scales available within each domain. We used Spearman-Brown corrections for estimating the reliability coefficients for the 1-rater and 30-rater cases, to allow ready comparisons across domains and to other studies. We used the harmonic mean of the number of raters available for each occupation as our estimate of k for making these calculations. This is a conservative estimate of k.

Scoring

In some cases--most notably, level and importance--different methods of using the responses to arrive at scale scores were available. These methods primarily differed in the way in which the not relevant or NR response was used. The intended and default method was to use not relevant as the zero point on the level scale and to indicate "not important" on the importance scale. We labeled this the "full scale" method. Alternatively, we examined the case when not relevant responses were treated as missing, i.e. only those selecting not relevant were not included in the reliability analyses. Finally, we also examined a dichotomous case for the level scale, where not relevant = 0 and any other response was coded as 1. These analyses were done primarily to identify any differences that might have occurred if not relevant was to be used other than as it was intended.

Analyses of Variance

We also computed an analysis of variance with occupations as a between-raters variable, and descriptors as a within-raters variable. Aside from describing the sources of variance in the descriptor measures, these analyses allowed a second, stringent method of computing the interrater agreement. We computed the intraclass correlation coefficient using the descriptor by occupation source of variance as the "true" variance and the descriptor by raters within occupation source of variance as the "error" source of variance. Note that the descriptor source of variance, which certainly is a non-error source of variance, is excluded from the calculation. Only the source of variance that serves to accurately describe each occupation as it differs from other occupations is included as true variance. This is, of course, the most appropriate coefficient for our purposes, but it is most likely an under-estimate of within-occupation, interrater agreement.

This kind of analysis was also applied to higher-level descriptor scores derived by computing the mean values for descriptors combined according to the a priori hierarchical structures for the content model domains. Since these higher-level scores would no doubt be used in some applications of the O*NET database, it was useful to determine the interrater agreement coefficients for such scores.

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All of these reliability analyses are by way of evaluating the degree to which incumbents appear to agree on the description of their occupations using the O*NET job analysis measures. Such analyses are the bedrock upon which all other analyses depend.

Descriptor and Scale Relationships

Correlations Between Scale Type

In most domains, more than one scale was used to collect information about descriptors. Most notably, level and importance were used in most domains. To estimate the redundancy of information for the different scales, intercorrelations were computed in two different ways--across descriptors within each occupation and across occupations within each descriptor.

Relationships of Descriptor Scale Scores

To assess the internal structure of the descriptor variables, correlations were computed between the level scale scores and between the importance scale scores, or other appropriate scores. These correlations were computed at the occupational level (i.e., occupational means were the scores that were correlated) and at the individual level (i.e., individual incumbent scores were correlated, but only four, randomly selected incumbents from each occupation were entered into these calculations in order to equally weight the occupations). Because the primary focus of the O*NET is at the occupational level, only the occupational-level data were examined and discussed.

Factor Structure

Principal components analyses were also conducted using the occupational-level correlational data. We attempted confirmatory factor analyses in some cases, but those attempts were generally not useful because of our relatively small sample sizes (30-35 occupations was the N). The correlational and principal component analyses, of course, provide evidence for evaluating the meaningfulness of the relationships observed among the measures (Harvey, Friedman, Hakel, & Cornelius, 1982).

Occupation Differences and Discriminant Analyses

Two kinds of analyses were conducted here. Six representative and relatively distinct occupations were selected and their profiles of descriptor scores were compared within each domain. The pattern of differences across these occupations was used to illustrate the ways in which each domain's descriptors served to separate occupations, and served as a check on the "sensibility" of the resulting occupational descriptions. The second analysis used discriminant function analysis with the descriptor level scores (generally) as predictor variables and occupations as criterion categories. The results were used to assess how well these measures could discriminate among occupations, and the nature of the descriptors yielding the best discrimination.

Convergence With Analysts' Ratings

Because we had incumbent and occupational analyst ratings for a subset of occupations, we could compare these ratings. We were able to complete these analyses for five of the nine content domains, since analysts had completed their ratings for those five domains. We calculated and displayed the means, standard deviations, and interrater agreement coefficients for all descriptors for both the level and importance scales in these five domains, except for the work context domain which used a different set of scales. In addition we calculated t tests for mean differences, F tests for variance differences, correlations between incumbent and analyst mean descriptor scores (within descriptor, across occupations), and mean d^2 values (that is, the mean across all occupations of the summed, squared differences between incumbent and occupational mean values for all descriptors within an occupation). This set of statistics allowed us to thoroughly evaluate the degree to which the two types of raters converged or diverged in the information they provided. The correlations indicate the degree of agreement in the pattern of the mean ratings while the $\underline{d}^2$ values indicate the averaged, absolute level of disagreement between mean ratings of the two types of raters. Thus, large correlation coefficients and small $\underline{d}^2$ values indicate convergence between the raters.

We also conducted principal component analyses of the correlations between descriptor level scores for the analyst data--that is, a parallel analysis of that completed for the incumbent data. These two solutions were compared and contrasted to shed further light on the similarities and differences of the information provided by the two types of raters.

Additional Validity Evidence

Other analyses were conducted within some of the domains. These were aimed at further construct validation of the measures, e.g. the skill level profiles for occupations with different levels of education were compared. These analyses are described in the individual chapters.

Within-Domain Analysis Tables

The results of the above-described analyses are presented in the domain chapters--Chapters 3 through 11--of this report. Each of these chapters presents the results of analyses for one of the O*NET questionnaires. Figure 2-17 describes the tables used to present the analysis results. The tables within these chapters are named and numbered uniformly, for ease of location and comparison, except for Table 17, which is unique to each chapter. Not all tables apply to all chapters, and tables may not be discussed sequentially within a given chapter.

Other Analyses

Other chapters in this report detail important sets of analyses intended to further evaluate the meaningfulness and usefulness of the O*NET system. Chapter 16 describes the initial analyses of measures of occupation-specific tasks as well as work conducted to develop an efficient method to collect knowledge, skill, and tool information at the occupation-specific level by capitalizing on the O*NET content model. Chapter 15 describes initial investigations at producing job descriptions that capitalize on, yet are not overwhelmed by, the richness of the O*NET information base. Chapter 12 enumerates and discusses possible covariates of O*NET descriptor ratings, and summarizes the available data with respect to some of those covariates. Chapter 13 describes analyses of the relationships across the content domains. Chapter 14 describes analyses conducted to evaluate cluster analysis techniques that might be applied to O*NET data. Each of these chapters thoroughly describes the methods used and results obtained.

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Figure 2-1
Example Pages From the Skills and Generalized Work Activities Questionnaires

Skill

1. Reading Comprehension — Understanding written sentences and paragraphs in work related documents.

Level
What level of this skill is needed to perform this job?

HIGH

7
6 ← *Reading a scientific journal article describing surgical procedures.*
5
4 ← *Reading a memo from management describing new personnel policies.*
3
2 ← *Reading step-by-step instructions for completing a form.*
1

LOW

NR Not relevant at all for performance on this job

Importance
How important is this skill to performance on this job?

Not Important	Somewhat Important	Important	Very Important	Extremely Important
1	2	3	4	5

Job Entry Requirement
Is this level of skill required for entry to this job?

1 YES, it is required for entry on the job. 2 NO, it can be learned on the job.

Generalized Work Activity

1. Getting Information Needed To Do The Job — Observing, receiving, and otherwise obtaining information from all relevant sources.

Level
What level of this activity is needed to perform this job?

Getting new information from many sources, often by actively interacting with the sources.

7
6 ← *Studying international tax laws.* *Reviewing the results of a large financial audit.* *Grading the performance of college students.*
5
4 ← *Following a wiring diagram.* *Reviewing a budget.* *Interviewing witnesses at a crime scene.*
3
2 ← *Feeling the smoothness of a sanded surface.* *Following a standard blueprint.* *Reading instructions to install clothes washers and dryers.*
1

Making regular use of the same types of information from a single source.

NR Not relevant at all for performance on this job

Importance
How important is this activity to performance on this job?

Not Important	Somewhat Important	Important	Very Important	Extremely Important
1	2	3	4	5

Frequency
How often is this activity performed on this job?

Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often
1	2	3	4	5	6	7

Figure 2-2
<u>Example Instructions for the Skills Questionnaire</u>

Instructions for Making Skill Ratings

In this questionnaire you will be presented with a list of 46 skills. Some of the skills are developed over time and are used not only to do work but to learn other skills; examples include Reading Comprehension, Writing, and Speaking. Other skills are important for performance on many jobs; examples include Idea Generation, Troubleshooting, and Time Management.

For each skill, please make the following three ratings: **LEVEL, IMPORTANCE,** and **JOB ENTRY REQUIREMENT.**

(1) **LEVEL.** Ask yourself, "What level of this skill is needed to perform this job?" To help you make this judgment, the LEVEL scale includes descriptions of activities requiring high, medium, and low levels of the skill. These are only examples, so they may or may not apply to the specific job you are describing.

Use the example descriptions to select the number on the scale that indicates the skill level required by the job, and mark through the appropriate number, from 1 (indicating that a very low level of the skill is required) to 7 (indicating that a very high level of the skill is required) on the LEVEL scale. For example, the level of "Reading Comprehension" needed for one job might be much higher than that needed for another job.

THE NOT-RELEVANT (NR) RESPONSE. If the skill is NOT RELEVANT at all to performance on the job, mark through the NR circle that appears at the bottom of the LEVEL scale. Carefully read all of the level descriptions before selecting the NR option. If you select NR, however, there is no need to complete the IMPORTANCE and JOB ENTRY REQUIREMENT ratings described below.

(2) **IMPORTANCE.** (Complete only if a 1 to 7 LEVEL rating was selected.) Ask yourself, "How important is this skill to performance on this job?" For example, "Information Gathering" might be very important for one job, but less important for another job. For the second job, however, "Listening/Questioning" might be very important.

Rate the IMPORTANCE of the skill for performance on the job by marking through the appropriate number, from 1 (indicating that the skill is of little or no importance) to 5 (indicating that the skill is very important) on the IMPORTANCE scale.

(3) **JOB ENTRY REQUIREMENT.** (Complete only if a 1 to 7 LEVEL rating was selected.) Bearing in mind the LEVEL of the skill that is needed to perform the job, ask yourself, "Is this <u>level</u> of the skill required for entry to this job?" For example, "Reading Comprehension" might be needed by an employee before starting one job. However, "Troubleshooting" might not be necessary before starting a different job. "Troubleshooting" might be learned during on-the-job training.

Rate the JOB ENTRY REQUIREMENT for the job by marking through the appropriate number, either 1 (indicating that the level of the skill is required for entry on the job) or 2 (indicating that the level of the skill can be learned on the job).

Notice that the LEVEL of a skill and the IMPORTANCE of the skill are different. For example, "Reading Comprehension" can be high in IMPORTANCE for two different jobs, but the LEVEL of "Reading Comprehension" that an employee in one job needs is not as high as the LEVEL of "Reading Comprehension" for an employee in another job.

[two completed examples were included here]

Turn the page to begin the Skills Questionnaire.

Figure 2-3
Sampling Stages

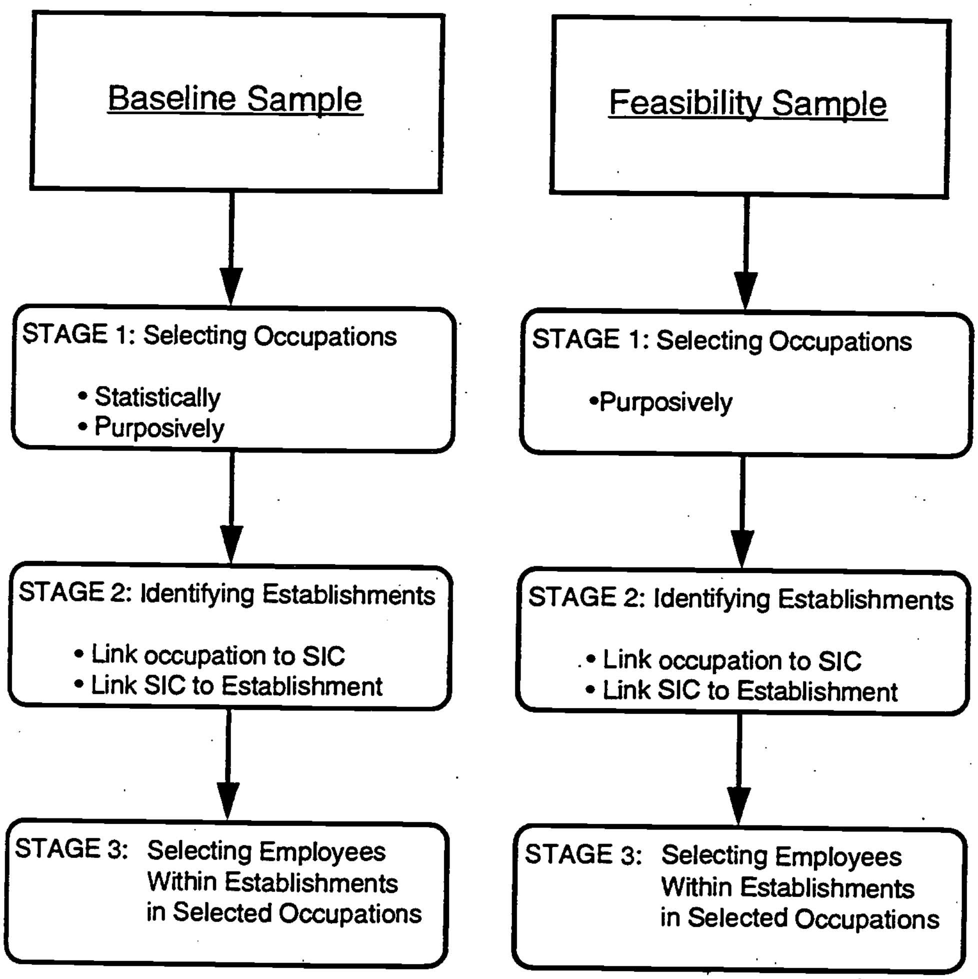

Figure 2-4

Counts of Occupations, Total Employment, and Sample Size by Job Family

Preparation Level	Distinguishing Activity	"02" Administrative and Finance Occupations	"05" Natural and Applied Science Occupations	"06" Health Service Occupations	"07" Law, Social Science Community Service
Management Education, Training or Experience	Job Family # Occupations Total Employment Column Percent E(n) n	"020" 7 4,509,870 0.19 3.38 3	"050" 1 348,760 0.09 0.26 1	"060" 1 158,680 0.02 0.12 0	"070" 1 69,280 0.03 0.05 0
University Degree	Job Family # Occupations Total Employment Column Percent E(n) n	"021" 11 1,635,760 0.07 1.23 1	"051" 34 2,518,990 0.65 1.89 1	"061" 16 2,823,910 0.44 2.12 2	"071" 13 1,239,950 0.60 0.93 1
Two to Three Years Post-Secondary Education or Equivalent	Job Family # Occupations Total Employment Column Percent E(n) n	"022" 12 2,110,950 0.09 1.58 1	"052" 17 1,023,140 0.26 0.77 1	"062" 15 1,374,570 0.21 1.03 1	"072" 8 761,760 0.37 0.57 1
High School Degree Preferred	Job Family # Occupations Total Employment Column Percent E(n) n	"023" 65 16,061,900 0.66 12.03 11		"063" 9 2,088,850 0.32 1.57 2	
High School Degree Not Required	Job Family # Occupations Total Employment Column Percent E(n) n				
	Column Total E(n) n	24,318,480 18.22034423 16	3,890,890 2.915205027 3	6,446,010 4.829599592 5	2,070,990 1.551665675 2

Figure 2-4 (continued)

Counts of Occupations, Total Employment, and Sample Size by Job Family

Preparation Level	Distinguishing Activity	"09" Education, Training and Instructional Occ.	"10" Art, Culture and Recreation Occupations	"12" Retail and Wholesale Sales Occupations	"14" Protective Service Occupations
Management Education, Training or Experience	Job Family	"090"	"100"	"120"	"140"
	# Occupations	1	Not available	1	Not available
	Total Employment	298,680	Not available	432,250	Not available
	Column Percent	0.05		0.03	
	E(n)	0.22		0.32	
	n	1		1	
University Degree	Job Family	"091"	"101"	"121"	"141"
	# Occupations	21	11	4	Not available
	Total Employment	4,403,740	491,270	703,120	Not available
	Column Percent	0.76	0.56	0.05	
	E(n)	3.30	0.37	0.53	
	n	2	1	1	
Two to Three Years Post-Secondary Education or Equivalent	Job Family	"092"	"102"	"122"	"142"
	# Occupations	2	9	10	9
	Total Employment	706,950	356,120	3,335,220	538,500
	Column Percent	0.12	0.41	0.26	0.26
	E(n)	0.53	0.27	2.50	0.40
	n	1	1	2	1
High School Degree Preferred	Job Family	"093"	"103"	"123"	"143"
	# Occupations	2	2	4	3
	Total Employment	365,080	23,410	4,139,480	661,960
	Column Percent	0.06	0.03	0.32	0.32
	E(n)	0.27	0.02	3.10	0.50
	n	1	0	2	1
High School Degree Not Required	Job Family		"104"	"124"	"144"
	# Occupations		Not available	5	4
	Total Employment		Not available	4,369,530	895,070
	Column Percent			0.34	0.43
	E(n)			3.27	0.67
	n			3	1
	Column Total	5,774,450	870,800	12,979,600	2,095,530
	E(n)	4.326440909	0.652436984	9.724817502	1.570051991
	n	5	2	9	3

Figure 2-4 (continued)
Counts of Occupations, Total Employment, and Sample Size by Job Family

Preparation Level	Distinguishing Activity	"15" Personal and Commercial Service Occupations	"17" Craft Occupations	"18" Transportation and Equipment Occupations	"19" Occupations Unique to Ag., Forest and Fishing
Management Education, Training or Experience	Job Family # Occupations Total Employment Column Percent E(n) n	"150" 2 359,420 0.03 0.27 1	"170" 2 193,050 0.05 0.14 0	"180" Not available Not available	"190" 2 17,940 0.02 0.01 0
University Degree	Job Family # Occupations Total Employment Column Percent E(n) n	"151" Not available Not available			
Two to Three Years Post-Secondary Education or Equivalent	Job Family # Occupations Total Employment Column Percent E(n) n	"152" 7 1,337,660 0.10 1.00 1	"172" 25 2,403,950 0.67 1.80 1	"182" 2 121,130 0.03 0.09 0	"192" 4 59,450 0.06 0.04 0
High School Degree Preferred	Job Family # Occupations Total Employment Column Percent E(n) n	"153" 15 4,230,730 0.33 3.17 3	"173" 11 282,450 0.08 0.21 1	"183" 32 3,596,780 0.93 2.69 3	"193" 12 710,770 0.75 0.53 1
High School Degree Not Required	Job Family # Occupations Total Employment Column Percent E(n) n	"154" 24 6,965,810 0.54 5.22 4	"174" 14 698,080 0.20 0.52 1	"184" 2 138,370 0.04 0.10 0	"194" 3 162,820 0.17 0.12 0
	Column Total E(n) n	12,893,620 9.660397966 9	3,577,530 2.680423615 3	3,856,280 2.889273879 3	950,980 0.712510936 1

Figure 2-4 (continued)

Counts of Occupations, Total Employment, and Sample Size by Job Family

Preparation Level	Distinguishing Activity	"20" Occupations Unique to Extractive Operations	"21" Occupations Unique to Manufacturing, Process, etc.	Totals
Management Education, Training or Experience	Job Family	"200"	"210"	
	# Occupations	Not available	1	19
	Total Employment	Not available	211,670	6,599,600
	Column Percent		0.03	
	E(n)		0.16	
	n		1	8
University Degree	Job Family			
	# Occupations			110
	Total Employment			13,816,740
	Column Percent			
	E(n)			
	n			9
Two to Three Years Post-Secondary Education or Equivalent	Job Family	"202"	"212"	
	# Occupations	97	52	269
	Total Employment	6,055,050	2,551,710	22,736,160
	Column Percent	0.95	0.35	
	E(n)	4.54	1.91	
	n	4	1	16
High School Degree Preferred	Job Family	"203"	"213"	
	# Occupations	8	60	223
	Total Employment	160,080	3,359,710	35,681,200
	Column Percent	0.03	0.46	
	E(n)	0.12	2.52	
	n	0	2	27
High School Degree Not Required	Job Family	"204"	"214"	
	# Occupations	1	7	60
	Total Employment	164,550	1,200,250	14,594,480
	Column Percent	0.03	0.16	
	E(n)	0.12	0.90	
	n	0	1	10
	Column Total	6,379,680	7,323,340	93,428,180
	E(n)	4.779902595	5.486929104	
	n.	4	5	70

Figure 2-5
Eighty Occupations Sampled in Initial O*NET Data Collection

Job Family	Occupation Code	Occupation Title	Total Employment
020	19005	General Managers & Top Executives	2,868,700
020	13002	Financial Managers	716,050
020	13014	Administrative Managers	248,210
021	21108	Loan Officers & Counselors	200,060
*021	25315	Financial Analysts, Statistical	29,960
022	51002	First Line Supervisors, Clerical & Administrative	1,229,930
023	55347	General Office Clerks	2,660,890
023	55108	Secretaries, except Legal & Medical	2,440,560
023	55338	Bookkeeping, Accounting, & Auditing Clerks	1,812,510
023	55305	Receptionists & Information Clerks	927,730
023	55307	Typists, including Word Processing	612,490
023	53102	Tellers	554,640
023	55344	Billing, Cost & Rate Clerks	319,940
023	56011	Computer Operators, except Peripheral Equipment	226,240
023	53121	Loan & Credit Clerks	178,860
023	53311	Insurance Claims Clerks	104,190
023	57105	Directory Assistance Operators	27,270
050	13017	Engineering, Mathematical, & Natural Sciences Manager	348,760
051	22302	Architects, Except Landscape & Marine	60,070
*051	22114	Chemical Engineers	53,930
*051	22127	Computer Engineers	207,490
*051	22135	Mechanical Engineers	228,850
*051	25102	Systems Analysts	39,354
*051	25105	Computer Programmers	448190
052	32905	Medical & Clinical Laboratory Technicians	100,600
*052	32902	Medical & Clinical Laboratory Technologists	148,800
061	32502	Registered Nurses	1,764,950
061	31114	Nursing Instructors	46,430
062	32926	Electrocardiograph Technicians	15,870
063	66008	Nursing Aides, Orderlies, & Attendants	1,117,980
063	66005	Medical Assistants	198,090
071	31502	Librarians, Professional	130,180
072	27311	Recreation Workers	191,050
090	15005	Education Administrators	298,680
091	31305	Teachers, Elementary School	1,313,510
091	31303	Teachers, Preschool	356,740
092	31321	Instructors & Coaches, Sports & Physical Training	257,680
093	53905	Teachers' Aides & Assistants, Clerical	355,580
101	34051	Musicians, Instrumental	47,140
102	34023	Photographers	53,910
120	13011	Marketing/Advertising/Public Relations Managers	432,250
121	49002	Sales Engineers	66,000

*Occupations in the High Performance sample

Figure 2-5 (continued)
Eighty Occupations Sampled in Initial O*NET Data Collection

Job Family	Occupation Code	Occupation Title	Total Employment
122	49008	Salespersons, Except Scientific & Retail	1,167,870
122	21302	Buyers, Except Farm Products	157,380
123	49011	Salespersons, Retail	3,438,510
123	49014	Salespersons, Parts	287,910
124	49023	Cashiers	2,660,370
124	49021	Stock Clerks, Sales Floor	1,088,520
124	49017	Counter & Rental Clerks	323,340
142	61005	Police & Detective Supervisors	84,860
143	63014	Police Patrol Officers	380,230
144	63047	Guards & Watch Guards	829,530
150	15026	Food Service/Lodging Managers	337,120
152	65026	Cooks, Restaurant	573,510
153	65008	Waiters & Waitresses	1,748,910
153	65005	Bartenders	369,830
153	53805	Reservation & Transportation Ticket Agents	116,180
154	67005	Janitors & Cleaners	1,806,380
154	65038	Food Preparation Workers	1,194,610
154	65041	Combined Food Preparation & Service Workers	1,116,790
154	68014	Amusement & Recreation Attendants	230,650
172	87814	Structural Metal Workers	41,780
173	87902	Earth Drillers, Except Oil & Gas	12,170
174	98312	Helpers, Carpenters	155,540
183	97102	Truck Drivers, Heavy or Tractor-Trailer	1,259,450
183	97105	Truck Drivers-Light, Include Delivery/Route Workers	884,040
183	97111	Bus Drivers, Schools	381,540
193	79855	General Farmworkers	175,290
202	85132	Maintenance Repairers, General Utility	1,118,560
202	85302	Automotive Mechanics	563,960
202	85119	Other Machinery Maintenance Mechanics	50,230
202	85123	Millwrights	68,720
*202	85705	Data Processing Equipment Repairers	79,520
*202	89108	Machinists	343,780
210	15014	Industrial Production Managers	211,670
212	83002	Precision Inspectors, Testers, & Graders	180,220
213	92974	Packaging & Filling Machine Operators	324,910
213	89802	Slaughterers & Butchers	60,020
*213	93905	Electrical & Electronic Assemblers	213,410
214	93938	Meat, Poultry & Fish Cutters & Trimmers, Hand	127,820

*Occupations in the High Performance sample

Note: The occupation code for Teachers, Preschool was corrected from 31302 to 31303.

Figure 2-6
Rotation Design

Set 1	Set 2	Set 3	Set 4	Set 5
Letter/Background/Instructions 1 Background Questionnaire Skills 27.5 Abilities 24.0 Occupation Specific Tasks 68.5	Letter/Background/Instructions 4 Background Questionnaire Work Context 23.0 Skills 27.5 Occupation Specific Tasks 67.5	Letter/Background/Instructions 7 Background Questionnaire GWAs 30.0 Occ. Values 5.4 Skills 27.5 Occupation Specific Tasks 81.9	Letter/Background/Instructions 10 Background Questionnaire T/E/L/E 11.1 Skills 27.5 Work Styles 8.8 Occupation Specific Tasks 66.4	Letter/Background/Instructions 13 Background Questionnaire Knowledges 14.0 Org Context 10.6 Skills 27.5 Occupation Specific Tasks 71.1
Letter/Background/Instructions 2 Background Questionnaire Knowledges 14.0 Org Context 10.6 Work Context 23.0 Occupation Specific Tasks 66.6	Letter/Background/Instructions 5 Background Questionnaire GWAs 30.0 Occ. Values 5.4 Abilities 24.0 Occupation Specific Tasks 78.4	Letter/Background/Instructions 8 Background Questionnaire Org Context 10.6 Abilities 24.0 Knowledges 14.0 Occupation Specific Tasks 67.6	Letter/Background/Instructions 11 Background Questionnaire Abilities 24.0 Work Context 23.0 Occupation Specific Tasks 64.0	Letter/Background/Instructions 14 Background Questionnaire Abilities 24.0 Work Styles 8.8 T/E/L/E 11.1 Occupation Specific Tasks 62.9
Letter/Background/Instructions 3 Background Questionnaire Occ. Values 5.4 Work Styles 8.8 GWAs 30.0 T/E/L/E 11.1 Occupation Specific Tasks 76.3	Letter/Background/Instructions 6 Background Questionnaire Work Styles 8.8 T/E/L/E 11.1 Knowledges 14.0 Org Context 10.6 Occupation Specific Tasks 65.5	Letter/Background/Instructions 9 Background Questionnaire Work Styles 8.8 Work Context 23.0 T/E/L/E 11.1 Occupation Specific Tasks 61.9	Letter/Background/Instructions 12 Background Questionnaire Occ. Values 5.4 Knowledges 14.0 Org Context 10.6 GWAs 30.0 Occupation Specific Tasks 81.0	Letter/Background/Instructions 15 Background Questionnaire Work Context 23.0 GWAs 30.0 Occ. Values 5.4 Occupation Specific Tasks 77.4

KEY:

minutes for administration of questionnaire ↓

questionnaire name → | Letter/Background/Instructions 1
Background Questionnaire
Skills 27.5
Abilities 24.0
Occupation Specific Task
68.5 | ← packet number

← minutes for administration of entire packet including instructions

NOTES:

1. Skills=Skills questionnaire; Abilities=Abilities questionnaire; Knowledges=Knowledges questionnaire; Org Context=Organizational Context questionnaire; Work Context=Work Context questionnaire; Occ. Values=Occupational Values questionnaire; Work Styles=Work Styles questionnaire; GWAs=Generalized Work Activities questionnaire; T/E/L/E=Training, Education, Licensure, and Experience questionnaire.
2. Generalized Work Activities and Knowledges times were estimates based on modifications made since the tryout, actual times from the tryouts were 21.7 and 18.5, respectively.
3. Packet administration times include 2 minutes between tests, 10 minutes for the cover letter, overall instructions, and background information questionnaire, and 5 minutes for the occupation-specific Tasks questionnaire.

Figure 2-7
Phase I, Baseline (Paper and Pencil) Response Counts

SCREENING (Receptionist)	
Total to Screening	1,240
Ineligible[1.]	143
Possible Ineligible[2.]	42
Refusal	1
Complete	1,054
Response Rate	100%
Survival Rate	85%
NEGOTIATIONS (Human Resources Representative)	
Total to Negotiation	1,054
Ineligible[1.]	80
Refusal	218
Complete	756
Response Rate	72%
ORGANIZATIONAL REPRESENTATIVE INTERVIEW (Human Resources Representative)	
Total to Interview	756
Ineligible[1.]	3
Refusal	92
Complete	661
Response Rate	88%
MAILOUT: EMPLOYER LEVEL (mailed 18 October to 15 December)	
Total to Mailout	661
Ineligible[1.]	2
Refusal	174
Nonresponse	304
Complete	181
Response Rate	27%
MAILOUT: TOTAL EMPLOYEES	
Total to Mailout	15,529
Ineligible[1.]	25
Refusal/Nonresponse	13,015
Complete	2,489
Response Rate	16%
MAILOUT: EMPLOYEES (employers who have returned data)	
Total Employers Who Have Returned Data	181
Total Employee Packets Sent	4,125
Total Employee Packets Returned	2,489
Response Rate	60%
MAILOUT: EMPLOYEES (employers who have returned data)	
Total Employers Who Have Returned Data with at least 1 General Manager or Secretary	96
Total Employee Packets Sent - General Managers	198
Total Employee Packets Returned - General Managers	145
Response Rate - General Managers	73%

Figure 2-8

Phase II Pilot Test (Reduced Burden Paper and Pencil) Response Counts

SCREENING(Receptionist)	
Total to Screening	175
Ineligible[1]	4
Possible Ineligible[2]	2
Refusal	0
Complete	169
Response Rate	100%
Survival Rate	97%
NEGOTIATIONS(Human Resources Representative)	
Total to Negotiation	169
Ineligible[1]	23
Refusal	11
Complete	135
Response Rate	92%
MAILOUT: EMPLOYER LEVEL(mailed 1 December to 15 January)	
Total to Mailout	135
Ineligible[1]	8
Refusal	10
Nonresponse	52
Complete	65
Response Rate	51%
MAILOUT: TOTAL EMPLOYEES	
Total to Mailout	457
Ineligible[1]	0
Refusal/Nonresponse	271
Complete	186
Response Rate	41%
MAILOUT: EMPLOYEES (employers who have returned data)	
Total Employers Who Have Returned Data	65
Total Employee Packets Sent	219
Total Employee Packets Returned	186
Response Rate	85%
MAILOUT: EMPLOYEES (employers who have returned data)	
Total Employers Who Have Returned Data	65
Total Employee Packets Sent - General Managers	92
Total Employee Packets Returned - General Managers	79
Response Rate - General Managers	86%
Total Employee Packets Sent - Secretaries	127
Total Employee Packets Returned - Secretaries	107
Response Rate - Secretaries	84%

1. Ineligible cases include: duplicates; fewer than 5 employees; English not spoken; out of business; no one in chosen occupations.
2. Possibly ineligible cases include: no answer at location; not locatable; phone number not in service.

Figure 2-9

Phase I. Feasibility (DOS-Based Software) Response Counts

SCREENING(Receptionist)	
Total to Screening	200
Ineligible[1]	18
Possible Ineligible[2]	5
Refusal	0
Complete	177
Response Rate	100%
Survival Rate	89%
NEGOTIATIONS(Human Resources Representative)	
Total to Negotiation	177
Ineligible[1]	54
Refusal	25
Complete	98
Response Rate	80%
ORGANIZATIONAL REPRESENTATIVE INTERVIEW(Human Resources Representative)	
Total to Interview	98
Ineligible[1]	2
Refusal	8
Complete	88
Response Rate	92%
MAILOUT: EMPLOYER LEVEL (mailed 18 October to 15 January)	
Total to Mailout	88
Ineligible[1]	0
Refusal	0
Nonresponse	54
Complete	34
Response Rate	39%
MAILOUT: TOTAL EMPLOYEES	
Total to Mailout	1,099
Ineligible[1]	25
Refusal/Nonresponse	827
Complete	247
Response Rate	23%

1. Ineligible cases include: duplicates; fewer than 5 employees; English not spoken; out of business; no one in chosen occupations.

2. Possibly ineligible cases include: no answer at location; not locatable; phone number not in service.

Figure 2-10
Distribution of Cases by Disposition Category

Disposition Category	Count	Percent
Negotiation Refusal	218	20.7
CATI Refusal	92	8.7
Mail Nonrespondents	323	30.6
Mail Refusals	174	16.5
Mail Completes	162	15.4
Ineligible Any Phase	85	8.1

Figure 2-11
Distribution of Completed Questionnaires by Disposition Category

Disposition Category	Count	Percent
Mail Nonrespondents	304	46
Mail Refusals	174	26
Mail Completes	181	27

Figure 2-12
Final Disposition by Geographical Region

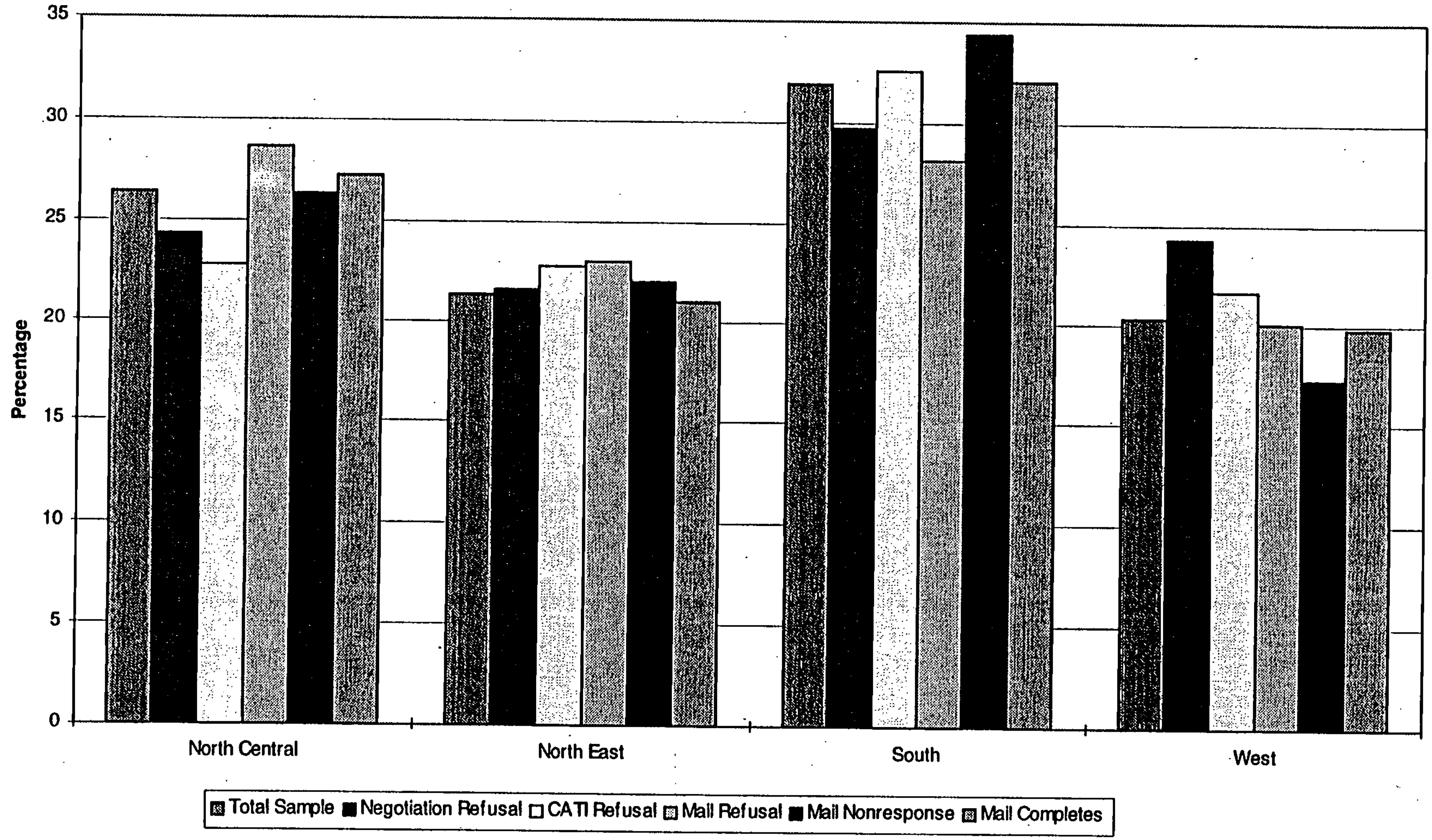

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Figure 2-13
Final Disposition by Firm Status

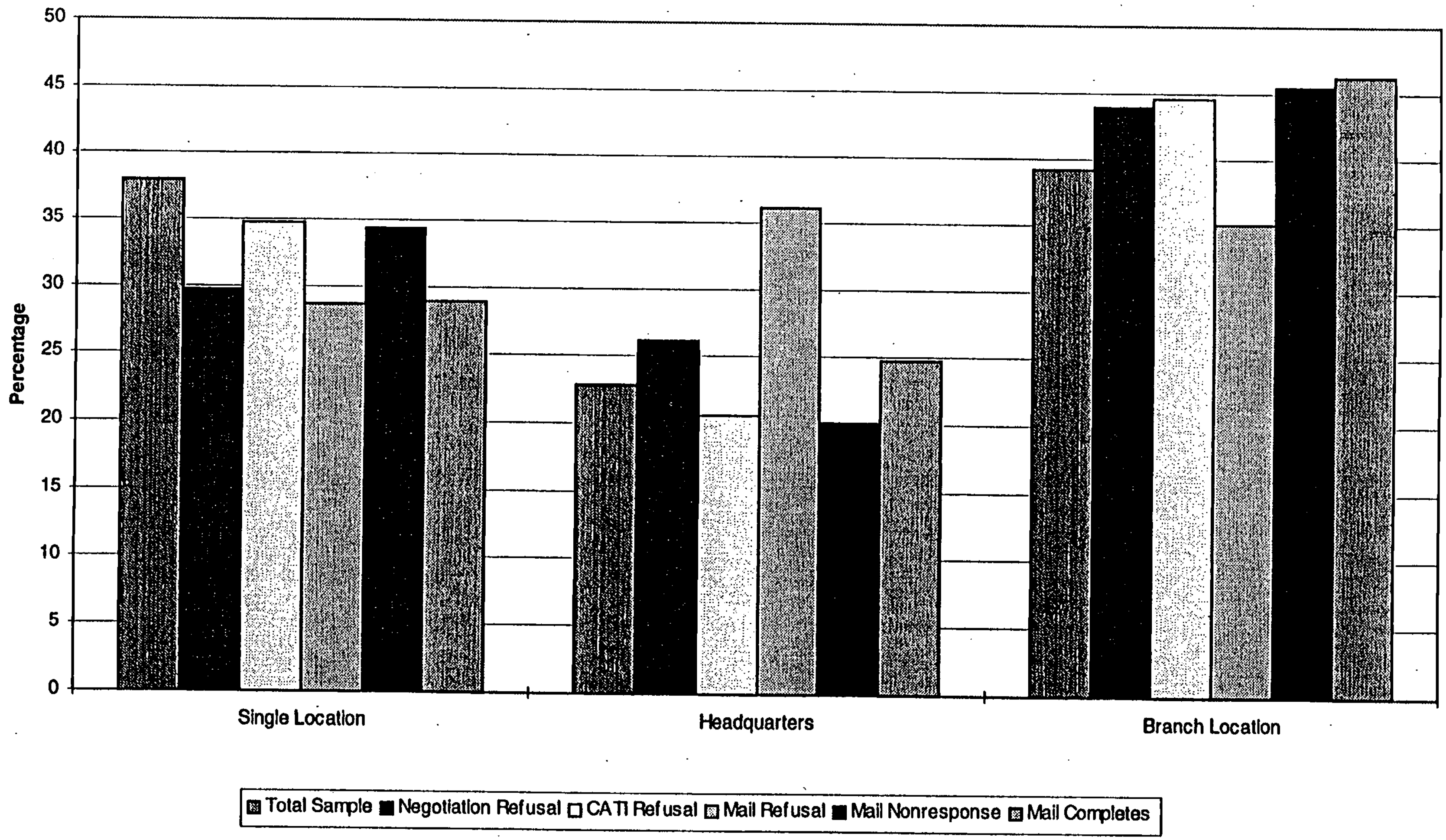

Figure 2-14
Final Disposition by Standard Industrial Classification

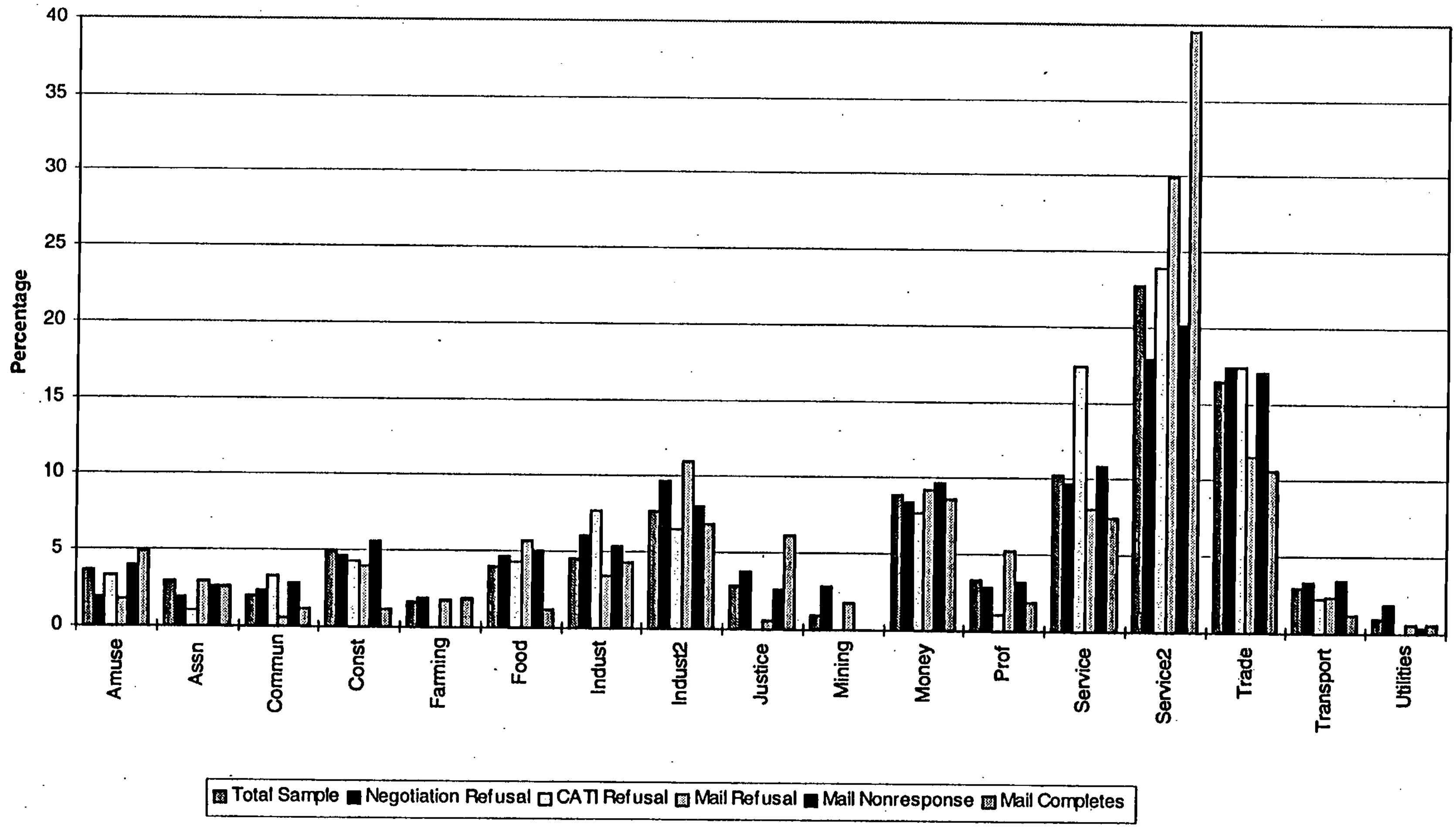

Figure 2-15
Average Number of Employees by Disposition

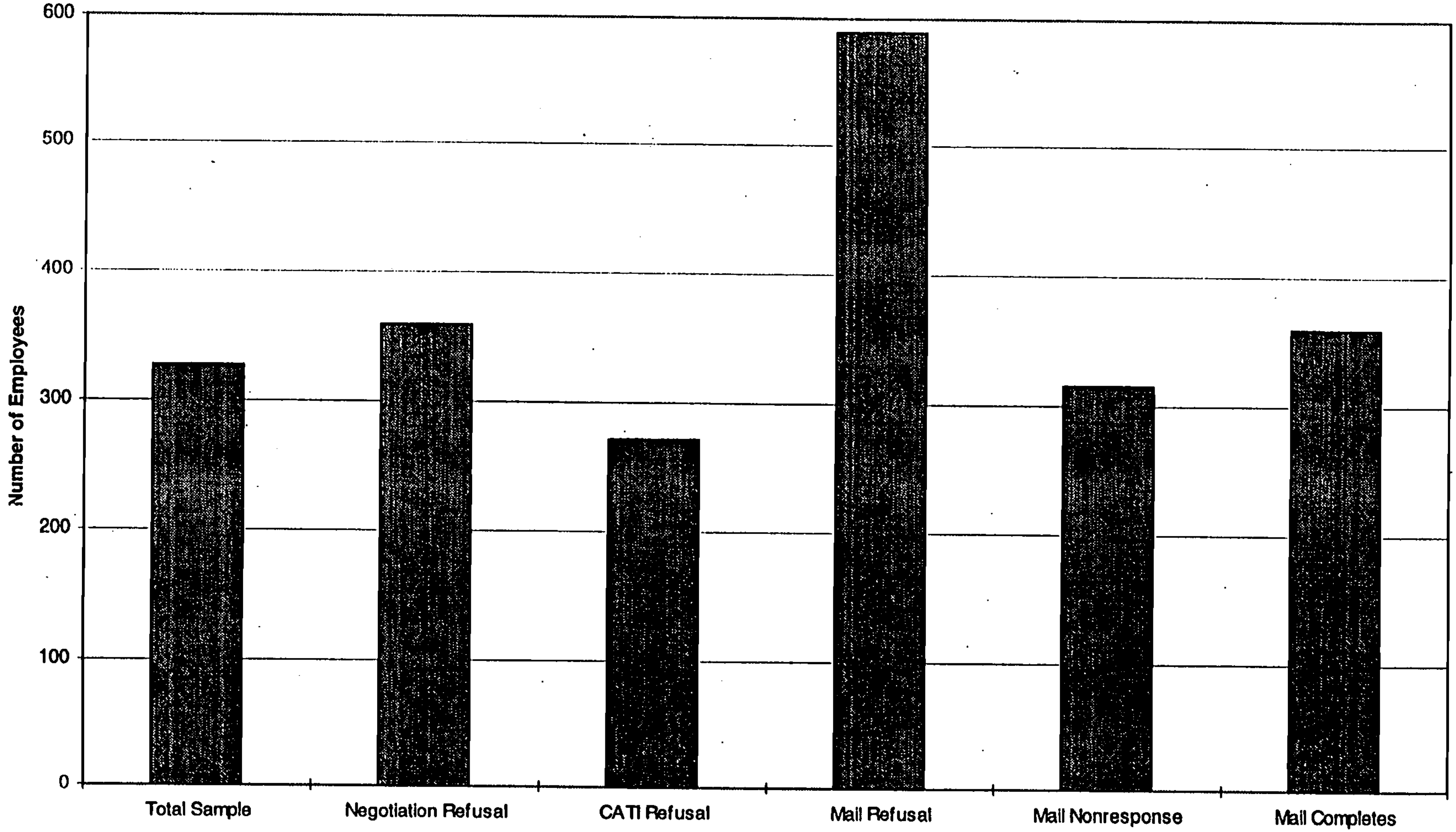

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Figure 2-16
Average Factor Score by Disposition Category

Factor	Disposition Category		
	Mail Nonrespondents	Mail Refusals	Mail Completed
Decentralization	2.3	2.3	2.4
Employee Benefits	62.4	63.6	63.4
Establishment Size	110.0	**199.1**	118.7
Extent of Training	3.4	3.1	3.5
Formalization	3.6	3.6	3.7
Goal Setting	40.4	39.7	40.0
High Performance	25.9	26.0	**21.2**
Information Sharing	51.4	47.4	48.9
Organizational Size	4778.6	3596.4	3898.4
People Orientation	5.5	5.5	5.6
Precision/Quality	5.4	5.6	5.3
Risk Taking	5.0	5.0	5.0
Stability	5.3	5.3	5.2
Use of Teams	15.7	15.3	14.9

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Figure 2-17
Tables Appearing in Domain Chapters

TABLE NUMBERS	TABLE TITLES	CHAPTERS								
		3. Skills	4. Knowledges	5. Education, Training, Experience & Licensure/ Certification	6. Generalized Work Activities	7. Work Context	8. Organizational Context	9. Abilities	10. Occupational Values	11. Work Styles
1	Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes	✓	✓		✓			✓		✓
4	Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the [Scale Type] Scale	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	Interrater Agreement Coefficients for Each Scale Type	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the [Scale Type] Scale	✓	✓		✓		✓	✓	✓	✓
7	Interrater Agreement Coefficients for Aggregate Descriptors for Each Scale Type	✓	✓		✓		✓	✓	✓	✓
8	Means and Standard Deviations of Correlations Between the [Scale Type], [Scale Type], and [Scale Type] Scales Across Occupations and Descriptors	✓	✓		✓			✓		✓
9	Intercorrelations of Descriptors for the [Scale Type] Scale (Occupation-Level Data)	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	Intercorrelations of Descriptors for the [Scale Type] Scale (Individual-Level Data)	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	Principal Components Analysis Pattern Matrix for the Level Scale [and/or Confirmatory Factor Analysis Results]	✓	✓	✓	✓	✓	✓	✓	✓	✓
12	Descriptor Means and Standard Deviations on the [Scale Type] Scale on Six Example Occupations	✓	✓	✓	✓	✓	✓	✓	✓	✓
13	Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for the Level Scale	✓	✓	✓	✓	✓	✓	✓	✓	✓
14	Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the [Scale Type] Scale	✓	✓		✓	✓		✓		
15	Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations for the [Scale Type] Scale Rescored Dichotomously	✓	✓					✓		
16	Principal Components Analysis Pattern Matrix for the Analyst Level Scale	✓	✓		✓	✓		✓		
17	Evidence Relating to Construct Validity (table titles and formats vary by domain)	✓			✓	✓	✓		✓	✓

Chapter 3

Basic and Cross-Functional Skills:

Evidence for the Reliability and Validity of the Measures

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Economics and changes in the nature of work have led to a new concern with work force skills. Policy makers ask what skills must be developed for the high wage/high skill occupations of the future. Educators ask what skills will be essential in the emerging information age. Business leaders ask how skills can be used to promote the design of more flexible person-oriented job structures.

The O*NET occupational information system is designed to provide the basic descriptive information needed to address these and a host of other questions about worker skills. In this chapter, we review the available evidence, beginning with the reliability and validity of the measures of occupational skill requirements used in the initial O*NET data collection effort. We also examine the implications of these initial findings for refinement and extension of the O*NET content model. Before turning to the relevant data, however, we first review the O*NET skills taxonomy and the procedures used to collect information about occupational skill requirements.

Background

Taxonomy

The O*NET skill measures are based on the taxonomy of workplace skills proposed by Mumford and Peterson (1995). Within this framework, a skill is viewed as a set of procedures for working with or applying knowledge within a central performance domain. The O*NET skills are intended to capture those developed performance capabilities that can be viewed as cross-occupation descriptions in the sense that these skills are, at least to some extent, relevant to describing performance in many different occupations.

Taking these propositions as starting points, Mumford and Peterson (1995) defined skills with respect to general performance domains likely to be involved in virtually all occupations. Development of their taxonomy began with the notion that the procedures involved in acquiring and conveying information are part of all occupations. Thus, basic skills such as Reading Comprehension (Descriptor #1), Active Listening (Descriptor #2), Writing (Descriptor #3), Speaking (Descriptor #4), Mathematics (Descriptor #5), and Science (Descriptor #6) are expressly included in the O*NET content model. In addition, Mumford and Peterson (1995) argue for the importance of skills likely to promote ongoing learning across peoples' careers. These learning to learn or learning process skills include Critical Thinking (Descriptor #7), Active Learning (Descriptor #8), Learning Strategies (Descriptor #9), and Monitoring (Descriptor #10).

It is not enough simply to acquire and convey knowledge. Workplace performance requires the effective application of knowledge. Using sociotechnical systems theory as a framework for defining the major domains of performance likely to be found on most jobs, Mumford and Peterson (1995) identified five general performance domains likely to occur on most jobs: (1) Social, (2) Problem Solving, (3) Technical, (4) Systems, and (5) Resource Management. These five general domains provide the basis for identifying the cross-functional skills included in the O*NET content model.

The problem solving skills were intended to capture key procedures involved in solving complex reactional problems. The problem solving skills included in the O*NET taxonomy were Problem Identification (Descriptor #17), Information Gathering (Descriptor #18), Information Organization (Descriptor #19), Synthesis/Reorganization (Descriptor #20), Idea Generation (Descriptor #21), Idea Evaluation (Descriptor #22), Implementation Planning (Descriptor #23), and Solution Appraisal (Descriptor #24). Not only must people solve problems on their jobs, they also must solve problems by working with others in the context of a broader sociotechnical system. The social skills that appeared to apply across a variety of occupations included Social Perceptiveness (Descriptor #11), Coordination (Descriptor #12), Persuasion (Descriptor #13), Negotiation (Descriptor #14), Instructing (Descriptor #15), and Service Orientation (Descriptor #16). The systems skills included Visioning (Descriptor #37), Systems Perception (Descriptor #38), Identification of Downstream Consequences (Descriptor #39), Identification of Key Causes (Descriptor #40), Judgment and Decision Making (Descriptor #41), and Systems Evaluation (Descriptor #42).

In addition to problem solving in a dynamic social setting, most jobs require people to work with technology and resources to provide certain products or services. Mumford and Peterson (1995), drawing from prior studies of managerial performance, identified four resource management skills, including Time Management (Descriptor #43), Management of Financial

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Resources (Descriptor #44), Management of Material Resources (Descriptor #45), and Management of Personnel Resources (Descriptor #46). In the case of technical skills, an examination of prior empirical studies, along with the development of a general performance model, led to the identification of twelve technical skills, including Operations Analysis (Descriptor #25), Technology Design (Descriptor #26), Equipment Selection (Descriptor #27), Installation (Descriptor #28), Programming (Descriptor #29), Testing (Descriptor #30), Operation Monitoring (Descriptor #31), Operation and Control (Descriptor #32), Product Inspection (Descriptor #33), Equipment Maintenance (Descriptor #34), Troubleshooting (Descriptor #35), and Repairing (Descriptor #36).

Figure 3-1 describes the 46 basic and cross-functional skills included in the O*NET content model. Mumford and Peterson (1995) provided some compelling support for this model of the skills domain. For example, they showed that skills included in each domain could be organized into performance models which found strong support in the broader theoretical literature. Further evidence for the meaningfulness of this taxonomy was provided by showing that the skills included in this taxonomy accounted for more than 90% of the skills variables identified in earlier taxonomic efforts.

However impressive this evidence for the substantive validity of the O*NET basic and cross-functional skills, the initial Mumford and Peterson (1995) study provided little empirical evidence for the meaningfulness of this taxonomy. Moreover, although they propose(d) measures for assessing occupational skill requirements with respect to the variables included in this model, evidence bearing on the reliability of these measures was not provided. In the following section we briefly review the procedures used to measure occupational skill requirements, before going

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on to consider the reliability and validity of the descriptive data resulting from use of these measures.

Sample and Measures

A detailed description of the procedures used to measure skill requirements within the O*NET system has been provided by Mumford (1995) and Mumford and Peterson (1995). Broadly speaking, the approach used to measure occupational skill requirements is based on earlier work (e.g., Fleishman, 1982; Fleishman & Quaintance, 1984) concerned with identification of the abilities held to determine job performance.

Initially, incumbents or analysts are presented with a definition of the skill written in operational terms. After reviewing this definition they are asked to rate the level at which this skill is required for a job, using a seven-point behaviorally-anchored rating scale. These level ratings are intended to reflect the amount of the skill someone must possess to perform requisite job assignments. In making these level ratings, incumbents or analysts are asked to review the anchors reflecting different levels of skill requirements and then choose the rating that best corresponds to the activities that occur on the target occupation. Figure 3-2 provides an illustration of these rating scales.

The anchors used to obtain these level ratings were developed based on an a priori analysis of the nature of a skill and its implications for performance in different settings (Childs & Whetzel, 1995; Mumford and Peterson, 1995). The meaningfulness of these anchors was then assessed in a categorization task, where analysts assigned anchors to skills, and in a rating task, where analysts rated the level of the skill called for by an anchor. Although the results obtained in these scaling studies generally provided support for the anchors, they indicated the need to modify or change a few anchors--typically low end anchors. These changes were made by having analysts generate remedial anchors and then checking those anchors in a second set of scaling studies.

After rating the level of skill requirements, two other ratings were made if it was indicated that the skill was relevant to understanding performance on the occupation at hand. First, the importance of the skill to performance on the job was rated using a five-point scale. The hypothesis here was that sometimes a high level of a skill might be required but the skill might not be crucial to job performance (e.g., reading for stock brokers). Second, after making importance ratings, the judges were asked to indicate whether this level of skill was required at job entry or if it could be acquired later as a function of job experience. This dichotomous rating was intended to indicate the degree to which skill development could occur on the job.

In our initial study, two sets of judges were used to describe various occupations using these rating scales. The first sample of judges consisted of incumbents--people working on the job--who were asked to describe the requirements of their job using these rating scales. This incumbent sample was obtained through a stratified random sampling of 80 occupations (out of 771 occupations) representing 46 percent of the employed U.S. population (see Chapter 2 for a complete description of the sampling procedures). The initial data collection, using a stratified random sampling of establishments with the targeted occupations, yielded 35 occupations with at least four incumbents completing the relevant skill measures. Figure 3-3 lists these occupations and the number of incumbents who completed the skill ratings. The following analyses are based on the responses of 648 incumbents from 138 establishments or organizational sites. It should be noted that the counts of incumbent respondents included some supervisors; however, for simplicity, they will be referred to simply as incumbents.

In addition to job incumbents, occupational analysts were also asked to describe the characteristics of occupations using these skill scales. The analysts' ratings were obtained with the cooperation of the five Occupational Analysis Field Centers (OAFCs). Here, a sample of at least six analysts was asked to review a list of the seven to 30 most important tasks found in an occupation as indicated by the job descriptions provided in the Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1991). Ratings of skill requirements were obtained for all 80 occupations included in the incumbent sample. To permit incumbent-analyst comparisons, only the 35 occupations for which incumbent data were also available were considered during analyses of the analyst data.

Results

Descriptive Statistics

Table 3-1 presents the basic descriptive statistics obtained for each skill scale when ratings of occupational skill requirements were obtained in the incumbent sample. This table presents the overall, cross-occupation means and standard deviations of the ratings where occupations were treated as the unit of analysis. The associated interrater agreement coefficients and standard errors of measurement are also presented.

Turning first to the basic descriptive statistics, one clear trend emerged which applied for all rating scales. Typically, basic skills, problem solving skills, and social skills had higher mean ratings on the level and importance scales than did technical skills, systems skills, and resource management skills. Additionally, the job entry requirement ratings produced a similar pattern of findings in the sense that they indicated that the requisite level of basic, problem solving, and social skills must be present at the time of job entry, while technical, systems, and resource management skills could be acquired later as people worked on the jobs.

With regard to variation in the ratings of skill requirements, the pattern of findings obtained in the incumbent analyses was typical of these types of scales. On the level scales, ratings varied from one to one and a half scale points on a seven point scale. This variation is typical of that found for well-developed level scales (Fleishman & Mumford, 1991). Importance ratings were obtained on a five-point scale and standard deviations lay between a half and a full scale point. On the job entry requirement scale, a dichotomous scale, standard deviations were, of course, smaller, ranging between .15 and .25.

Reliability

Although variation was observed between occupations in the incumbents' skill ratings, the question arose as to whether this variation reflected meaningful differences across occupations. Some initial evidence bearing on the ability of these scales to capture meaningful variation is provided by the standard errors of measurement, and, more centrally, the interrater agreement coefficients obtained for judges drawn from the same job. These interrater agreement coefficients are based on a harmonic mean of 9.01 judges per occupation and are presented in Table 3-1, along with the associated standard error of measurement.

As may be seen, the interrater agreement coefficients for the level scales ranged from .75 to .92, with most coefficients lying in the .80s. These are excellent interrater agreement coefficients, particularly given the relatively small sample of judges available. The interrater agreement coefficients obtained for the importance scale produced a similar pattern of results. Again, agreement coefficients lay in the .80s, ranging from .71 to .93. It is of note that these results did not appear to vary noticeably as a function of scale type. Thus, similar coefficients were obtained for the basic and cross-functional skills.

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The interrater agreement coefficients obtained for the job entry requirements scale were somewhat lower. Here, agreement coefficients, across scales, lay in the .70s, ranging between .61 and .86. Some caution should be exercised, however, when contrasting these agreement coefficients to those obtained for the level and importance scales, since the smaller agreement coefficients obtained for the job entry requirements scale may simply reflect an artifact of the use of a dichotomous scoring procedure.

Overall, these initial analyses indicate that the skill scales yielded adequate, consistent, descriptions of occupational skill requirements, even with relatively small samples of incumbents within each occupation. These interrater agreement coefficients, however, are dependent on the number of judges available. Thus, it is useful to examine the single judge agreement coefficients and the interrater agreement coefficients that would have been obtained if 30 judges were available for each occupation. The results obtained in this analysis are summarized in Table 3-2.

As may be seen in Table 3-2, the interrater agreement coefficients that could be expected if 30 incumbents were available for each occupation are quite large. In the case of the level and importance scales, these interrater agreement coefficients would be in the mid .90s. Even in the case of the job entry requirements scale, with 30 incumbents per occupation, interrater agreement coefficients in the high .80s or low .90s would be obtained.

The good reliability of incumbent assessments of occupational skill requirements is also evident in the single rater agreement coefficients. For the level scale, single rater agreement coefficients were in the .40s, while the importance scale yielded single rater coefficients in the .30s, although lower single rater agreement coefficients, typically in the .20s, were obtained for the job entry requirements scale. In all cases, these coefficients were of a magnitude indicating that four incumbents should, for most occupations, be sufficient to obtain useable data. Fully adequate data with respect to requisite interrater agreement coefficients should result from samples of 10 to 15 incumbents. In this regard, however, it should be noted that this represents a general cross-occupation conclusion and that larger samples may be required in certain somewhat more heterogeneous occupations.

Scoring

The results presented above speak to reliability under conditions where the skills are scored using the full scale. In other words, these findings apply under conditions where not relevant responses were included in scoring all scales, including the level scale. If not relevant was endorsed, the level was scored as 0, the importance as 1 (not important), and the job entry requirement as 2 (no, it can be learned on the job). Although we view this scoring as the most appropriate method, others might argue for different methods that ignore the not relevant response option or use that response differently to address this issue, interrater agreement coefficients were recalculated for each scale, dropping not relevant responses. Additionally, the level scale agreement coefficients were recalculated using a simple relevant/not relevant coding scheme.

The interrater agreement coefficients obtained after these rescalings are presented in Table 3-3. The interrater agreement coefficients decreased when not relevant responses were not included in scoring. The decrease averaged .10 for level, .17 for importance, and .19 for job entry requirement. The most notable differences, found across all three scales, occurred for the technology skills, which had much lower interrater agreement coefficients when not relevant was scored as missing, instead of zero. We view these findings as supporting the intended use of the not relevant response--that is, if a skill is not exercised on an occupation, it is not important and not required at job entry.

When the level scale was dichotomized to relevant/not relevant, the interrater agreement coefficients were smaller than for the full scale scoring procedure. This result is not surprising; more noteworthy is the finding that sizable interrater agreement coefficients lying primarily in the .60s or .70s were obtained with the use of this dichotomous scoring procedure. This finding suggests that not relevant ratings provided some unique information about occupation characteristics which should be considered in scoring the skill scales. This observation, of course, recommends use of the full scale scoring procedure, the procedure where not relevant responses are used as the lowest scale point. This scoring system was applied in all subsequent analyses, except those reported in Table 3-15.

Analyses of Variance

Another way one might examine interrater agreement, in addition to the simple one-way analyses described above, is by examining interrater agreement under conditions where the descriptions of skills on a given scale are treated as a repeated measures variable. The results obtained in this analysis are presented in Tables 3-4a, 3-4b, and 3-4c, which present the variance attributable to each of the relevant sources on the level, importance, and job entry requirements scales, respectively.

Across all three rating scales, significant differences were observed among scores for a given skill. Apparently, some skills are viewed as being more central to incumbent performance with respect to level, importance, and job entry requirements--a finding consistent with our earlier observations about the need for basic, problem solving, and social skills. Even taking this general trend into account, however, both the occupations and descriptor by occupations terms had significant effects. These findings indicate that the skills, regardless of the scales in use, can discriminate occupations and that some skills were particularly important in discriminating certain occupations from each other. Thus, some justification is provided for aggregating individual data to describe occupations.

The interrater agreement coefficients resulting from these analyses are presented in Table 3-5, along with the single rater and thirty rater agreement coefficients implied by these analyses. As with our earlier, single skill analyses, these overall analyses indicate that the skill ratings evidenced adequate interrater agreement, yielding coefficients of .79, .74, and .60 for the level, importance, and job entry requirements scales, respectively. Again, single rater agreement coefficients were good, particularly for the level and importance ratings, and with thirty judges these agreement coefficients would lie in the .90s. Again, however, the dichotomous job entry requirements scale provided somewhat weaker results, yielding a thirty judge agreement coefficient of .83.

The hierarchical structure of the skills permitted higher-order aggregate scales to be formulated. Thus, one might examine the eight discrete problem solving skills or the six discrete social skills to obtain an overall estimate of problem solving skills or social skills. These aggregate scales, of course, might prove useful in drawing general conclusions or structuring an information search. Accordingly, these interrater agreement analyses were rerun, treating scores on aggregates of the discrete skill scales (simple mean scores across individual scales within each aggregate) specified by Mumford and Peterson (1995) as variables. Tables 3-6a, 3-6b, and 3-6c present the results obtained in these analyses for the level, importance, and job entry requirements scales. Table 3-7 presents the resulting interrater agreement coefficients, assuming a harmonic mean of 9.01 judges, along with the derivative single rater and thirty rater agreement coefficients.

In all of these analyses, significant effects were obtained for occupations, the aggregate scales, and the occupation by aggregate scale interactions. More centrally, these theoretically-specified aggregates of the discrete skills evidenced good reliability, with coefficients of .86, .86, and .69 being obtained for the level, importance, and job entry requirement scales, respectively. These aggregates, as expected due to the covariation among skills, yielded higher observed agreement coefficients. In fact, the single rater agreement coefficients for these scale aggregates were .40, .40, and .20 for the level, importance, and job entry requirements scales, while the thirty judge coefficients were .95, .95, and .88, respectively. Thus, these aggregates, like the discrete skill scales they were developed from, evidenced adequate reliability.

Descriptor and Scale Relationships

Although the skill ratings appear to be reliable, little has been said about the relationships among the rating scales. Table 3-8 presents the average, across skills correlations among the level, importance, and job entry requirement ratings. As can be seen, the level and importance scales yielded a sizable positive correlation of .95. When this finding is considered, along with the relatively small standard deviation obtained in this analysis, it seems reasonable to conclude that the importance scale added little to the level scale ratings.

The correlations of the level and importance scales with the job entry requirements scale are also presented in Table 3-8. Bearing in mind the scaling of the job entry requirements ratings, where lower ratings (one on a two-point scale) indicated that the skill was required at the time of job entry, it is not surprising that negative relationships were obtained in this analysis. This scale yielded sizable negative correlations of -.71, and -.74 with the level and importance ratings, respectively. When these relatively smaller correlations are considered along with the larger standard deviations obtained for the scale, they suggest that the job entry requirements ratings might provide some unique descriptive information.

In evaluating the relationships among ratings of job entry requirements and the level and importance ratings, another point must be borne in mind: the job entry requirements ratings were substantially less reliable than the level and importance ratings. Because these findings with regard to the job entry requirements scales may reflect an artifact associated with reliability and because the level and importance ratings were strongly related, further discussion of the findings for the skill scales will focus on the level ratings. However, as necessary, the data for the other scales will be presented.

Tables 3-9a, 3-9b, and 3-9c present the correlations among the level, importance, and job entry requirements ratings at the occupation level. Tables 3-10a, 3-10b, and 3-10c present the same correlations but at the individual level using four individuals per occupation. Because our primary concern of the present study is occupation description, we will focus on the correlations obtained at the occupation level--particularly, the level ratings, which appeared to provide the most unique information.

In examining the correlations among skills on the level scale, it is clear that the skills evidenced an interpretable, substantively meaningful pattern of relationships. For example, ratings of the Mathematics (Descriptor #5) and Science (Descriptor #6) skills evidenced the expected positive relationship (r = .56). These skills, however, were only weakly related to Social Perceptiveness (Descriptor #11), yielding correlations of .09 and .26 for Mathematics (Descriptor #5) and Science (Descriptor #6), respectively. Along similar lines, learning to learn skills, such as Learning Strategies (Descriptor #9), yielded the expected positive correlations with Operations Analysis (Descriptor #25) (r = .49) and Technology Design (Descriptor #26) (r = .42), but weaker relationships with more routine technical skills, such as Operation Monitoring (Descriptor #31) (r = .10) and Operation and Control (Descriptor #32) (r = .06).

Other examples of this sort might be cited. However, the examples presented above suffice to indicate that the skill scales evidence a meaningful pattern of relationships. In this regard, however, it is important to note three broader trends in the pattern of the relationships observed among level requirement ratings on the skill scales. First, these skills typically evidenced sizable positive relationships, suggesting that a job requiring one skill is likely to require a number of other skills. Second, somewhat stronger relationships were observed among skills within categories as opposed to across categories. Thus, the problem solving skills were more strongly related to each other than to the social skills. Third, and finally, the technical skills tended to produce the weakest correlations with skills drawn from other categories--a finding which suggests that technical skills may reflect a relatively distinct set of occupational skill requirements.

Factor Structure

The correlations observed among the skills brings to the fore a new question: do those correlations, overall, evidence a meaningful pattern of interrelationships? To address this issue, a principal components factoring was conducted using the correlations obtained at the job level. Table 3-11 summarizes the results obtained in this analysis, following a varimax rotation.

Inspection of the eigenvalues and a scree plot indicated that a three factor solution provided the most plausible structure for summarizing the relationships observed among the skill scales. These factors accounted for 81% of the total variance for ratings on the level scale. The communalities indicated that these factors also accounted for most of the variance in ratings of the various basic and cross-functional skills.

The first factor extracted in this analysis, accounting for 38% of this variance, was labeled cognitive skills. As might be expected, all of the basic and problem solving skills yielded sizable loadings on this factor. For example, Writing (Descriptor #3) (r = .89), Synthesis/Reorganization (Descriptor #20) (r = .89), Critical Thinking (Descriptor #7) (r = .85), Speaking (Descriptor #4) (r = .85), Problem Identification (Descriptor #17) (r = .83) and Information Gathering (Descriptor #18) (r = .89) all produced sizable loadings. It was also found, however, that most of the social skills provided sizable loadings, including Coordination (Descriptor #12) (r = .80), Persuasion (Descriptor #13) (r = .80), and Instructing (Descriptor #15) (r = .74). This pattern of loadings, although at first glance surprising, is consistent with the observations of Carroll (1993) and Mumford and Peterson (1995), who note that interactional skills often depend on broader cognitive capacities.

The second factor extracted in this analysis, accounting for 25% of the total variance, was labeled technical skills. As might be expected, virtually all of the technical skills, including Troubleshooting (Descriptor #35) (r = .96), Testing (Descriptor #30) (r = .94), Operation Monitoring (Descriptor #31) (r = .88), Equipment Maintenance (Descriptor #34) (r = .87), and Technology Design (Descriptor #26) (r = .82), had high loadings on this factor. Science (Descriptor #6) (r = .70) and Mathematics (Descriptor #5) (r = .54) also yielded sizable loadings on this factor.

The third, and final, factor extracted in this analysis accounted for 17% of the variance in level ratings on the skill scales. This factor, labeled organizational skills, was defined in terms of the systems skills, including Visioning (Descriptor #37) (r = .71), Identification of Downstream Consequences (Descriptor #39) (r = .78), and Judgment and Decision Making (Descriptor #41) (r = .56), as well as the four resource management skills--Management of Personnel Resources

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(Descriptor #46) (r = .83), Management of Financial Resources (Descriptor #44) (r = .81), Management of Material Resources (Descriptor #45) (r = .80), and Time Management (Descriptor #43) (r = .52). In addition, certain social skills, particularly those that would influence getting things done in complex social systems, such as Negotiation (Descriptor #14) (r = .68) and Persuasion (Descriptor #13) (r = .46), also yielded sizable loadings on this factor.

Taken as a whole, the results obtained in this analysis provide some initial evidence for the meaningfulness of the occupational skill ratings. It is hardly surprising that occupational skills could be organized in terms of cognitive, technical, and organizational skills. In this regard, however, a word of caution is in order. Those factors indeed tell us something about relationships among the skill scales. However, they have little to say about how these skills differentiate occupations. Thus, it should not be assumed that these factors necessarily provide an adequate summarization system when our concern is describing the similarities and differences among occupations.

Future analyses of O*NET data will likely include confirmatory factor analyses investigating both the robustness of the exploratory model described above, and the strength of the theoretical hierarchical relationship among the skills described by Mumford and Peterson (1995). However, the currently-available data are not sufficient to support either analysis.

Occupation Differences

Some initial evidence bearing on the ability of the skill scales to capture the similarities and differences among occupations might be obtained by contrasting the mean profiles of occupations on the various skill scales. Table 3-12a presents the means and standard deviations of level scale ratings on six occupations selected to reflect distinct types of employment: (1) General Managers and Top Executives, (2) Computer Programmers, (3) Registered Nurses, (4)

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Police Patrol Officers, (5) Janitors and Cleaners, and (6) Maintenance Repairers, General Utility. Table 3-12b summarizes the importance scale ratings.

The mean scores of incumbents on these skill scales, of course, reflect the general trends noted in our earlier discussion of these overall descriptive data. For example, across occupations, problem solving and social skills typically received high ratings with respect to level requirements. Even bearing these general trends in mind, however, a review of mean ratings for these occupations does indicate that they evidenced an interpretable pattern of differences on the level scale. For example, Computer Programmers indicated the highest level of Programming (Descriptor #29) (M = 6.40, SD = .89) of all the occupations under consideration. On the other hand, Programmers tended to indicate that their jobs did not require a high level of Social Perceptiveness (Descriptor #11) (M = 2.60, SD = .89). As might be expected, General Managers and Top Executives had the highest level ratings on the four resource management skills vis-à-vis the five other occupations under consideration: Time Management (Descriptor #43) (M = 5.42, SD = 1.16), Management of Financial Resources (Descriptor #44) (M = 4.43, SD = 1.76), Management of Material Resources (Descriptor #45) (M = 4.50, SD = 1.80), and Management of Personnel Resources (Descriptor #46) (M = 5.44, SD = 1.44). Moreover, Police Patrol Officers, consistent with the nature of the Patrol Officers' jobs, had unusually low scores on Management of Financial Resources (Descriptor #44) (M = .90, SD = 1.64). Police Officers, however, did need the highest level of Active Listening (Descriptor #2) (M = 5.86, SD = .74) and Negotiation (Descriptor #14) (M = 5.14, SD = 1.28) skills.

As might be expected, Janitors and Cleaners typically had the lowest reported skill requirements for all of the skill scales. In this regard, however, it is important to note that Janitors and Cleaners did have somewhat higher scores on the Equipment Maintenance (Descriptor #34)

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(M = 3.17, SD = 2.41), Troubleshooting (Descriptor #35) (M = 2.96, SD = 2.55), and Repairing (Descriptor #36) (M = 2.65, SD = 2.39) scales, a finding consistent with the nature of janitorial jobs. As might be expected, Maintenance Repair Workers had substantially higher scores on Equipment Maintenance (Descriptor #34) (M = 5.01, SD-1.38), Troubleshooting (Descriptor #35) (M = 4.96, SD = 1.29), and Repairing (Descriptor #36) (M = 5.04, SD = 1.34) than did Janitors and Cleaners.

Although other examples of this sort might be cited, the evidence presented above does lead to a noteworthy conclusion. Specifically, it appears that the skill scales provide a meaningful description of the similarities and differences among occupations. This point is of some importance since ultimately a viable descriptive system must be capable of capturing and accurately reflecting meaningful differences in occupational requirements.

Discriminant Analyses

Our foregoing analysis of mean differences across occupations was, of course, based on a limited set of well-known occupations. This analysis, however valuable, begs a further question. How well do level ratings on the skill scales differentiate occupations in a larger sample of occupations? To address this issue, a discriminant analysis was conducted. The results obtained in this analysis are presented in Table 3-13, which displays both the loadings on the discriminant functions and the discriminating variance attributable to a given skill.

The discriminant analysis provided six functions which appeared to be interpretable and had nontrivial eigenvalues. These functions and the skill variables they were derived from appear to provide a useful mechanism for discriminating occupations. If all functions, including these six, are used, 62% of the incumbents are assigned to the occupations from which they were drawn. If incumbents were evenly distributed across the 35 occupations in this analysis, then the expected or base rate of correct classification would be about 3% for random assignment. In this sample, incumbents are not evenly distributed across occupations, but, even if we double their expected rate to 6%, the observed number is still substantially higher, indicating that patterns of scores on the level scale are indeed an effective vehicle for capturing the similarities and differences among occupations across a range of occupations.

The results obtained in this discriminant analysis also indicate that all of the skills made some contribution to discriminating the occupations from each other. Table 3-13 presents the sum of the squared function coefficients, as well as the η^2 coefficients reflecting the variance in job assignments accounted for by ratings on each of the skill scales. The squared function coefficients ranged between .72 and .10 and the η^2 coefficients between .41 and .18.. The best discriminators of job assignments were apparently the technical and scientific skills, particularly Repairing (Descriptor #36), Installation (Descriptor #28), and Operation Monitoring (Descriptor #31)--skills characterizing production jobs. The Learning Strategies (Descriptor #9), Instructing (Descriptor #15), and Service Orientation (Descriptor #16) skills produced the weakest discrimination. In this regard, however, it should be recognized the η^2 and function coefficients obtained for these skills indicated that they still made nontrivial contributions to discrimination.

In addition to indicating that all of the skills contributed to discrimination, the findings obtained in this analysis provide some clues about how skills discriminate occupations. Inspection of the skills loading on the six functions retained in this analysis indicated that the functions appeared to reflect, respectively: (1) <u>technical repair</u>, (2) <u>systems direction</u>, (3) <u>machine production</u>, (4) <u>research and development</u>, (5) <u>interactive problem solving</u>, and (6) <u>computer applications</u>. The nature of these functions, as defined by the function loadings, suggests that the skills discriminate occupations by capturing integrated patterns of skills related to core job

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functions. However, these particular findings are limited in generality, since we have just 35 occupations in our sample. A broader group of occupations might indicate different skills as the best discriminators.

Convergence With Analysts' Ratings

These discriminant analysis findings, of course, provide some important evidence for the meaningfulness, or validity, of the descriptive information provided by the skill scales. Some further evidence for the meaningfulness of the descriptive information provided by these scales may be obtained by contrasting incumbents' and analysts' ratings on the skill level scales. The results of this comparison are summarized in Table 3-14a, which provides the means, standard deviations, and interrater agreement coefficients obtained for incumbents' and analysts' ratings on each skill for the level scale. (Table 3-14b presents the importance ratings). Table 3-14a also presents the $\underline{t}$ and $\underline{F}$ tests comparing the means and standard deviations of incumbents' and analysts' ratings, along with the correlation coefficient and $\underline{d}^2$ index contrasting incumbents' and analysts' ratings of occupational skill requirements. The analysts' and incumbents' ratings both provided sizable interrater agreement coefficients for ratings of the level of skill requirements The interrater agreement coefficients obtained in the analyst sample, however, were typically somewhat larger than those obtained in the incumbent sample. Overall, the analyst agreement coefficients were .10 points higher than the incumbents' ratings, resulting in agreement coefficients in the mid .90s as opposed to the mid .80s.

More centrally, however, both incumbent and analysts ratings of occupational skill requirements displayed good agreement. The median correlation observed between the incumbents' and analysts' ratings was .73. Thus, analysts and incumbents displayed substantial agreement in their descriptions of the patterns of occupational skill requirements. This finding, of course, provides some compelling evidence for the convergent validity of ratings of occupations' skill requirements. Along similar lines, the F test indicated that variances of incumbents' and analysts' mean ratings of skill requirements across occupations were also quite similar, with only 5 of the 46 F tests yielding significant differences at the .05 level.

Although incumbents and analysts displayed substantial agreement in the patterns of occupational skill ratings, differences were generally observed between incumbents and analysts with respect to mean level ratings. Typically, analysts' ratings on the basic, problem solving, social, systems, and resource management skills were lower than incumbents' ratings. This finding suggests that incumbents may see higher levels of skill requirements than analysts. It should be noted, however, that this trend was not as pronounced for the technical skills, where in some cases analysts indicated higher levels of skill requirements than incumbents. Thus, it appears that analysts' and incumbents' ratings may reflect distinct perspectives--in the case of analysts, one based on cross-occupation comparisons, and in the case of incumbents, one based on the more salient aspects of work on the occupation at hand. The d^2 results in Table 3-14a indicate that the absolute sizes of these differences are less than one and one-half scale points (the square root of d^2), with the exception of some of the basic, social, and resource management skills.

Table 3-15 displays analogous results, but based on a dichotomous rescoring of the data as relevant/not relevant. In general, analysts were more likely to rate skills as relevant than were incumbents. This is an interesting finding, particularly in light of the above finding that, overall, level ratings tended to be lower for analysts. As we also saw in Table 3-3, the reliabilities are predictably lower, as a result of the dichotomization of the scale. In fact, for Operation and

Control (Descriptor #32), which had the lowest reliability when scored on the full scale, the reliability for the analysts' ratings scored dichotomously is zero.

Table 3-16 reports the results for a principle components analysis of the analysts' mean level ratings for the 35 occupations. The analysts' ratings were found to support only two factors, in contrast to the three factors yielded in the analysis of the incumbents' ratings, presented in Table 3-11 and described in detail above. The second of these is very similar in loading patterns to the technical skills factor in the analysis of incumbents' ratings. The first, however, is essentially a combination of the first and third factors--cognitive skills and organizational skills--in that analysis. Morgeson and Campion (1996) have suggested that raters with limited knowledge of an occupation may rely on overall impressions of an occupation in making their ratings, possibly causing their ratings to be more internally consistent than those of job incumbents with their greater job knowledge. If occupational analysts, in relying on a list of occupation-specific tasks for their knowledge of an occupation, tend to rate skills generally high or low based on a general impression of the occupation, then their ratings would indeed be likely to yield fewer factors, as was found here.

Additional Validity Evidence

Convergence is, of course, only one characteristic of meaningful descriptive systems. As Messick (1995) points out, valid descriptive systems should also allow us to draw meaningful inferences about the objects of interest--in this case, occupations. Recently, in the popular press, we have heard a number of discussions about the relationship between skills and employment patterns. Neither time nor the nature of the available data allows us to explore all of the hypotheses formulated in the course of this debate. Two questions, however, seem of particular interest with regard to the skill measures. First, are formal educational requirements related to higher skill levels? Second, are skill requirements in high performance organizations different than in more traditional organizations?

To address our question about educational requirements, the measures described in the Training, Education, Licensure, and Experience chapter, Chapter 5, were used. Here, a measure of overall educational requirements was developed by determining the level of education required. The majority of incumbents in 19 of the 35 occupations reported that their jobs required a high school diploma (or high school equivalence certificate) or less. The majority of incumbents in the remaining 16 occupations reported that their jobs required at least some post-secondary training (e.g., vocational training, college courses, or college or graduate degrees). The means and standard deviations of occupational mean ratings on the level scale in these two groups were contrasted using a t test and an F test. Table 3-17a summarizes the results obtained in this analysis.

In accordance with the hypothesis that increased educational requirements are related to higher skills, it was found that scores on the level scales were generally higher for occupations with higher educational requirements ($M_M = 3.53$, $M_{SD} = 1.16$) than for occupations with lower educational requirements ($M_M = 2.20$, $M_{SD} = 0.89$). Thus, overall, our findings seem to confirm the conventional wisdom. In this regard, however, it should be noted that these differences were more pronounced with regard to basic skills (Descriptor #1-Descriptor #11) ($M_M = 4.32$, $M_{SD} = 0.79$ vs. $M_M = 2.97$, $M_{SD} = 0.79$) and problem solving skills (Descriptor # 17-Descriptor #24) ($M_M = 4.26$, $M_{SD} = 0.91$ vs. $M_M = 2.58$, $M_{SD} = 0.82$), than technical skills (Descriptor #25-Descriptor #36) ($M_M = 2.38$, $M_{SD} = 1.64$ vs. $M_M = 1.26$, $M_{SD} = 1.06$).

To provide some data that might be used to answer our second question, we drew from the analyses presented in the chapter on organizational context, Chapter 8. In that chapter, the

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characteristics of the establishments employing incumbents are assessed. A hierarchical factoring of the organizational context items administered to organizational representatives resulted in a coherent factor structure where factors (use of teams and organizational goal setting, for example) were related to the known characteristics of high performance organizations. Four factor scores were used in this analysis--use of teams, information sharing, organizational goal setting, and high performance human resources practices. This selection was based on these factors' high loadings on a high performance practices second-order factor in the analysis reported in Table 8-23 in Chapter 8, combined with their theoretical identification as organizational characteristics related to high performance. The scores of incumbent establishments on these factors were obtained, standardized, and summed, and those establishments in the upper quartile on the composite were assigned to the high performance group, while those with scores in the lower quartile were assigned to the traditional (not high performance) group.

Two occupations were selected for this analysis: (1) General Office Clerks, and (2) First Line Supervisors, Clerical/Administrative. For each of these occupations, at least 15 incumbents from high performance establishments and 15 from traditional establishments provided Skills ratings. Most of the other sampled occupations did not have adequate numbers of incumbents in each of these groups to permit this analysis. We anticipate that, as the O*NET database grows, we will be able to repeat this analysis for more occupations, and with more incumbents for these occupations.

The results of these analyses are presented in Tables 3-17b and 3-17c. Generally, there are few statistically significant differences--not a surprising finding given the relatively low numbers of respondents in each group, and the fact that these are within-occupation comparisons.

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Perhaps the most clear-cut conclusion to emerge from this analysis is that variances of skill level ratings were generally higher for incumbents in high performance organizations, suggesting that such organizations may be allowing employees to develop and express their skills in idiosyncratic ways.

Additionally, it seems that while some lower-level jobs in high performance organizations may require higher skill levels, supervisory jobs in high performance organizations may actually require lower skill levels. For General Office Clerks, across all skills, incumbents working in high performance organizations reported slightly higher skill requirements ($\underline{M}_{M}$ = 2.11, $\underline{M}_{SD}$ = 1.78) than incumbents working in more traditional organizations ($\underline{M}_{M}$ = 1.68, $\underline{M}_{SD}$ = 1.55). These differences, however, were especially large with regard to the problem solving skills (Descriptor #17-Descriptor #24) ($\underline{M}_{M}$ = 2.81, $\underline{M}_{SD}$ = 1.83 vs. $\underline{M}_{M}$ = 2.24, $\underline{M}_{SD}$ = 1.60), social skills (Descriptor #11-Descriptor #16) ($\underline{M}_{M}$ = 2.83, $\underline{M}_{SD}$ = 2.02 vs. $\underline{M}_{M}$ = 2.04, $\underline{M}_{SD}$ = 1.81), and resource management skills (Descriptor #43-Descriptor #46) ($\underline{M}_{M}$ = 1.87, $\underline{M}_{SD}$ = 2.06 vs. $\underline{M}_{M}$ = 1.21, $\underline{M}_{SD}$ = 1.49). This finding is consistent with the goal of many high performance organizations to encourage employees to manage their own work.

In contrast, for First Line Supervisors, those working in high performance organizations reported lower skill requirements than those working in traditional organizations ($\underline{M}_{M}$ = 3.30, $\underline{M}_{SD}$ = 1.71 vs. $\underline{M}_{M}$ = 3.91, $\underline{M}_{SD}$ = 1.57). These differences were especially large with regard to the problem solving skills (Descriptor #17-Descriptor #24) ($\underline{M}_{M}$ = 3.89, $\underline{M}_{SD}$ = 1.65 vs. $\underline{M}_{M}$ = 4.85, $\underline{M}_{SD}$ = 1.22), social skills (Descriptor # 11-Descriptor #16) ($\underline{M}_{M}$ = 4.08, $\underline{M}_{SD}$ = 1.83 vs. $\underline{M}_{M}$ = 4.75, $\underline{M}_{SD}$ = 1.07), systems skills (Descriptor #37-Descriptor #42) ($\underline{M}_{M}$ = 3.29, $\underline{M}_{SD}$ = 1.93 vs. $\underline{M}_{M}$ = 4.39, $\underline{M}_{SD}$ = 1.73), and resource management skills (Descriptor #43-Descriptor #46) ($\underline{M}_{M}$ = 4.02, $\underline{M}_{SD}$ = 1.78 vs. $\underline{M}_{M}$ = 4.60, $\underline{M}_{SD}$ = 1.87). It appears, then, that at least some low-level supervisory jobs in high performance organizations have lower skill demands than similar jobs in traditional organizations. This may be related to the above finding that lower level employees in high performance organizations have higher levels of skills--perhaps such employees require less supervision. This issue merits further investigation when additional data are available.

Conclusions

Having evaluated the meaningfulness of the skill scales using the data gathered in this prototype study, it would seem germane to consider some of the broader methodological and substantive conclusions flowing from these findings. Before turning to these broader implications of the present study, certain limitations of the present study should be noted. To begin, although our findings are based on a sample of the more populous occupations found in the American economy, it is certainly true that we have examined only a small number of occupations. Accordingly, some caution is called for in generalizing our findings to all jobs in the economy.

Along similar lines, it must be recognized that despite the systematic random sampling procedures in use, our findings cannot be viewed as providing definitive normative data about occupational skill requirements. In many cases, only a relatively small number of incumbents--four or five--provided descriptive data bearing on occupational skill requirements. Overall, about 18 incumbents on average were available for the 35 occupations. Samples of this size may be sufficient to obtain adequate agreement with respect to the description of occupational skill requirements. Nevertheless, they should not be viewed as providing a truly normative description of jobs employing tens of thousands of workers.

In addition to these concerns about the number of occupations and the number of incumbents per occupation, three other limitations of the present study need to be borne in mind. The first of these limitations pertains to the nature and range of the evidence bearing on the meaningfulness of the descriptive information provided by the skill scales. In the present study, evidence bearing on the meaningfulness of the descriptive information provided by these scales was derived primarily through analyses examining internal validity. This evidence, however impressive, cannot tell us whether these scales will evidence meaningful relationships with other measures of occupational requirements. This external validity evidence, at a minimum, requires cross-domain analyses beyond the scope of the present effort. Some relevant cross-domain analyses are reported in Chapter 15.

The second limitation inherent in these analyses must be recognized by any effort intended to provide evidence for the meaningfulness of a new set of measures. Evidence for the meaningfulness of a set of measures can be obtained using a variety of techniques. Although a number of analyses were used to accrue evidence for the meaningfulness of our skill measures, we could not, and have not, conducted every analysis that might be used to provide evidence bearing on the meaningfulness of these measures. As a result, any conclusions flowing from these findings must be viewed as contingent and subject to change with future research.

Third, and finally, it should be noted that any evidence bearing on the meaningfulness of a measure is referenced against a particular application of the measure. In the present study, our intent was to describe occupational skill requirements. Accordingly, our findings must be assessed with this point in mind and some caution is called for in extrapolating our findings to other potential uses of skill measures. For example, our findings have little to say in any direct sense about the procedures that should be used to develop occupational skills nor can they be used to draw explicit conclusions about the kind of procedures that should be used to assess workers' skills. Instead, our findings speak primarily to the measurement, structure, and nature of occupational skill requirements.

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Methodological Conclusions

Even bearing these caveats in mind, we do believe that the findings obtained in the present study have some important implications for the assessment of occupational skill requirements. To begin, it appears that it is possible to formulate rating scales that can be used to obtain reliable, meaningful assessments of occupational skill requirements from either incumbents or analysts. The apparent feasibility of assessing occupational skill requirements using a rating strategy is noteworthy because it represents a relatively low-cost procedure for establishing occupational skill requirements.

In this regard, however, it seems necessary to note the important characteristics of the procedures used to obtain these ratings. First, the skills were defined in simple operational terms which were intended to be understood by job incumbents with about a sixth grade reading level. Second, the level scale provided a set of concrete behavioral illustrations of the skill under consideration. It is therefore quite possible that similar results would not be obtained using different definitions or different rating procedures.

These procedural implications are of some importance with regard to another issue: what rating scales should be used to assess occupational skill requirements? In the present study, occupational skill requirements were assessed using: (1) a level scale, (2) an importance scale, and (3) a job entry requirements scale. The evidence presented in the scale correlations indicated that the level and importance scales provided effectively identical information in describing occupational skill requirements. Thus, if an occupation required a high level of a skill, this skill was also viewed as important to performance on the job.

This finding suggests that either the level or the importance scale could be dropped in future studies. Because importance ratings were collected in the context of level ratings, the reliability and meaningfulness of importance ratings may be contingent on the level ratings collected earlier. Further, the behavioral anchors attached to the level scale serve to clarify and extend initial definitions of the skill. Based on these considerations, it appears more appropriate to retain the level scale, if a scale must be dropped in future studies.

The level scale was not as strongly related to the job entry requirements scale as it was to the importance scale. Thus, it is possible that the job entry requirements scale might provide some unique descriptive information. The job entry requirements scale, however, was less reliable than the level scale, indicating that the level scale provides a better single measure of occupational skill requirements. If the job entry requirements scale is retained in future studies, it should, therefore, be treated as a supplement to level ratings. Because this is a relatively simple rating requiring very little time, we think it should be retained.

Not only do our findings have some bearing on the rating scales that should be used in future research, they also have some noteworthy implications for the scoring of skill ratings. In the present effort, a number of analyses were conducted examining the effects of scoring not relevant responses and whether not relevant responses provided viable descriptive information. Broadly speaking, the findings obtained in these analyses indicate that the inclusion of not relevant responses produced more reliable ratings that provided sensible patterns of results. Moreover, the not relevant responses provided some unique descriptive information. Thus, it appears that not relevant responses should be collected and scored in further studies using the level scales to describe occupational skill requirements.

Having addressed the rating scales that should be used, and how these scales should be scored, in describing occupational skill requirements, a new issue comes to the fore. Specifically, who should use these rating scales? Completing the questionnaire, as it is currently administered, by mail in paper-and-pencil format, does require some degree of literacy. Thus, these scales should not be used as they stand by incumbents or analysts without some level of reading comprehension skill.

Although it appears that most incumbents can make viable skill ratings using these scales, in cases where incumbent data cannot be obtained, our findings suggest that analysts might be used to assess occupational skill requirements. In this regard, however, a word of caution is in order. Clearly, incumbent and analysts' ratings of skill requirements displayed good convergence with regard to the pattern of skills called for. Nonetheless, the comparative nature of analysts' ratings resulted in lower mean scores than incumbents' ratings, while incumbents seemed to feel that higher levels of salient skills were called for on their jobs. This pattern of findings suggests that some control for mean differences should be considered if analysts' ratings are to be used in lieu of incumbents' ratings. Further, given the existence of these mean differences, incumbents' ratings should be preferred whenever our concern is describing the occupation at hand without reference to other occupations.

These observations about operational uses of the scales bring us to a final concern likely to arise in routine application of the level scale. Specifically, would it be possible to obtain similar descriptive information using a smaller set of skills? The correlations observed among the skill ratings would seem, at least at first glance, to justify some reduction in the number of skills. However, the results obtained in the discriminant analysis indicate that all of the skills contributed to distinguishing occupations, even in a relatively small sample. While it is recognized that discriminating occupations is our ultimate concern in assessing occupational skill requirements, these discriminant analysis findings indicate that reductions in the number of skills being evaluated cannot be justified at present.

Substantive Conclusions

Another reason for retaining the present set of skills is that these skills have a strong foundation in prior research and reflect a cohesive set of attributes required for performance in different domains (Mumford & Peterson, 1995). In fact, the results obtained in the present study provide some compelling support for the taxonomy of basic and cross-functional skills proposed by Mumford and Peterson (1995). To begin, all of these skills were seen by both incumbents and analysts as being required across a range of occupations. In fact, no skill included in this taxonomy had mean level ratings, with the possible exception of Programming (Descriptor #29), which would indicate that they were not applicable across a range of occupations.

Along similar lines, the descriptive statistics indicated that the basic, problem solving, and social skills were required at a relatively high level across all occupations. This finding, of course, provides some support for the notion that both learning and performance skills must be considered in any viable taxonomy of occupational skill requirements. As an aside, however, this finding also provides some support for current educational initiatives which assert that problem solving and social skills must be developed, along with basic skills, to prepare students for entry into the workplace.

Perhaps somewhat more compelling evidence for this taxonomy of skills was provided by the results obtained in the principal components and discriminant analyses. In the principal components analysis, three factors, labeled cognitive skills, technical skills, and organizational skills, were identified. These factors are related to, but not isomorphic with, the traditional distinction between data, people, and things, made in describing occupational skill requirements. This structure, moreover, was used by Mumford and Peterson (1995) as a basis for identifying the performance domains to be covered by the skill scales, and the confirmation of this

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assumption in our factor analysis findings provides some crucial empirical evidence justifying both this assumption and the procedures used in developing the skills taxonomy.

The discriminant analysis is of interest because it extends the factor analytic findings by showing how skills operate together to distinguish among occupations. The findings obtained in the discriminant analysis indicate that skills distinguish among occupations based on patterns of skills needed to perform certain core duties. Thus, functions were identified, such as technical repair, research and development, machine production, and system direction, which involved multiple sets of interrelated skills. This finding is of some importance because it indicates that an occupation cannot be described with reference to one or two skills. Instead, it suggests that occupations are differentiated in terms of patterns of skill requirements.

Based on the findings obtained in this initial study, it appears that the taxonomy of basic and cross-functional skills proposed by Mumford and Peterson (1995) provides a reasonably comprehensive system for identifying the patterns of skill requirements that distinguish occupations. For example, in the discriminant analyses it was found that the vast majority of individuals could be accurately allocated to their occupations based on the pattern of their level ratings for the basic and cross-functional skills. Given the systematic procedures used in developing this taxonomy, this finding, while gratifying, is hardly surprising. By the same token, however, it should be recognized that changes in job functions or the need to consider certain unique functions may require the addition of some new skills to this initial taxonomic system.

In considering the comprehensiveness of this taxonomy of basic and cross-functional skills, it is important to bear in mind an assumption underlying the development of this taxonomy. Specifically, these taxonomies were expressly developed to capture those skills involved in broad performance domains which are likely to occur on most jobs. Thus, some caution is called for in extending this taxonomy to more narrowly defined domains or specific occupations, although, as Mumford (1995) points out, in many cases, these occupation-specific skills may reflect instantiations of the basic and cross-functional skills within the context of a particular job or set of job tasks. Bearing this point in mind, however, it appears that the proposed taxonomy of basic and cross-functional skills provides an adequate basis for assessing the similarities and differences among occupations with respect to general basic and cross-functional skill requirements.

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Figure 3-1
Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale
Basic Skills		
Reading Comprehension	Understanding written sentences & paragraphs in work related documents	**High:** Reading a scientific journal article describing surgical procedures. **Medium:** Reading a memo from management describing new personnel policies. **Low:** Reading step-by-step instructions for completing a form.
Active Listening	Listening to what other people are saying & asking questions as appropriate	**High:** Presiding as judge in a complex legal disagreement. **Medium:** Answering inquiries regarding credit references. **Low:** Taking a customer's order.
Writing	Communicating effectively with others in writing as indicated by the needs of the audience	**High:** Writing novel for publication. **Medium:** Writing a memo to staff outlining new directives. **Low:** Taking a telephone message.
Speaking	Talking to others to effectively convey information	**High:** Arguing a legal case before the Supreme Court. **Medium:** Interviewing applicants to obtain personal and work history. **Low:** Greeting tourists and explaining tourist attractions.
Mathematics	Using mathematics to solve problems	**High:** Developing a mathematical model to simulate and resolve an engineering problem. **Medium:** Calculating the square footage of a new home under construction. **Low:** Counting the amount of change to be given to a customer.
Science	Using scientific methods to solve problems	**High:** Conducting analyses of aerodynamic systems to determine the practicality of an aircraft design. **Medium:** Conducting product tests to insure safety standards are met, following written instructions. **Low:** Conducting standard tests to determine soil quality.
Critical Thinking	Using logic & analysis to identify the strengths & weaknesses of different approaches	**High:** Writing a legal brief challenging a federal law. **Medium:** Evaluating customer complaints and determining appropriate responses. **Low:** Determining whether a subordinate has a good excuse for being late.

Figure 3-1 (continued)
Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale	
Active Learning	Working with new material or information to grasp its implications	**High:**	Identifying the implications of a new scientific theory for product design.
		Medium:	Determining the impact of new menu changes on a restaurant's purchasing requirements.
		Low:	Thinking about the implications of a newspaper article for job opportunities.
Learning Strategies	Using multiple approaches when learning or teaching new things	**High:**	Applying principles of educational psychology to developing new teaching methods.
		Medium:	Identifying an alternative approach that might help trainees who are having difficulties.
		Low:	Learning a different method of completing a task from a co-worker.
Monitoring	Assessing how well one is doing when learning or doing something	**High:**	Reviewing corporate productivity and developing a plan to increase productivity.
		Medium:	Monitoring a meeting's progress and revising the agenda to ensure that important topics are discussed.
		Low:	Proofreading and correcting a letter.
Social Skills			
Social Perceptiveness	Being aware of others' reactions and understanding why they react the way they do	**High:**	Counseling depressive patients during a crisis period.
		Medium:	Being aware how a co-worker's promotion would affect a work group.
		Low:	Noticing that customers are angry because they have been waiting too long.
Coordination	Adjusting actions in relation to others' actions	**High:**	Working as director of a consulting project calling for interaction with multiple subcontractors.
		Medium:	Working with others to put a new roof on a house.
		Low:	Scheduling appointments for a medical clinic.

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Figure 3-1 (continued)
Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale	
Persuasion	Persuading others to approach things differently	**High:**	Changing the opinion of the jury in a complex legal case.
		Medium:	Convincing a supervisor to purchase a new copy machine.
		Low:	Soliciting donations for a charity.
Negotiation	Bringing others together and trying to reconcile differences	**High:**	Working as an ambassador in negotiating a new treaty.
		Medium:	Contracting with a wholesaler to sell items at a given cost.
		Low:	Presenting justification to manager for altering work schedule.
Instructing	Teaching others how to do something	**High:**	Demonstrating surgical procedures to interns in a teaching hospital.
		Medium:	Instructing a co-worker in how to operate a software program.
		Low:	Instructing a new employee in the use of time clock.
Service Orientation	Actively looking for ways to help people	**High:**	Directing relief agency operations in a disaster area.
		Medium:	Making flight reservations for customers using airline reservation system.
		Low:	Asking customers if they would like cups of coffee.
Complex Problem Solving Skills			
Problem Identification	Identifying the nature of problems	**High:**	Analyzing corporate finances to develop a restructuring plan.
		Medium:	Identifying and resolving customer complaints.
		Low:	Comparing invoices of incoming articles to ensure they meet required specifications.
Information Gathering	Knowing how to find information & identifying essential information	**High:**	Analyzing industry indices and competitors' annual reports to determine feasibility of expansion.
		Medium:	Conducting an employee opinion survey.
		Low:	Looking up procedures in a manual.
Information Organization	Finding ways to structure or classify multiple pieces of information	**High:**	Developing a prototype for a new database system.
		Medium:	Classifying library materials according to subject matter.
		Low:	Laying out tools to complete a job.

Figure 3-1 (continued)

Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale	
Synthesis/ Reorganization	Reorganizing information to get a better approach to problems or tasks	**High:**	Determining the best order in which to present evidence in a criminal trial.
		Medium:	Redesigning floor layout to take advantage of new manufacturing techniques.
		Low:	Rearranging a filing system to make it easier to get needed material.
Idea Generation	Generating a number of different approaches to problems	**High:**	Developing alternative transportation plans for a growing urban area.
		Medium:	Developing recruitment strategies.
		Low:	Finding alternative routes while making deliveries.
Idea Evaluation	Evaluating the likely success of an idea in relation to the demands of the situation	**High:**	Analyzing probable outcomes of public health policies to combat a disease epidemic.
		Medium:	Evaluating and selecting employee suggestions for possible implementation.
		Low:	Determining which procedure to apply to get a report typed more quickly.
Implementation Planning	Developing approaches for implementing an idea	**High:**	Developing and implementing a plan to provide emergency relief for a major metropolitan area.
		Medium:	Scheduling deliveries based on distance between sites, staffing time, availability of vehicles, and cost.
		Low:	Scheduling and coordinating a one-day meeting.
Solution Appraisal	Observing & evaluating the outcomes of problem solution to identify lessons learned or redirect efforts	**High:**	Reviewing, assessing, and modifying the implementation of a new business plan.
		Medium:	Measuring customer satisfaction after introduction of new billing procedures.
		Low:	Identifying and correcting an error made in preparing a report.

Figure 3-1 (continued)

Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale
Technical Skills[1]		
Operations Analysis	Analyzing needs and product requirements to create a design	**High**: Identifying the control system needed for a new process production plant. **Medium:** Suggesting changes in software to make a system more user friendly. **Low**: Selecting a photocopy machine for an office.
Technology Design	Generating or adapting equipment and technology to serve user needs	**High**: Creating new technology for producing industrial diamonds. **Medium:** Redesigning the handle on a hand tool for easier gripping. **Low**: Adjusting exercise equipment for use by customer.
Equipment Selection	Determining the kind of tools and equipment needed to do a job.	**High:** Identifying the equipment needed to produce a new product line. **Medium:** Choosing a software application to use to complete a work assignment. **Low:** Selecting a screwdriver to use in adjusting vehicle carburetor.
Installation	Installing equipment, machines, wiring, or programs to meet specifications	**High:** Installing "one of a kind" process production molding machine. **Medium:** Installing new switches for a telephone exchange. **Low:** Installing a new air filter in an air conditioner.
Programming	Writing computer programs for various purposes	**High:** Writing expert system programs to analyze ground radar geological data for probable existence of mineral deposits. **Medium:** Writing a statistical analysis program to analyze demographic data. **Low:** Writing a program in BASIC to sort objects in a database.
Testing	Conducting tests to determine whether equipment, software, or procedures are operating as expected	**High:** Developing procedures to test a prototype of a new computer system. **Medium:** Starting a machine to obtain a first-run workpiece and verify dimensional tolerances. **Low:** Using a test station to assess whether a car meets emission requirements.

[1] Citations are not included for Technical Skills because prior taxonomic efforts have not produced systematic taxonomies in this area.

Figure 3-1 (continued)
Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale	
Operation Monitoring	Watching gauges, dials, or other indicators to make sure a machine is working properly	**High:**	Monitoring and integrating control feedback in a petrochemical processing facility to maintain production flow.
		Medium:	Monitoring machine functions on an automated production line.
		Low:	Monitoring completion times in running a computer program.
Operation and Control	Controlling operations of equipment or systems	**High:**	Controlling aircraft approach and landing at a large airport during a busy period.
		Medium:	Adjusting the speed of an assembly line equipment based on the type of product being assembled.
		Low:	Adjusting the settings on a copy machine to make reduced size photocopies.
Product Inspection	Inspecting and evaluating the quality of products	**High:**	Establishing and monitoring quality control procedures for a large manufacturing operation.
		Medium:	Measuring new part requirements for tolerance to specifications.
		Low:	Inspecting draft of memorandum for clerical errors.
Equipment Maintenance	Performing routine maintenance and determining when and what kind of maintenance is needed	**High:**	Conducting maintenance checks on an experimental aircraft.
		Medium:	Clearing moving parts in production machinery.
		Low:	Adding oil to an engine as indicated by a gauge or warning light.
Troubleshooting	Determining what is causing an operating error and deciding what to do about it	**High:**	Directing the debugging of control code for a new operating system.
		Medium:	Identifying the circuit causing an electrical system to fail.
		Low:	Identifying the source of a leak by looking under a machine.
Repairing	Repairing machines or systems using the needed tools	**High:**	Repairing structural damage to a building following an earthquake.
		Medium:	Replacing a faulty hydraulic valve.
		Low:	Tightening screw to get a door to close properly.

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Figure 3-1 (continued)

Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale	
Systems Skills			
Visioning	Developing an image of how a system should work under ideal conditions.	**High:**	Creating a new vision for a large manufacturing organization that lets the company respond to changes in market and technology.
		Medium:	Preparing a presentation detailing the role of a work unit in relation to the organizational structure.
		Low:	Understanding of co-workers' roles in finishing a job.
Systems Perception	Determining when important changes have occurred in a system or are likely to occur	**High:**	Identifying how changes in tax laws are likely to affect preferred sites for manufacturing operations in different industries.
		Medium:	Observing conditions that may impede the flow of work on an assembly line & notifying personnel that corrective action is necessary.
		Low:	Identifying how an argument among team members might affect the days work.
Identification of Downstream Consequences	Determining the long-term outcomes of a change in operations	**High:**	Determining changes that might occur in an industry if a new piece of legislation is passed.
		Medium:	Determining how the introduction of a new piece of equipment will affect production rates.
		Low:	Determining how loss of a team member will affect completion of a job.
Identification of Key Causes	Identifying the things that must be changed to achieve a goal	High:	Identifying the changes in organizational policy needed to encourage research and development efforts.
		Medium:	Identifying the major reasons why a client might be unhappy with a product.
		Low:	Determining which route to take to deliver a passenger to a destination quickly.

Figure 3-1 (continued)
Descriptions and Definitions of Basic and Cross-Functional Skills

Construct Label	Operational Definition	Level Scale	
Judgment and Decision Making	Weighing the relative costs and benefits of a potential action	**High:**	Deciding whether a manufacturing company should invest in new robotics technology.
		Medium:	Evaluating a loan application for degree of risk.
		Low:	Deciding how scheduling a break will affect work flow.
Systems Evaluation	Looking at many indicators of system performance taking into account their accuracy	**High:**	Evaluating the long-term performance problem of a company.
		Medium:	Determining why a manager has underestimated production costs.
		Low:	Determining why a co-worker has been overly optimistic about how long it would take to complete a task.
Resource Management Skills			
Time Management	Managing one's own time and the time of others	**High:**	Allocating the time of scientists to multiple research projects.
		Medium:	Allocating time of subordinates to projects for the coming week.
		Low:	Keeping a monthly calendar of appointments.
Management of Financial Resources	Determining how money will be spent to get the work done and accounting for these expenditures	**High:**	Developing and approving yearly budgets for a large corporation and obtaining financing as necessary.
		Medium:	Preparing and managing a budget for a short-term project.
		Low:	Taking money from petty cash to buy office supplies and recording the amount of the expenditure.
Management of Material Resources	Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work	**High:**	Determining the computer system needs of a large corporation and monitoring use of the equipment.
		Medium:	Evaluating an annual uniform service contract for delivery drivers.
		Low:	Renting a meeting room for a management meeting.
Management of Personnel Resources	Motivating, developing, and directing people as they work, identifying the best people for the job	**High:**	Planning, implementing and managing recruitment, training and incentive programs for a high performance company.
		Medium:	Directing the activities of a road repair crew with minimal disruption of traffic flow.
		Low:	Encouraging a co-worker who is having difficulty finishing a piece of work.

Figure 3-2
Example Page From the Skills Questionnaire

1. Reading Comprehension

Understanding written sentences and paragraphs in work related documents.

Level

What level of this skill is needed to perform this job?

HIGH

7

6 ← *Reading a scientific journal article describing surgical procedures.*

5

4 ← *Reading a memo from management describing new personnel policies.*

3

2 ← *Reading step-by-step instructions for completing a form.*

LOW

1

NR Not relevant at all for performance on this job

Importance

How important is this skill to performance on this job?

Not Important	Somewhat Important	Important	Very Important	Extremely Important
1	2	3	4	5

Job Entry Requirement

Is this level of skill required for entry to this job?

1. YES, it is required for entry on the job. 2. NO, it can be learned on the job.

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Figure 3-3

Thirty-Five Occupations With Four or More Incumbents Completing the Skills Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	9
19005	General Managers & Top Executives	45
22135	Mechanical Engineers	6
25105	Computer Programmers	5
27311	Recreation Workers	5
31303	Teachers, Preschool	4
31305	Teachers, Elementary School	13
31502	Librarians, Professional	4
32502	Registered Nurses	32
32902	Medical & Clinical Laboratory Technologists	4
49008	Salespersons, Except Scientific & Retail	11
49011	Salespersons, Retail	13
49017	Counter & Rental Clerks	4
49021	Stock Clerks, Sales Floor	8
49023	Cashiers	28
51002	First Line Supervisors, Clerical/Administrative	51
53121	Loan & Credit Clerks	4
53311	Insurance Claims Clerks	7
53905	Teachers' Aides & Assistants, Clerical	8
55108	Secretaries, Except Legal & Medical	90
55305	Receptionists & Information Clerks	12
55338	Bookkeeping, Accounting, & Auditing Clerks	32
55347	General Office Clerks	73
61005	Police & Detective Supervisors	13
63014	Police Patrol Officers	21
65008	Waiters & Waitresses	16
65038	Food Preparation Workers	17
66008	Nursing Aides, Orderlies, & Attendants	18
67005	Janitors & Cleaners	23
85132	Maintenance Repairers, General Utility	27
87902	Earth Drillers, Except Oil & Gas	7
89108	Machinists	4
92974	Packaging & Filling Machine Operators	8
97102	Truck Drivers, Heavy or Tractor Trailer	17
97111	Bus Drivers, Schools	9

Table 3-1

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Basic and Cross-Functional Skills

	Variable											
	Level				Importance				Job Entry Requirement			
Descriptor	M	SD	SEM[a]	r_k[b]	M	SD	SEM	r_k	M	SD	SEM	r_k
1. Reading Comprehension	4.42	0.89	.36	.84	3.65	0.61	.25	.83	1.18	0.20	.11	.71
2. Active Listening	4.28	0.95	.39	.83	3.63	0.56	.26	.78	1.34	0.21	.12	.66
3. Writing	3.82	1.07	.34	.90	3.22	0.64	.23	.87	1.36	0.27	.11	.82
4. Speaking	4.20	0.80	.38	.77	3.54	0.49	.24	.75	1.33	0.22	.13	.65
5. Mathematics	3.26	1.16	.50	.82	2.96	0.65	.33	.74	1.37	0.25	.14	.67
6. Science	1.53	1.35	.42	.90	1.88	0.82	.26	.90	1.78	0.27	.09	.88
7. Critical Thinking	3.68	1.02	.46	.80	3.12	0.70	.30	.81	1.50	0.21	.11	.72
8. Active Learning	3.62	1.14	.49	.81	3.01	0.67	.31	.79	1.59	0.22	.12	.72
9. Learning Strategies	3.83	0.91	.42	.78	3.12	0.50	.27	.71	1.62	0.22	.12	.70
10. Monitoring	3.26	1.19	.42	.88	2.81	0.65	.27	.83	1.66	0.22	.12	.71
11. Social Perceptiveness	3.62	1.08	.44	.83	3.06	0.61	.30	.76	1.62	0.19	.13	.52
12. Coordination	3.57	1.07	.48	.80	2.99	0.63	.31	.75	1.66	0.19	.12	.59
13. Persuasion	3.19	1.15	.42	.86	2.65	0.68	.26	.85	1.75	0.21	.11	.72
14. Negotiation	2.90	1.26	.44	.88	2.62	0.69	.28	.84	1.75	0.20	.10	.75
15. Instructing	3.78	1.08	.49	.79	3.18	0.57	.30	.71	1.65	0.21	.11	.73
16. Service Orientation	3.28	1.02	.51	.75	2.86	0.67	.35	.73	1.69	0.18	.11	.61
17. Problem Identification	4.16	1.08	.43	.84	3.45	0.62	.29	.79	1.59	0.19	.11	.66
18. Information Gathering	3.92	1.07	.43	.84	3.25	0.72	.30	.83	1.64	0.21	.13	.62
19. Information Organization	3.21	1.11	.51	.78	2.79	0.65	.32	.76	1.69	0.21	.14	.54
20. Synthesis/ Reorganization	3.24	1.15	.45	.84	2.79	0.60	.28	.78	1.70	0.20	.11	.66
21. Idea Generation	3.33	1.26	.45	.87	2.79	0.69	.26	.86	1.72	0.23	.10	.80
22. Idea Evaluation	3.07	1.25	.46	.86	2.67	0.72	.30	.83	1.73	0.25	.11	.80
23. Implementation Planning	2.83	1.39	.47	.88	2.54	0.84	.29	.88	1.77	0.22	.10	.80
24. Solution Appraisal	3.02	1.40	.44	.90	2.68	0.76	.29	.86	1.75	0.22	.11	.77
25. Operations Analysis	2.02	1.37	.56	.83	2.06	0.79	.33	.82	1.84	0.16	.09	.65
26. Technology Design	1.76	1.40	.51	.87	1.92	0.75	.30	.84	1.84	0.17	.10	.63
27. Equipment Selection	2.57	1.32	.57	.82	2.36	0.77	.33	.81	1.82	0.14	.10	.50
28. Installation	1.28	1.54	.46	.91	1.69	0.88	.24	.92	1.90	0.15	.06	.83
29. Programming	0.83	1.20	.57	.78	1.49	0.78	.33	.82	1.90	0.17	.10	.65
30. Testing	1.53	1.60	.60	.86	1.85	0.95	.34	.87	1.86	0.17	.09	.70
31. Operation Monitoring	1.69	1.75	.50	.92	1.97	0.94	.29	.90	1.86	0.16	.09	.73
32. Operation and Control	2.05	1.39	.56	.84	2.13	0.80	.35	.80	1.84	0.16	.09	.71
33. Product Inspection	2.31	1.34	.62	.78	2.34	0.75	.36	.77	1.80	0.16	.09	.68

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Table 3-1 (continued)

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Basic and Cross-Functional Skills

	Variable											
	Level				Importance				Job Entry Requirement			
Descriptor	M	SD	SEM[a]	r_k[b]	M	SD	SEM	r_k	M	SD	SEM	r_k
34. Equipment Maintenance	1.67	1.63	.47	.92	1.95	0.96	.26	.93	1.88	0.17	.07	.84
35. Troubleshooting	2.25	1.74	.61	.88	2.27	1.01	.36	.88	1.83	0.16	.08	.74
36. Repairing	1.33	1.49	.42	.92	1.75	0.85	.25	.91	1.89	0.15	.06	.82
37. Visioning	2.34	1.15	.48	.82	2.31	0.63	.30	.78	1.80	0.19	.10	.76
38. Systems Perception	2.22	1.23	.48	.84	2.27	0.68	.31	.79	1.80	0.20	.10	.77
39. Identification of Downstream Consequences	2.19	1.13	.44	.85	2.22	0.65	.26	.84	1.81	0.18	.09	.75
40. Identification of Key Causes	3.17	1.17	.43	.86	2.74	0.66	.27	.84	1.77	0.19	.10	.75
41. Judgment and Decision Making	2.93	1.33	.44	.89	2.70	0.79	.29	.86	1.70	0.24	.10	.84
42. Systems Evaluation	2.02	1.36	.46	.89	2.09	0.75	.28	.87	1.84	0.15	.08	.73
43. Time Management	3.61	1.18	.48	.83	3.20	0.67	.29	.81	1.64	0.24	.12	.76
44. Management of Financial Resources	1.84	1.50	.50	.89	2.10	0.90	.32	.87	1.81	0.22	.10	.80
45. Management of Material Resources	1.94	1.29	.47	.87	2.09	0.73	.28	.85	1.85	0.18	.08	.77
46. Management of Personnel Resources	2.67	1.38	.45	.89	2.57	0.80	.30	.86	1.75	0.23	.09	.86

Note. Statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.51, median = 12, harmonic mean = 9.01).

[a]This estimate of the standard error of measurement was calculated as $\underline{SEM} = \underline{SD} * \sqrt{(1 - r_k)}$.

[b]This estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each job.

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Table 3-2

Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Basic and Cross-Functional Skills

Descriptor	Level r_1[a]	Level r_{30}[b]	Importance r_1	Importance r_{30}	Job Entry Requirement r_1	Job Entry Requirement r_{30}
1. Reading Comprehension	37	95	36	94	21	89
2. Active Listening	36	94	29	92	18	87
3. Writing	49	97	42	96	34	94
4. Speaking	27	92	25	91	17	86
5. Mathematics	33	94	24	91	18	87
6. Science	51	97	50	97	44	96
7. Critical Thinking	30	93	32	94	22	89
8. Active Learning	33	94	29	92	22	90
9. Learning Strategies	28	92	21	89	21	89
10. Monitoring	44	96	35	94	21	89
11. Social Perceptiveness	36	94	26	91	11	78
12. Coordination	30	93	25	91	14	83
13. Persuasion	41	96	39	95	22	89
14. Negotiation	44	96	37	95	25	91
15. Instructing	30	93	22	89	23	90
16. Service Orientation	25	91	23	90	15	84
17. Problem Identification	37	95	29	93	18	87
18. Information Gathering	37	95	35	94	16	85
19. Information Organization	29	92	26	91	12	80
20. Synthesis/ Reorganization	37	95	28	92	18	86
21. Idea Generation	44	96	40	95	31	93
22. Idea Evaluation	42	96	35	94	30	93
23. Implementation Planning	46	96	45	96	31	93
24. Solution Appraisal	50	97	40	95	27	92
25. Operations Analysis	35	94	34	94	17	86
26. Technology Design	42	96	38	95	16	85
27. Equipment Selection	33	94	33	94	10	77
28. Installation	53	97	57	98	34	94
29. Programming	28	92	34	94	17	86
30. Testing	40	95	43	96	21	89
31. Operation Monitoring	55	97	51	97	23	90
32. Operation and Control	36	94	31	93	21	89
33. Product Inspection	29	92	27	92	19	88
34. Equipment Maintenance	55	97	58	98	36	94
35. Troubleshooting	44	96	44	96	24	90
36. Repairing	56	97	54	97	33	94
37. Visioning	34	94	28	92	26	91
38. Systems Perception	37	95	29	92	27	92
39. Identification of Downstream Consequences	39	95	36	94	25	91
40. Identification of Key Causes	41	95	36	94	25	91

Table 3-2 (continued)
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Basic and Cross-Functional Skills

Descriptor	Level r_1[a]	Level r_{30}[b]	Importance r_1	Importance r_{30}	Job Entry Requirement r_1	Job Entry Requirement r_{30}
41. Judgment and Decision Making	47	96	41	95	37	95
42. Systems Evaluation	46	96	42	96	23	90
43. Time Management	36	94	32	93	26	92
44. Management of Financial Resources	47	96	43	96	31	93
45. Management of Material Resources	42	96	39	95	27	92
46. Management of Personnel Resources	48	97	41	95	40	95

Note. Reliability estimates are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents=18.51, median=12, harmonic mean=9.01). Decimals are omitted.
[a]Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judge ratings across occupations: ICC(1,1)=[BMS-WMS]/[BMS+(k-1)WMS] (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each job.
[b]Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

Table 3-3
Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Basic and Cross-Functional Skills

Descriptor	Type of Scale and Recoding Scheme Applied						
	Level			Importance		Job Entry Requirement	
	r_a	r_b	r_c	r_a	r_b	r_a	r_b
1. Reading Comprehension	84	80	50	83	80	71	64
2. Active Listening	83	77	69	78	61	66	50
3. Writing	90	85	73	87	79	82	72
4. Speaking	77	75	53	75	69	65	55
5. Mathematics	82	74	70	74	60	67	43
6. Science	90	60	87	90	54	88	46
7. Critical Thinking	80	71	62	81	70	72	55
8. Active Learning	81	74	64	79	63	72	56
9. Learning Strategies	78	79	54	71	67	70	63
10. Monitoring	88	84	81	83	66	71	59
11. Social Perceptiveness	83	84	61	76	70	52	48
12. Coordination	80	72	64	75	52	59	41
13. Persuasion	86	77	73	85	75	72	60
14. Negotiation	88	82	68	84	73	75	60
15. Instructing	79	78	58	71	69	73	70
16. Service Orientation	75	68	66	73	52	61	48
17. Problem Identification	84	80	62	79	69	66	58
18. Information Gathering	84	77	69	83	73	62	53
19. Information Organization	78	63	72	76	53	54	47
20. Synthesis/ Reorganization	84	79	78	78	61	66	61
21. Idea Generation	87	84	70	86	78	80	70
22. Idea Evaluation	86	84	74	83	71	80	72
23. Implementation Planning	88	81	78	88	76	80	67
24. Solution Appraisal	90	85	80	86	64	77	61
25. Operations Analysis	83	74	78	82	54	65	38
26. Technology Design	87	58	84	84	33	63	10
27. Equipment Selection	82	53	78	81	53	50	06
28. Installation	91	61	87	92	64	83	40
29. Programming	78	42	63	82	49	65	08
30. Testing	86	41	83	87	63	70	25
31. Operation Monitoring	92	76	84	90	69	73	13
32. Operation and Control	84	85	68	80	75	71	70
33. Product Inspection	78	77	71	77	56	68	51
34. Equipment Maintenance	92	76	84	93	79	84	56
35. Troubleshooting	88	80	75	88	79	74	55
36. Repairing	92	77	83	91	70	82	41
37. Visioning	82	79	61	78	61	76	68
38. Systems Perception	84	81	64	79	58	77	67
39. Identification of Downstream Consequences	85	75	72	84	64	75	58

Table 3-3 (continued)

Reliability of Rated DifferencesBetween Occupations Considering Various Recoding Schemes: Basic and Cross-Functional Skills

Descriptor	Type of Scale and Recoding Scheme Applied						
	Level			Importance		Job Entry Requirement	
	r_a	r_b	r_c	r_a	r_b	r_a	r_b
40. Identification of Key Causes	86	81	69	84	74	75	62
41. Judgment and Decision Making	89	82	75	86	76	84	72
42. Systems Evaluation	89	79	77	87	69	73	41
43. Time Management	83	73	75	81	62	76	66
44. Management of Financial Resources	89	75	83	87	61	80	51
45. Management of Material Resources	87	76	84	85	55	77	54
46. Management of Personnel Resources	89	87	71	86	78	86	78

Note. Reliability estimates are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents=18.51, median=12, harmonic mean=9.01). Reliability estimates stipulated as r_a were calculated using the full eight point scale for level, and retaining all of the data for the importance and "Job Entry Requirement" scales. Reliability estimates stipulated as r_b were calculated using a reduced seven point scale for level, and excluding the data for the importance and "Job Entry Requirement" scales where the rater marked "NR" on the level scale. Reliability estimates stipulated as r_c were calculated using a binary coded scale for level (relevant/not relevant). Decimals are omitted.

Table 3-4a

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Basic and Cross-Functional Skills

Source of Variation	SS	df	MS	F
Occupations	20282.98	34	596.56	10.57*
S(Occupations)	34594.09	613	56.43	
Descriptor	12023.43	45	267.19	135.00*
Descriptor x Occupations	14750.96	1530	9.64	4.87*
Descriptor x S(Occupations)	54593.81	27585	1.98	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

Table 3-4b

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Basic and Cross-Functional Skills

Source of Variation	SS	df	MS	F
Occupations	5393.96	34	158.65	8.81*
S(Occupations)	11034.76	613	18.00	
Descriptor	4341.32	45	96.47	121.81*
Descriptor x Occupations	5764.59	1530	3.77	4.76*
Descriptor x S(Occupations)	21846.80	27585	0.79	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 3-4c

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Job Entry Requirement Scale: Basic and Cross-Functional Skills

Source of Variation	SS	df	MS	F
Occupations	507.02	34	14.91	6.70*
S(Occupations)	1364.67	613	2.23	
Descriptor	398.16	45	8.85	78.47*
Descriptor x Occupations	429.84	1530	0.28	2.49*
Descriptor x S(Occupations)	3110.58	27585	0.11	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 3-5
Interrater Agreement Coefficients for Each Scale Type: Basic and Cross-Functional Skills

Scale Type	Number of Raters on Each Variable $\underline{r}_k$	$\underline{r}_1$	$\underline{r}_{30}$
Level	79	30	93
Importance	79	29	93
Job Entry Requirement	60	14	83

Note. Interrater agreement coefficient estimates are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents=18.51, median=12, harmonic mean=9.01). Full sample interrater agreement coefficients ($\underline{r}_k$) were obtained by considering the "Descriptor x Occupations" term from Tables 3-4a, 3-4b, and 3-4c as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the $\underline{k}$ rater reliability estimates, where $\underline{k}$ is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

Table 3-6a

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Basic and Cross-Functional Skills

Source of Variation	SS	df	MS	F
Occupations	3416.92	34	100.50	11.14*
S(Occupations)	5530.07	613	9.02	
Aggregate	934.74	6	155.79	216.00*
Aggregate x Occupations	1016.73	204	4.98	6.91*
Aggregate x S(Occupations)	2652.75	3678	0.72	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 3-6b

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Basic and Cross-Functional Skills

Source of Variation	SS	df	MS	F
Occupations	922.90	34	27.14	9.28*
S(Occupations)	1792.61	613	2.92	
Aggregate	322.10	6	53.68	201.74*
Aggregate x Occupations	382.77	204	1.88	7.05*
Aggregate x S(Occupations)	978.72	3678	0.27	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.

*$p < .05$

Table 3-6c

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Basic and Cross-Functional Skills

Source of Variation	SS	df	MS	F
Occupations	92.92	34	2.73	7.44*
S(Occupations)	225.23	613	0.37	
Aggregate	43.89	6	7.31	174.08*
Aggregate x Occupations	28.07	204	0.14	3.27
Aggregate x S(Occupations)	154.55	3678	0.04	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.

*$p < .05$

Table 3-7
Interrater Agreement Coefficients for Aggregate Descriptors for Each Scale Type: Basic and Cross-Functional Skills

Scale Type	Number of Raters on Each Variable		
	r_k	r_1	r_{30}
Level	86	40	95
Importance	86	40	95
Job Entry Requirement	69	20	88

Note. Interrater agreement coefficient estimates are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents=18.51, median=12, harmonic mean=9.01). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Aggregate x Occupations" term from Tables 3-6a, 3-6b, and 3-6c as true variance. Error variance was defined as the "Aggregate x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

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Table 3-8

Means and Standard Deviations of Correlations Between Level, Importance, and Job Entry Requirement Scales Across Occupations and Descriptors: Basic and Cross-Functional Skills

	Level			Importance			Job Entry Requirement		
Scale	n[a]	M	SD	n	M	SD	n	M	SD
Level	--	--	--	35	.96	.04	35	-.71	.18
Importance	46	.95	.04	--	--	--	35	-.74	.17
Job Entry Requirement	46	-.66	.11	46	-.69	.12	--	--	--

Note. All correlations were calculated based on the mean of ratings assigned by raters for a given occupation, descriptor, and scale. Level-importance means above the diagonal were calculated by taking the level scale means on a given occupation for all descriptors, correlating them with importance scale means, for that occupation, and then averaging them with the correlations for other occupations. Level-importance means below the diagonal were calculated by taking the level scale means on a given descriptor for all occupations, correlating them with importance scale means for that descriptor, and averaging them with correlations for other descriptors. Other means in the table were calculated in a similar manner.

[a]Number of correlations averaged, not number of observations on which correlations were calculated.

Table 3-9a

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Reading Comprehension	--																	
2.	Active Listening	70	--																
3.	Writing	82	81	--															
4.	Speaking	66	84	82	--														
5.	Mathematics	57	45	43	56	--													
6.	Science	52	37	45	48	57	--												
7.	Critical Thinking	81	74	82	75	65	64	--											
8.	Active Learning	77	66	72	70	75	79	90	--										
9.	Learning Strategies	53	57	70	67	44	57	59	70	--									
10.	Monitoring	69	70	83	81	52	59	74	76	85	--								
11.	Social Perceptiveness	49	68	69	62	09	26	54	46	68	67	--							
12.	Coordination	70	74	78	79	55	70	83	82	71	83	62	--						
13.	Persuasion	70	80	82	80	43	47	79	72	71	81	76	82	--					
14.	Negotiation	46	62	70	65	18	35	62	51	64	73	78	70	84	--				
15.	Instructing	52	62	61	64	35	61	54	65	83	75	65	66	69	54	--			
16.	Service Orientation	60	71	62	51	19	20	55	53	58	61	73	52	69	66	58	--		
17.	Problem Identification	68	75	70	74	62	62	83	81	65	71	63	76	77	61	70	55	--	
18.	Information Gathering	87	76	83	80	72	61	86	86	68	79	58	77	79	56	65	58	82	--
19.	Information Organization	78	70	78	64	56	66	81	79	61	75	45	81	76	64	55	56	62	78
20.	Synthesis/Reorganization	81	73	81	75	62	60	84	84	75	80	59	75	81	60	73	59	84	90
21.	Idea Generation	69	69	75	74	60	63	84	82	68	75	52	81	84	67	67	45	83	80
22.	Idea Evaluation	74	67	75	67	61	69	86	86	59	74	49	83	81	70	54	50	75	77
23.	Implementation Planning	69	61	80	62	47	58	78	75	69	77	56	76	79	72	59	52	67	74
24.	Solution Appraisal	68	66	81	74	42	63	73	70	77	88	65	82	81	82	68	56	68	72
25.	Operations Analysis	64	50	58	45	60	79	75	79	49	62	26	72	60	50	52	36	68	67
26.	Technology Design	45	24	37	33	62	87	61	73	42	47	08	62	43	36	42	16	54	56
27.	Equipment Selection	46	29	42	36	57	80	55	67	49	58	19	68	48	39	53	24	48	57
28.	Installation	14	-02	03	12	53	63	26	41	19	21	-14	41	23	11	24	-10	28	31

Table 3-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29.	Programming	22	05	17	07	38	60	36	41	06	10	-20	33	17	09	06	-20	19	24
30.	Testing	26	-03	12	17	58	81	38	55	24	29	-16	42	16	08	27	-19	32	36
31.	Operation Monitoring	07	-18	-08	-01	43	59	16	34	10	16	-14	27	04	01	16	-18	20	16
32.	Operation and Control	10	-15	-03	03	47	52	20	34	06	15	-19	24	03	-01	10	-19	19	19
33.	Product Inspection	28	02	20	21	61	60	41	54	29	41	-16	38	22	14	23	01	34	38
34.	Equipment Maintenance	00	-21	-10	-01	37	55	13	30	09	11	-15	29	04	04	12	-20	17	16
35.	Troubleshooting	26	-05	12	11	56	76	40	53	18	21	-15	39	16	07	25	-14	39	35
36.	Repairing	10	-15	-01	07	45	60	21	35	12	13	-20	34	14	04	19	-23	25	24
37.	Visioning	39	33	43	38	50	50	57	58	40	53	26	61	61	64	28	29	49	53
38.	Systems Perception	45	33	43	45	56	66	61	70	49	60	31	64	57	59	40	33	58	60
39.	Identification of Downstream Consequences	54	44	49	43	48	51	65	62	43	58	39	60	64	69	36	53	55	60
40.	Identification of Key Causes	59	59	62	66	63	56	78	79	67	75	57	71	75	70	58	53	82	75
41.	Judgment and Decision Making	62	64	68	64	56	59	78	76	60	71	54	74	76	77	49	53	80	75
42.	Systems Evaluation	60	37	53	41	51	66	67	70	53	68	38	67	63	65	45	47	58	66
43.	Time Management	72	69	78	70	45	47	72	70	75	81	69	76	79	70	70	66	72	82
44.	Management of Financial Resources	56	49	55	49	48	33	63	59	46	63	42	62	71	69	36	54	49	60
45.	Management of Material Resources	50	39	53	44	43	50	54	58	50	66	46	66	68	67	44	49	47	59
46.	Management of Personnel Resources	46	43	55	50	37	42	58	58	64	78	54	63	71	78	48	60	53	59

Table 3-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
19.	Information Organization	--																	
20.	Synthesis/Reorganization	82	--																
21.	Idea Generation	77	89	--															
22.	Idea Evaluation	85	79	85	--														
23.	Implementation Planning	85	87	84	83	--													
24.	Solution Appraisal	82	79	77	83	85	--												
25.	Operations Analysis	83	75	77	83	80	74	--											
26.	Technology Design	67	54	63	74	59	58	85	--										
27.	Equipment Selection	65	50	59	68	55	61	74	87	--									
28.	Installation	36	23	36	44	24	27	58	82	79	--								
29.	Programming	55	32	45	49	48	31	68	74	50	59	--							
30.	Testing	45	35	44	51	40	37	70	88	77	83	76	--						
31.	Operation Monitoring	14	06	20	24	06	11	43	64	69	80	36	79	--					
32.	Operation and Control	15	07	20	27	05	14	43	65	69	78	35	76	94	--				
33.	Product Inspection	37	33	39	47	34	36	62	74	78	75	39	76	78	84	--			
34.	Equipment Maintenance	14	03	16	23	07	09	38	66	68	84	37	77	92	88	73	--		
35.	Troubleshooting	37	32	43	47	33	29	70	87	78	85	66	93	86	84	81	83	--	
36.	Repairing	24	16	30	36	18	20	50	75	73	94	54	85	85	82	74	90	90	--
37.	Visioning	66	54	65	77	65	63	75	72	65	65	49	55	45	45	58	48	55	56
38.	Systems Perception	62	59	63	76	60	67	78	78	72	67	40	65	58	59	70	56	65	60
39.	Identification of Downstream Consequences	69	62	65	78	69	72	77	66	64	47	33	42	33	35	53	29	46	35
40.	Identification of Key Causes	65	80	84	83	74	75	72	62	56	37	25	39	25	26	48	20	40	27
41.	Judgment and Decision Making	72	73	79	87	73	78	75	67	60	39	31	39	24	29	48	27	42	30
42.	Systems Evaluation	76	70	67	80	80	79	85	76	73	53	44	60	42	42	63	41	57	46
43.	Time Management	71	85	76	71	80	78	62	39	54	19	03	17	09	08	33	08	20	11

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Table 3-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
44.	Management of Financial Resources	66	63	64	76	68	72	65	47	55	36	17	27	22	28	47	19	26	25
45.	Management of Material Resources	65	57	57	74	69	71	67	60	73	54	23	43	43	42	57	43	44	46
46.	Management of Personnel Resources	63	63	60	69	72	76	61	49	57	34	10	29	24	22	50	24	26	25

Table 3-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	37	38	39	40	41	42	43	44	45	46
37.	Visioning	--									
38.	Systems Perception	90	--								
39.	Identification of Downstream Consequences	86	87	--							
40.	Identification of Key Causes	75	81	80	--						
41.	Judgment and Decision Making	77	81	81	89	--					
42.	Systems Evaluation	83	87	90	76	78	--				
43.	Time Management	55	60	70	76	74	72	--			
44.	Management of Financial Resources	81	78	89	74	74	83	74	--		
45.	Management of Material Resources	83	84	86	70	71	87	74	88	--	
46.	Management of Personnel Resources	76	79	83	77	75	86	78	83	87	--

Note. N=35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 3-9b

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Reading Comprehension	--																	
2.	Active Listening	58	--																
3.	Writing	80	63	--															
4.	Speaking	55	81	69	--														
5.	Mathematics	47	40	33	36	--													
6.	Science	52	20	41	21	52	--												
7.	Critical Thinking	82	64	76	56	47	57	--											
8.	Active Learning	77	55	68	53	61	76	84	--										
9.	Learning Strategies	43	41	61	52	26	53	50	58	--									
10.	Monitoring	70	61	88	68	41	50	70	71	76	--								
11.	Social Perceptiveness	32	68	49	65	04	12	41	32	54	52	--							
12.	Coordination	71	64	76	59	43	62	74	75	58	78	45	--						
13.	Persuasion	66	61	77	67	24	36	72	58	61	77	67	77	--					
14.	Negotiation	43	47	63	50	05	27	59	45	62	61	69	63	82	--				
15.	Instructing	42	36	44	46	33	66	37	56	69	64	40	55	54	38	--			
16.	Service Orientation	53	72	49	58	17	08	51	43	47	50	79	44	62	53	34	--		
17.	Problem Identification	49	61	57	56	50	56	75	72	54	62	48	59	62	52	55	43	--	
18.	Information Gathering	88	48	73	51	47	54	78	74	49	67	35	60	68	49	48	47	63	--
19.	Information Organization	88	51	76	40	48	64	85	80	48	71	29	82	67	52	44	47	50	77
20.	Synthesis/Reorganization	78	51	72	53	47	53	73	79	60	77	37	69	74	52	60	55	68	84
21.	Idea Generation	67	43	60	44	41	56	78	78	51	63	29	71	73	55	49	40	74	71
22.	Idea Evaluation	69	50	66	46	51	67	82	82	50	67	35	83	71	64	42	37	66	61
23.	Implementation Planning	68	38	75	33	34	57	80	75	57	70	39	74	72	67	37	38	64	68
24.	Solution Appraisal	71	48	77	54	44	63	74	71	68	79	46	81	78	74	57	40	63	68
25.	Operations Analysis	62	28	48	14	52	79	69	77	36	49	09	70	46	40	44	17	63	60
26.	Technology Design	44	08	20	02	48	81	52	62	31	26	-01	49	30	30	39	02	46	48
27.	Equipment Selection	41	06	28	-01	46	78	39	56	35	43	-03	57	32	24	48	-03	33	40
28.	Installation	13	-16	-02	-16	42	61	12	31	10	12	-22	36	16	07	35	-23	16	22
29.	Programming	34	-09	11	-19	39	62	42	45	03	00	-31	33	07	02	12	-24	23	27
30.	Testing	28	-19	07	-18	45	81	30	51	11	12	-23	32	04	02	33	-31	30	32
31.	Operation Monitoring	01	-31	-14	-30	23	53	-03	20	-07	00	-27	11	-06	-06	18	-36	03	04

Table 3-98 (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
32.	Operation and Control	11	-18	-07	-13	29	49	03	22	-07	03	-28	14	-05	-06	14	-35	03	09
33.	Product Inspection	29	-01	24	01	44	55	28	45	17	37	-23	33	13	06	24	-18	24	32
34.	Equipment Maintenance	-05	-32	-14	-32	16	47	-07	17	-08	-05	-23	13	-04	-01	13	-35	-01	02
35.	Troubleshooting	22	-20	03	-23	39	72	28	44	01	07	-27	29	07	03	25	-31	32	28
36.	Repairing	04	-29	-10	-26	33	59	06	29	-04	00	-36	23	-02	-04	22	-39	14	11
37.	Visioning	32	17	34	09	29	33	48	44	32	41	19	50	54	61	10	18	36	40
38.	Systems Perception	33	18	34	20	38	54	44	57	37	47	23	52	49	54	30	19	44	43
39.	Identification of Downstream Consequences	51	27	43	22	39	51	62	60	38	49	34	58	60	65	28	37	48	57
40.	Identification of Key Causes	47	44	44	40	45	53	70	69	52	57	44	59	68	63	41	41	77	60
41.	Judgment and Decision Making	54	45	59	41	38	51	72	66	55	62	40	66	70	75	35	39	71	63
42.	Systems Evaluation	53	19	50	15	45	65	62	68	47	60	27	61	56	57	36	27	54	60
43.	Time Management	69	42	69	47	29	42	65	66	54	71	46	65	73	64	45	48	54	78
44.	Management of Financial Resources	55	45	58	40	45	38	59	61	46	68	38	75	70	63	34	42	49	54
45.	Management of Material Resources	47	28	54	25	34	54	47	59	46	67	34	69	63	61	42	30	36	48
46.	Management of Personnel Resources	32	30	52	31	28	36	48	47	55	70	45	58	67	69	38	41	43	39

Table 3-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
19.	Information Organization	--																	
20.	Synthesis/Reorganization	78	--																
21.	Idea Generation	67	81	--															
22.	Idea Evaluation	81	71	77	--														
23.	Implementation Planning	80	76	78	84	--													
24.	Solution Appraisal	77	74	70	88	84	--												
25.	Operations Analysis	75	67	73	84	80	75	--											
26.	Technology Design	54	40	57	67	54	59	80	--										
27.	Equipment Selection	57	41	48	60	51	58	71	84	--									
28.	Installation	29	22	30	39	21	32	54	77	83	--								
29.	Programming	46	23	43	51	50	39	74	75	57	53	--							
30.	Testing	39	26	36	48	41	40	74	83	76	76	77	--						
31.	Operation Monitoring	07	00	11	19	05	11	39	59	66	79	37	77	--					
32.	Operation and Control	09	-01	09	24	01	18	38	61	64	76	35	71	91	--				
33.	Product Inspection	36	32	28	44	36	42	58	65	74	72	42	67	68	77	--			
34.	Equipment Maintenance	07	-02	10	17	07	07	34	59	68	82	34	72	91	84	64	--		
35.	Troubleshooting	31	21	37	45	34	32	70	82	77	84	70	93	85	80	72	80	--	
36.	Repairing	18	10	22	33	14	20	51	70	73	91	53	83	85	80	69	86	91	--
37.	Visioning	50	47	53	71	65	64	61	61	55	53	37	37	30	32	52	36	43	43
38.	Systems Perception	46	51	51	70	57	65	65	69	64	65	31	55	52	55	71	53	59	57
39.	Identification of Downstream Consequences	64	60	60	77	70	72	72	65	57	46	34	45	31	33	51	29	48	36
40.	Identification of Key Causes	56	69	80	80	76	71	70	63	47	33	35	37	15	13	36	13	38	21
41.	Judgment and Decision Making	62	64	72	82	78	80	72	66	52	36	33	35	16	23	49	20	38	23
42.	Systems Evaluation	69	65	63	79	82	78	82	70	68	50	45	61	39	36	64	38	55	42
43.	Time Management	69	82	69	68	78	72	57	36	41	18	12	21	-02	-01	31	01	18	05
44.	Management of Financial Resources	63	69	66	77	69	76	64	45	52	40	18	26	21	27	49	20	29	24

Table ... (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Basic and Cross-Functional Skills

Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
45. Management of Material Resources	63	62	53	73	69	72	65	52	69	55	20	42	42	39	61	44	44	42
46. Management of Personnel Resources	53	54	47	63	63	67	47	36	49	36	02	19	21	16	51	22	22	20

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Table 3-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Basic and Cross-Functional Skills

Descriptor	37	38	39	40	41	42	43	44	45	46
37. Visioning	--									
38. Systems Perception	85	--								
39. Identification of Downstream Consequences	82	86	--							
40. Identification of Key Causes	73	72	77	--						
41. Judgment and Decision Making	77	75	78	87	--					
42. Systems Evaluation	77	83	85	75	81	--				
43. Time Management	55	56	72	73	71	67	--			
44. Management of Financial Resources	78	78	81	69	74	78	69	--		
45. Management of Material Resources	77	84	82	65	67	82	74	84	--	
46. Management of Personnel Resources	72	78	76	67	72	80	65	78	85	--

Note. N=35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 3-9c

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Reading Comprehension	--																	
2.	Active Listening	54	--																
3.	Writing	63	54	--															
4.	Speaking	38	74	63	--														
5.	Mathematics	55	58	58	46	--													
6.	Science	49	17	46	25	62	--												
7.	Critical Thinking	62	53	66	61	63	66	--											
8.	Active Learning	60	46	81	53	68	71	80	--										
9.	Learning Strategies	50	27	64	40	61	61	68	80	--									
10.	Monitoring	42	37	49	51	37	33	46	53	68	--								
11.	Social Perceptiveness	36	55	42	40	36	07	33	41	55	68	--							
12.	Coordination	44	44	54	44	56	33	58	61	73	67	76	--						
13.	Persuasion	47	51	55	43	38	18	55	52	65	73	85	76	--					
14.	Negotiation	37	34	41	32	28	19	49	51	67	72	80	81	89	--				
15.	Instructing	38	18	38	23	29	34	46	47	67	72	65	71	67	65	--			
16.	Service Orientation	18	46	47	47	33	20	47	53	66	57	72	68	67	69	61	--		
17.	Problem Identification	44	46	48	39	53	44	75	69	69	47	50	69	60	67	49	65	--	
18.	Information Gathering	54	49	57	68	60	60	73	75	73	64	49	56	59	56	45	54	58	--
19.	Information Organization	49	29	57	26	70	64	60	77	77	55	27	55	37	36	47	38	59	56
20.	Synthesis/Reorganization	48	36	55	42	62	51	74	65	77	55	42	73	60	61	47	47	79	63
21.	Idea Generation	49	52	66	40	56	43	72	74	69	46	58	69	71	63	52	58	74	58
22.	Idea Evaluation	44	56	50	29	58	30	59	59	54	41	64	72	65	61	40	48	60	47
23.	Implementation Planning	39	44	55	36	54	18	57	61	73	60	76	86	77	78	59	74	74	53
24.	Solution Appraisal	49	49	46	35	52	31	66	60	68	60	60	73	71	71	55	57	71	60
25.	Operations Analysis	45	48	44	27	67	56	62	58	57	32	39	60	41	45	27	39	65	50
26.	Technology Design	39	08	31	09	61	78	53	51	62	17	05	41	16	19	28	22	51	45
27.	Equipment Selection	22	17	14	17	40	46	24	27	48	51	34	42	25	27	37	23	28	42
28.	Installation	12	-01	-06	-06	20	25	08	17	31	16	21	28	18	32	22	16	25	32

Table 3-9c (continued)

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Occupation-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29.	Programming	23	-16	02	-28	35	47	28	19	20	-29	-27	16	-17	-10	-01	-19	23	02
30.	Testing	23	-01	04	-08	45	60	29	33	43	18	-06	13	02	07	08	-04	30	39
31.	Operation Monitoring	08	-15	-16	-33	08	24	-07	04	18	13	11	-01	08	16	-01	-09	07	21
33.	Product Inspection	10	08	08	04	25	18	00	21	30	50	17	21	08	19	15	05	13	21
34.	Equipment Maintenance	-06	-16	-23	-40	-01	00	-17	-06	12	-01	18	12	05	20	08	03	14	-06
35.	Troubleshooting	17	-28	-06	-33	24	36	08	20	32	08	-05	20	-07	17	15	-06	31	12
36.	Repairing	23	-12	-06	-23	26	43	16	16	31	03	-04	20	04	19	12	-03	33	15
37.	Visioning	22	38	25	25	29	05	29	34	45	35	71	61	55	63	26	49	53	34
38.	Systems Perception	31	43	34	26	56	35	54	50	63	44	60	69	56	63	37	50	69	47
39.	Identification of Downstream Consequences	31	34	43	15	52	31	54	53	57	35	52	71	50	57	42	46	67	28
40.	Identification of Key Causes	37	45	39	32	49	28	57	48	61	49	59	67	58	63	40	50	64	50
41.	Judgment and Decision Making	51	56	54	52	62	35	72	67	64	40	57	70	52	61	32	53	77	55
42.	Systems Evaluation	31	30	38	22	47	26	55	57	62	49	58	81	55	73	52	59	77	42
43.	Time Management	33	66	54	58	60	17	50	57	56	56	69	67	55	53	35	55	59	57
44.	Management of Financial Resources	36	42	42	27	40	09	53	52	55	44	61	67	71	76	37	51	62	46
45.	Management of Material Resources	27	45	36	29	37	18	40	45	51	51	78	75	73	80	42	58	57	42
46.	Management of Personnel Resources	23	29	37	29	32	10	46	46	57	56	66	73	59	76	49	58	60	39

Table 3-9c (continued)

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Occupation-Level Data): Basic and Cross-Functional Skills

Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
19. Information Organization	--																	
20. Synthesis/Reorganization	73	--																
21. Idea Generation	58	75	--															
22. Idea Evaluation	56	70	80	--														
23. Implementation Planning	59	77	76	81	--													
24. Solution Appraisal	65	82	80	84	84	--												
25. Operations Analysis	65	78	72	80	65	79	--											
26. Technology Design	63	68	43	34	34	37	65	--										
27. Equipment Selection	41	43	33	31	29	31	42	55	--									
28. Installation	15	23	22	22	16	15	20	43	64	--								
29. Programming	33	43	27	33	13	24	52	71	20	27	--							
30. Testing	56	47	31	22	11	28	50	73	67	53	53	--						
31. Operation Monitoring	20	18	18	19	04	13	28	34	51	59	23	75	--					
32. Operation and Control	28	20	09	17	21	08	12	18	30	40	19	51	73	--				
33. Product Inspection	46	30	17	24	23	29	29	24	58	42	05	48	50	49	--			
34. Equipment Maintenance	07	15	22	28	17	15	26	25	50	75	33	52	77	67	47	--		
35. Troubleshooting	41	40	18	20	20	21	40	58	46	64	60	67	64	67	50	75	--	
36. Repairing	27	38	28	21	11	21	40	65	56	79	64	68	57	34	44	72	80	--
37. Visioning	23	53	63	70	71	57	55	20	36	35	13	15	30	31	29	48	25	28
38. Systems Perception	59	79	70	82	77	77	83	53	46	37	30	44	39	33	39	44	41	39
39. Identification of Downstream Consequences	59	73	63	77	78	66	74	53	30	18	35	25	14	23	21	26	36	22
40. Identification of Key Causes	55	79	74	81	78	85	86	43	43	15	25	38	30	23	28	28	29	20
41. Judgment and Decision Making	52	72	66	71	77	68	70	39	20	14	22	14	-03	08	14	05	22	16
42. Systems Evaluation	59	73	66	77	87	79	72	38	27	23	26	15	07	22	28	24	39	25
43. Time Management	53	62	65	69	75	64	60	21	41	12	-11	17	07	10	32	06	01	-07

Table 3-9c (continued)
Intercorrelations of Descriptors for the Job Entry Requirement Scale (Occupation-Level Data): Basic and Cross-Functional Skills

Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
44. Management of Financial Resources	45	68	73	83	84	85	64	25	14	24	17	11	12	14	25	22	16	20
45. Management of Material Resources	29	58	71	80	77	68	61	25	40	38	09	10	21	09	30	35	17	28
46. Management of Personnel Resources	43	63	60	69	81	69	56	17	20	16	02	00	07	24	33	19	22	10

Table 3-9c (continued)

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Occupation-Level Data): Basic and Cross-Functional Skills

Descriptor	37	38	39	40	41	42	43	44	45	46
37. Visioning	--									
38. Systems Perception	76	--								
39. Identification of Downstream Consequences	63	84	--							
40. Identification of Key Causes	69	89	77	--						
41. Judgment and Decision Making	70	76	73	74	--					
42. Systems Evaluation	68	78	85	77	79	--				
43. Time Management	66	74	66	76	74	65	--			
44. Management of Financial Resources	72	75	72	74	68	79	62	--		
45. Management of Material Resources	87	75	69	69	65	75	66	82	--	
46. Management of Personnel Resources	75	76	74	74	77	87	68	76	75	--

Note. N=35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 3-10a

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Basic and Cross-Functional Skills

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Reading Comprehension	--																	
2. Active Listening	56	--																
3. Writing	67	74	--															
4. Speaking	49	81	71	--														
5. Mathematics	51	52	56	58	--													
6. Science	34	29	38	35	43	--												
7. Critical Thinking	63	60	75	62	66	42	--											
8. Active Learning	55	61	64	65	66	49	71	--										
9. Learning Strategies	51	58	59	63	46	40	56	65	--									
10. Monitoring	46	44	60	49	49	37	60	52	58	--								
11. Social Perceptiveness	45	59	54	60	30	29	52	49	58	59	--							
12. Coordination	45	60	64	66	54	42	61	69	66	62	65	--						
13. Persuasion	56	64	65	64	48	39	62	60	62	55	73	68	--					
14. Negotiation	41	47	54	54	31	36	49	42	54	54	73	59	76	--				
15. Instructing	52	58	57	62	43	45	50	55	61	51	63	65	68	57	--			
16. Service Orientation	30	53	45	58	25	11	49	48	49	40	59	57	52	50	40	--		
17. Problem Identification	46	58	57	63	49	38	61	57	49	57	58	56	63	54	64	45	--	
18. Information Gathering	62	57	63	59	53	37	60	61	60	54	52	57	64	48	62	45	69	--
19. Information Organization	53	59	67	62	53	43	62	68	57	50	51	67	66	60	61	48	63	68
20. Synthesis/Reorganization	54	58	59	63	52	43	57	66	65	57	59	62	71	57	69	47	68	78
21. Idea Generation	52	58	62	59	46	41	64	61	58	55	57	63	69	55	73	43	69	72
22. Idea Evaluation	48	56	57	61	46	40	62	60	56	58	55	59	64	57	55	52	64	69
23. Implementation Planning	49	50	63	57	42	39	59	58	59	59	56	60	68	66	60	45	62	62
24. Solution Appraisal	50	55	62	59	50	47	55	58	60	66	62	68	67	69	70	44	63	66
25. Operations Analysis	41	39	47	39	50	54	42	49	42	47	38	56	52	46	51	27	46	54
26. Technology Design	33	27	36	38	46	61	39	49	39	39	25	44	40	36	43	25	43	44
27. Equipment Selection	36	29	34	35	41	49	33	47	41	34	33	52	49	34	61	27	41	48
28. Installation	15	08	13	21	32	54	19	27	21	21	02	29	27	15	32	07	25	29

Table 3-10a (continued)
Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29.	Programming	11	06	20	15	30	38	24	29	16	13	03	19	24	21	23	01	17	18
30.	Testing	23	14	23	26	38	53	26	32	28	21	11	28	29	24	41	06	33	32
31.	Operation Monitoring	14	06	08	23	21	36	13	21	18	19	12	28	23	17	33	13	27	20
32.	Operation and Control	04	07	06	22	27	34	08	18	16	16	06	27	20	16	23	12	23	16
33.	Product Inspection	22	27	25	41	44	36	23	38	32	26	17	44	28	28	38	27	25	28
34.	Equipment Maintenance	06	07	07	25	22	41	13	21	17	11	13	23	20	19	30	14	18	17
35.	Troubleshooting	23	15	21	26	38	52	22	32	28	18	05	30	26	22	39	07	33	33
36.	Repairing	11	06	15	26	26	52	17	24	25	10	05	28	26	21	35	08	21	22
37.	Visioning	40	31	38	37	36	30	35	37	38	50	27	42	41	42	42	24	41	38
38.	Systems Perception	30	25	32	33	27	35	25	36	38	42	24	41	35	32	39	30	37	43
39.	Identification of Downstream Consequences	42	36	40	42	37	33	41	45	46	46	40	42	46	52	47	45	45	47
40.	Identification of Key Causes	49	51	47	55	48	38	52	57	55	50	49	49	56	53	56	46	59	58
41.	Judgment and Decision Making	51	51	55	54	52	43	49	56	52	45	41	46	59	55	56	37	56	62
42.	Systems Evaluation	43	36	50	42	38	44	43	45	43	47	39	48	48	58	48	34	43	46
43.	Time Management	49	55	56	58	41	32	44	54	58	55	54	51	60	57	64	40	58	62
44.	Management of Financial Resources	40	33	37	42	39	30	34	42	39	43	38	42	47	54	42	35	37	45
45.	Management of Material Resources	37	29	35	37	35	41	28	43	39	41	39	45	48	50	47	33	35	43
46.	Management of Personnel Resources	47	40	44	42	36	37	36	41	47	56	43	43	50	58	52	34	45	48

Table 3-10a (continued)
Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
19.	Information Organization	--																	
20.	Synthesis/Reorganization	76	--																
21.	Idea Generation	71	77	--															
22.	Idea Evaluation	71	73	75	--														
23.	Implementation Planning	72	75	74	75	--													
24.	Solution Appraisal	73	75	71	68	75	--												
25.	Operations Analysis	64	58	55	55	65	67	--											
26.	Technology Design	54	49	47	54	56	51	72	--										
27.	Equipment Selection	53	47	48	48	44	55	64	64	--									
28.	Installation	30	30	29	34	30	28	49	67	58	--								
29.	Programming	42	31	29	29	41	29	47	47	30	42	--							
30.	Testing	41	34	40	34	39	38	56	62	56	70	59	--						
31.	Operation Monitoring	22	17	24	27	21	21	35	46	60	59	23	59	--					
32.	Operation and Control	21	15	17	21	16	21	34	41	51	53	16	51	75	--				
33.	Product Inspection	37	33	31	38	35	41	54	53	65	52	30	55	63	71	--			
34.	Equipment Maintenance	21	15	24	22	21	20	32	54	54	65	24	58	76	70	60	--		
35.	Troubleshooting	39	33	35	32	36	38	57	62	60	67	51	78	68	65	66	69	--	
36.	Repairing	26	25	31	29	32	28	40	63	56	75	38	65	65	59	58	76	75	--
37.	Visioning	47	47	42	50	57	57	49	56	53	44	28	38	36	33	48	35	41	41
38.	Systems Perception	43	44	37	44	45	49	53	52	48	48	30	43	37	37	48	32	44	44
39.	Identification of Downstream Consequences	53	56	46	57	60	63	50	52	53	32	29	41	39	37	51	33	43	36
40.	Identification of Key Causes	54	63	63	64	62	67	51	53	50	33	20	41	30	30	47	32	40	29
41.	Judgment and Decision Making	59	61	61	62	61	67	62	51	52	35	27	44	33	35	46	32	46	32
42.	Systems Evaluation	60	53	48	55	67	60	61	54	50	41	43	55	40	41	55	36	55	40
43.	Time Management	57	66	62	56	64	66	52	36	44	20	10	21	22	19	38	22	26	19

Table 3-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Basic and Cross-Functional Skills

Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
44. Management of Financial Resources	49	53	42	58	54	54	50	43	41	28	21	28	22	34	43	18	29	27
45. Management of Material Resources	44	49	40	50	54	52	61	49	60	48	20	42	45	51	58	43	47	45
46. Management of Personnel Resources	52	55	50	56	60	62	52	48	50	36	11	33	35	40	48	32	40	37

Table 3-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	37	38	39	40	41	42	43	44	45	46
37.	Visioning	--									
38.	Systems Perception	71	--								
39.	Identification of Downstream Consequences	73	64	--							
40.	Identification of Key Causes	60	52	73	--						
41.	Judgment and Decision Making	61	55	70	73	--					
42.	Systems Evaluation	64	67	74	62	66	--				
43.	Time Management	48	37	51	62	67	53	--			
44.	Management of Financial Resources	56	54	67	59	62	67	53	--		
45.	Management of Material Resources	53	53	65	57	64	65	56	74	--	
46.	Management of Personnel Resources	67	57	71	69	69	70	62	70	72	--

Note. N=140 (4 incumbents selected at random from each of 35 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 3-10b

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Reading Comprehension	--																	
2.	Active Listening	41	--																
3.	Writing	55	61	--															
4.	Speaking	40	77	63	--														
5.	Mathematics	34	35	44	40	--													
6.	Science	32	20	30	27	30	--												
7.	Critical Thinking	51	47	59	45	42	38	--											
8.	Active Learning	51	52	51	55	48	45	59	--										
9.	Learning Strategies	41	44	44	49	37	27	42	55	--									
10.	Monitoring	44	42	61	50	43	29	57	50	57	--								
11.	Social Perceptiveness	25	65	42	56	27	20	45	36	50	52	--							
12.	Coordination	42	55	56	63	35	37	58	63	55	64	56	--						
13.	Persuasion	46	51	54	55	20	31	56	47	47	53	58	64	--					
14.	Negotiation	32	41	48	47	16	32	49	35	47	51	62	55	71	--				
15.	Instructing	35	35	36	43	32	39	31	38	52	42	44	52	50	45	--			
16.	Service Orientation	25	55	40	54	17	09	42	42	39	41	56	50	52	45	32	--		
17.	Problem Identification	31	50	51	48	40	32	52	47	41	55	54	51	50	50	52	41	--	
18.	Information Gathering	55	36	53	39	30	35	49	53	45	50	28	49	55	40	47	35	55	--
19.	Information Organization	50	45	57	43	36	42	57	60	48	53	38	66	61	54	51	44	58	66
20.	Synthesis/Reorganization	50	46	53	48	34	38	51	58	52	60	50	65	72	58	56	48	64	69
21.	Idea Generation	43	42	48	40	26	37	55	52	43	49	41	53	56	45	60	40	58	61
22.	Idea Evaluation	51	45	47	45	29	44	60	58	48	54	42	62	64	54	45	47	56	57
23.	Implementation Planning	41	34	51	36	27	40	57	50	43	56	40	61	65	57	45	42	58	56
24	Solution Appraisal	45	38	50	43	39	46	50	53	48	61	45	66	57	55	56	34	58	54
25.	Operations Analysis	35	26	38	26	39	54	44	45	41	48	28	54	45	40	46	27	51	52
26.	Technology Design	19	18	20	19	31	47	25	36	24	25	14	37	26	25	35	19	41	37
27.	Equipment Selection	25	12	23	11	30	43	20	34	28	26	15	43	34	22	54	17	32	35
28.	Installation	07	-04	06	03	18	50	10	18	09	12	-08	22	17	15	34	03	18	22

Table 3-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29.	Programming	18	01	14	03	25	40	28	29	10	07	-03	20	20	13	17	-01	19	19
30.	Testing	17	-02	15	06	22	54	21	26	16	14	00	19	16	18	39	-02	28	24
31.	Operation Monitoring	01	-04	-01	08	08	31	-04	06	02	07	-01	12	07	10	30	-03	14	07
32.	Operation and Control	-05	-03	00	12	15	30	-02	06	09	07	-06	17	08	10	23	-02	19	07
33.	Product Inspection	20	12	17	24	31	33	14	29	25	26	07	34	20	26	37	15	25	24
34.	Equipment Maintenance	-04	-13	-04	01	03	27	-05	05	01	-01	-05	11	01	08	29	-04	08	09
35.	Troubleshooting	13	-04	09	05	18	47	10	21	08	06	-14	17	04	11	33	-05	25	26
36.	Repairing	04	-04	03	05	09	45	04	12	09	00	-06	17	08	14	35	-02	17	13
37.	Visioning	29	23	35	26	28	21	31	30	33	44	31	38	36	41	36	24	43	29
38.	Systems Perception	15	21	26	22	16	29	21	35	33	40	25	41	32	34	37	28	40	35
39.	Identification of Downstream Consequences	33	29	31	32	26	33	38	42	38	44	40	47	41	49	40	41	41	35
40.	Identification of Key Causes	34	36	37	35	32	33	49	51	42	44	39	44	45	46	42	34	52	47
41.	Judgment and Decision Making	44	34	48	39	33	40	41	44	37	45	27	46	50	52	44	28	49	54
42.	Systems Evaluation	34	24	40	28	26	41	37	40	33	42	31	47	43	52	44	26	43	42
43.	Time Management	40	38	46	45	26	33	41	54	47	47	40	55	59	50	52	36	47	59
44.	Management of Financial Resources	33	32	41	41	28	36	42	43	39	50	38	54	49	56	35	33	40	45
45.	Management of Material Resources	26	21	33	27	16	37	25	38	32	42	27	46	47	46	38	27	34	45
46.	Management of Personnel Resources	26	30	36	30	20	28	27	27	37	50	37	40	42	51	45	27	41	34

Table 3-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
19.	Information Organization	--																	
20.	Synthesis/Reorganization	77	--																
21.	Idea Generation	59	66	--															
22.	Idea Evaluation	65	67	69	--														
23.	Implementation Planning	66	68	63	73	--													
24.	Solution Appraisal	64	66	59	67	72	--												
25.	Operations Analysis	64	56	50	60	70	64	--											
26.	Technology Design	45	36	34	45	49	45	65	--										
27.	Equipment Selection	52	43	40	46	43	51	62	56	--									
28.	Installation	29	26	22	26	26	25	44	64	58	--								
29.	Programming	38	25	22	31	44	27	46	41	35	42	--							
30.	Testing	38	26	21	32	38	34	52	54	53	63	62	--						
31.	Operation Monitoring	19	12	17	18	15	18	26	42	51	57	22	57	--					
32.	Operation and Control	20	10	11	15	10	15	26	41	42	53	15	46	72	--				
33.	Product Inspection	35	30	27	36	31	38	50	43	53	47	25	49	55	60	--			
34.	Equipment Maintenance	11	07	23	17	13	13	23	50	48	63	15	46	73	61	48	--		
35.	Troubleshooting	31	20	27	27	31	30	47	57	52	67	50	69	64	59	59	71	--	
36.	Repairing	23	18	27	22	22	21	34	54	48	75	39	60	62	59	50	76	77	--
37.	Visioning	51	42	31	44	46	49	41	41	45	33	25	29	28	25	41	24	28	31
38.	Systems Perception	49	42	36	44	41	45	44	45	42	41	25	36	27	30	38	24	30	40
39.	Identification of Downstream Consequences	53	52	41	54	52	60	42	44	43	31	23	36	33	31	48	26	35	32
40.	Identification of Key Causes	44	51	53	59	58	57	50	49	39	23	18	32	17	16	37	21	34	20
41.	Judgment and Decision Making	56	58	52	61	61	66	56	43	46	33	28	37	27	27	44	25	40	25
42.	Systems Evaluation	58	51	40	52	63	53	60	49	47	39	37	54	37	36	51	35	51	40
43.	Time Management	56	64	54	55	60	57	49	31	38	19	16	21	16	14	38	16	24	13

Table 3-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Basic and Cross-Functional Skills

Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
44. Management of Financial Resources	56	54	40	56	53	53	53	38	36	28	15	23	15	25	38	17	26	22
45. Management of Material Resources	52	54	37	50	53	47	60	45	51	48	16	36	33	38	53	36	42	35
46. Management of Personnel Resources	44	48	39	44	50	49	43	34	40	32	03	26	30	27	46	27	34	31

Table 3-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Basic and Cross-Functional Skills

Descriptor	37	38	39	40	41	42	43	44	45	46
37. Visioning	--									
38. Systems Perception	62	--								
39. Identification of Downstream Consequences	67	62	--							
40. Identification of Key Causes	50	41	62	--						
41. Judgment and Decision Making	55	48	61	63	--					
42. Systems Evaluation	56	60	66	57	66	--				
43. Time Management	41	33	46	59	65	51	--			
44. Management of Financial Resources	48	46	59	47	55	61	49	--		
45. Management of Material Resources	45	50	59	48	58	63	52	72	--	
46. Management of Personnel Resources	58	57	62	57	62	64	47	59	66	--

Note. N=140 (4 incumbents selected at random from each of 35 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 3-10c

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Reading Comprehension	--																	
2.	Active Listening	39	--																
3.	Writing	49	49	--															
4.	Speaking	46	62	60	--														
5.	Mathematics	34	39	53	41	--													
6.	Science	28	17	29	25	32	--												
7.	Critical Thinking	31	41	52	48	37	30	--											
8.	Active Learning	30	32	32	39	38	27	41	--										
9.	Learning Strategies	32	29	32	34	38	30	49	64	--									
10.	Monitoring	26	30	32	34	26	44	33	41	54	--								
11.	Social Perceptiveness	29	43	44	40	32	23	38	40	47	49	--							
12.	Coordination	30	36	38	41	32	30	49	44	51	58	61	—						
13.	Persuasion	27	33	41	27	27	22	37	41	40	51	61	54	--					
14.	Negotiation	25	26	19	34	16	30	33	39	38	59	56	63	65	--				
15.	Instructing	27	18	30	25	20	32	32	36	43	60	63	53	50	62	--			
16.	Service Orientation	20	40	33	36	25	17	37	38	51	52	63	58	42	46	54	--		
17.	Problem Identification	18	28	28	29	25	28	45	41	42	49	49	49	38	47	45	57	--	
18.	Information Gathering	25	25	34	36	30	36	37	37	47	44	42	44	46	47	43	47	52	--
19.	Information Organization	27	11	30	26	33	37	39	50	50	47	35	50	32	37	45	32	46	46
20.	Synthesis/Reorganization	28	23	28	31	32	31	35	43	47	50	48	60	44	49	49	50	52	53
21.	Idea Generation	23	25	23	26	27	33	43	40	50	40	38	47	39	51	52	53	56	59
22.	Idea Evaluation	24	31	25	28	32	28	40	41	44	37	50	54	42	54	46	46	45	50
23.	Implementation Planning	21	24	28	32	28	21	45	41	47	47	54	62	47	56	57	52	49	49
24.	Solution Appraisal	23	34	24	28	28	29	45	43	46	53	55	60	51	59	51	51	63	51
25.	Operations Analysis	20	15	18	16	22	36	30	38	40	30	25	30	33	31	38	30	40	36
26.	Technology Design	16	02	14	20	19	41	23	31	29	27	26	31	20	37	39	26	32	24
27.	Equipment Selection	23	15	19	20	15	25	29	30	37	35	41	39	40	31	34	40	43	37
28.	Installation	14	01	11	14	11	38	11	10	11	30	20	30	15	36	29	16	15	16

Table 3-10c (continued)

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29.	Programming	15	-02	06	10	17	24	13	13	-01	00	02	11	-05	02	11	-03	01	01
30.	Testing	16	07	00	07	14	36	16	19	20	22	13	17	10	18	17	15	27	18
31.	Operation Monitoring	06	-05	03	-05	03	16	05	11	14	20	23	16	13	21	19	15	29	13
32.	Operation and Control	05	-02	-03	-02	-03	17	00	17	15	26	17	22	14	22	21	21	28	10
33.	Product Inspection	09	20	04	20	20	23	23	28	30	33	19	37	12	25	17	26	33	19
34.	Equipment Maintenance	09	-05	-07	-05	03	10	01	01	13	14	15	14	05	20	19	12	30	05
35.	Troubleshooting	14	08	-02	09	12	30	17	30	28	26	25	30	22	36	38	29	41	18
36.	Repairing	11	-08	-08	-01	06	33	06	02	08	10	06	15	-03	16	19	08	25	02
37.	Visioning	12	18	14	19	14	22	24	28	26	29	43	37	28	37	28	33	49	35
38.	Systems Perception	09	13	13	10	21	28	23	28	26	37	39	45	31	40	40	42	55	35
39.	Identification of Downstream Consequences	07	18	14	19	21	18	20	28	26	29	35	37	28	36	36	37	41	35
40.	Identification of Key Causes	15	27	22	23	23	23	36	37	44	39	51	50	50	50	42	48	52	45
41.	Judgment and Decision Making	29	32	30	39	30	28	40	37	31	31	42	57	42	44	30	41	49	47
42.	Systems Evaluation	14	08	12	18	16	20	19	39	23	26	33	39	27	41	38	29	36	27
43.	Time Management	21	42	37	43	37	21	37	47	44	38	48	48	42	43	37	44	46	54
44.	Management of Financial Resources	15	24	18	20	22	13	22	34	28	26	33	34	38	46	29	30	36	41
45.	Management of Material Resources	18	20	22	25	18	28	29	34	36	34	43	48	40	49	33	33	32	45
46.	Management of Personnel Resources	17	21	17	25	14	25	21	30	26	40	43	47	39	61	42	41	49	38

Table 3-10c (continued)
Intercorrelations of Descriptors for the Job Entry Requirement Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
19.	Information Organization	--																	
20.	Synthesis/Reorganization	66	--																
21.	Idea Generation	55	62	--															
22.	Idea Evaluation	55	52	58	--														
23.	Implementation Planning	54	59	58	65	--													
24.	Solution Appraisal	49	61	60	67	78	--												
25.	Operations Analysis	53	42	49	50	50	51	--											
26.	Technology Design	45	39	32	32	37	33	57	--										
27.	Equipment Selection	37	39	41	34	43	48	44	43	--									
28.	Installation	16	27	16	20	22	20	17	54	35	--								
29.	Programming	31	24	15	29	21	18	23	44	19	29	--							
30.	Testing	26	15	11	19	17	26	33	52	47	52	32	--						
31.	Operation Monitoring	16	10	16	16	05	08	09	37	36	38	22	51	--					
32.	Operation and Control	18	16	18	13	16	18	10	38	33	47	16	46	64	--				
33.	Product Inspection	39	37	31	19	28	33	16	31	40	33	05	33	25	52	--			
34.	Equipment Maintenance	12	17	18	16	13	11	14	35	30	45	17	39	67	62	42	--		
35.	Troubleshooting	30	24	30	25	24	31	24	43	36	27	25	42	46	53	45	52	--	
36.	Repairing	19	22	19	12	09	12	18	56	32	67	39	50	48	50	43	68	60	--
37.	Visioning	30	28	38	48	44	49	39	39	49	22	20	29	27	34	37	38	32	27
38.	Systems Perception	47	45	43	57	46	50	39	50	37	38	23	37	42	39	31	39	42	46
39.	Identification of Downstream Consequences	34	32	43	48	49	45	34	50	44	29	13	35	27	39	42	31	43	33
40.	Identification of Key Causes	49	51	53	56	53	61	48	44	41	17	16	30	31	33	34	26	41	22
41.	Judgment and Decision Making	49	50	46	57	60	59	41	28	33	10	23	18	09	15	31	05	27	07
42.	Systems Evaluation	49	42	35	49	54	46	36	55	31	27	33	29	23	36	40	30	45	33
43.	Time Management	42	43	49	50	49	44	32	27	33	14	12	24	22	23	39	15	23	06

Table 3-10c (continued)

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Individual-Level Data): Basic and Cross-Functional Skills

Descriptor	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
44. Management of Financial Resources	35	38	35	54	45	46	44	33	23	17	16	19	09	22	31	21	24	11
45. Management of Material Resources	44	42	39	54	53	39	44	47	39	39	20	25	27	22	37	34	24	23
46. Management of Personnel Resources	35	48	46	53	50	50	26	35	29	29	14	22	34	45	41	30	39	26

Table 3-10c (continued)

Intercorrelations of Descriptors for the Job Entry Requirement Scale (Individual-Level Data): Basic and Cross-Functional Skills

	Descriptor	37	38	39	40	41	42	43	44	45	46
37.	Visioning	--									
38.	Systems Perception	53	--								
39.	Identification of Downstream Consequences	55	53	--							
40.	Identification of Key Causes	51	62	56	--						
41.	Judgment and Decision Making	51	46	43	56	--					
42.	Systems Evaluation	48	58	59	52	45	--				
43.	Time Management	51	43	47	56	64	36	--			
44.	Management of Financial Resources	45	34	45	43	45	53	45	--		
45.	Management of Material Resources	52	48	48	58	45	50	50	57	--	
46.	Management of Personnel Resources	53	50	53	58	57	54	53	60	53	--

Note. N=140 (4 incumbents selected at random from each of 35 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 3-11
Principal Components Analysis Pattern Matrix for the Level Scale: Basic and Cross-Functional Skills

	Descriptor	Factor F1	F2	F3	Communality
1.	Reading Comprehension	.82	.12	.15	.71
2.	Active Listening	.87	-.17	.16	.82
3.	Writing	.89	-.04	.24	.84
4.	Speaking	.85	.01	.16	.75
5.	Mathematics	.56	.54	.04	.60
6.	Science	.58	.70	.05	.82
7.	Critical Thinking	.85	.25	.23	.84
8.	Active Learning	.82	.42	.19	.88
9.	Learning Strategies	.75	.07	.28	.64
10.	Monitoring	.80	.11	.40	.81
11.	Social Perceptiveness	.67	-.32	.39	.70
12.	Coordination	.80	.29	.31	.82
13.	Persuasion	.80	.02	.46	.86
14.	Negotiation	.58	-.08	.68	.80
15.	Instructing	.74	.12	.13	.59
16.	Service Orientation	.61	-.30	.47	.68
17.	Problem Identification	.83	.22	.19	.77
18.	Information Gathering	.87	.22	.22	.85
19.	Information Organization	.77	.28	.33	.78
20.	Synthesis/Reorganization	.89	.16	.25	.88
21.	Idea Generation	.82	.29	.28	.83
22.	Idea Evaluation	.73	.36	.44	.86
23.	Implementation Planning	.76	.18	.43	.79
24.	Solution Appraisal	.75	.16	.50	.83
25.	Operations Analysis	.60	.58	.34	.82
26.	Technology Design	.41	.82	.23	.90
27.	Equipment Selection	.39	.74	.33	.81
28.	Installation	.05	.90	.22	.85
29.	Programming	.23	.67	-.07	.51
30.	Testing	.19	.94	.03	.93
31.	Operation Monitoring	-.09	.88	.15	.81
32.	Operation and Control	-.09	.87	.16	.79
33.	Product Inspection	.13	.81	.30	.76
34.	Equipment Maintenance	-.12	.87	.17	.80
35.	Troubleshooting	.15	.96	.06	.95
36.	Repairing	-.02	.92	.13	.86
37.	Visioning	.30	.50	.71	.85
38.	Systems Perception	.35	.58	.66	.90
39.	Identification of Downstream Consequences	.39	.34	.78	.88

Table 3-11 (continued)
Principal Components Analysis Pattern Matrix for Level Scale: Basic and Cross-Functional Skills

	Descriptor	Factor F1	F2	F3	Communality
40.	Identification of Key Causes	.66	.27	.54	.80
41.	Judgment and Decision Making	.64	.29	.56	.81
42.	Systems Evaluation	.45	.47	.68	.89
43.	Time Management	.74	.04	.52	.82
44.	Management of Financial Resources	.41	.19	.81	.85
45.	Management of Material Resources	.35	.36	.80	.90
46.	Management of Personnel Resources	.42	.17	.83	.90
	Percent of Variance	38	25	17	
	Eigenvalue	17.60	11.56	7.98	

Note. N = 35. The correlation matrix was based on means calculated at the occupation level. F1 = Cognitive Skills, F2 = Technical Skills, F3 = Organizational Skills. These loadings are based on an orthogonal varimax rotation.

Table 3-12a

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Basic and Cross-Functional Skills

	Occupations											
	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Reading Comprehension	5.27	1.37	5.20	0.45	5.59	1.16	4.90	1.00	3.26	1.54	3.77	1.69
2. Active Listening	5.33	1.07	4.80	1.30	5.38	1.36	5.86	0.79	2.43	2.21	3.52	1.74
3. Writing	5.16	1.07	4.80	1.10	5.16	1.02	5.33	0.91	2.00	1.88	3.26	1.51
4. Speaking	5.11	1.09	4.40	0.89	4.84	1.83	5.52	0.93	2.43	2.25	3.70	1.51
5. Mathematics	4.18	1.35	4.60	0.55	3.97	1.47	2.62	1.16	1.87	2.05	3.56	1.93
6. Science	2.62	2.07	4.80	1.79	3.69	1.93	1.76	1.84	1.48	1.93	1.93	2.13
7. Critical Thinking	5.32	0.99	5.40	1.14	4.19	1.79	4.76	1.18	2.70	2.32	3.11	1.89
8. Active Learning	5.27	0.89	5.60	1.14	4.66	1.86	4.38	1.28	2.52	2.31	3.41	1.93
9. Learning Strategies	4.58	1.44	3.80	1.48	4.97	1.28	4.19	1.33	3.52	1.86	3.85	1.59
10. Monitoring	5.28	1.21	3.20	1.79	4.59	1.81	3.52	1.40	1.35	1.85	2.67	1.98
11. Social Perceptiveness	4.93	1.56	2.60	0.89	5.38	1.56	5.14	1.74	2.43	2.11	3.56	1.58
12. Coordination	5.20	1.60	4.60	1.14	4.16	1.82	4.81	1.08	2.17	2.23	4.33	1.54
13. Persuasion	5.02	1.14	3.60	0.55	4.34	1.38	4.76	1.04	2.09	1.78	3.07	1.82
14. Negotiation	4.98	1.47	2.80	1.30	3.91	1.84	5.14	1.28	1.87	2.07	2.93	2.15
15. Instructing	4.60	1.51	4.20	1.30	5.19	1.38	4.33	0.73	2.91	1.95	4.00	1.49
16. Service Orientation	4.69	1.66	2.00	1.41	4.91	1.94	4.52	1.75	2.22	1.88	3.33	1.80
17. Problem Identification	5.56	0.97	5.40	0.89	5.16	1.25	5.38	0.67	2.39	2.25	4.67	1.04
18. Information Gathering	5.39	1.03	4.60	1.82	4.78	1.52	4.95	1.40	2.87	1.94	3.74	1.91
19. Information Organization	4.69	1.77	5.60	1.67	4.00	1.83	3.81	1.54	2.39	1.95	3.19	1.66
20. Synthesis/ Reorganization	4.75	1.58	5.20	1.48	3.84	1.83	3.33	2.03	1.74	2.05	3.11	1.74
21. Idea Generation	5.00	1.31	6.00	1.41	3.77	1.81	3.81	1.36	1.70	1.84	3.56	1.65
22. Idea Evaluation	5.02	1.34	5.60	1.67	3.97	1.47	3.38	1.99	2.26	1.98	3.04	1.60

Table 3-12a (continued)

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Basic and Cross-Functional Skills

	Occupations											
	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
23. Implementation Planning	5.09	1.29	6.20	0.84	3.75	1.88	3.10	1.89	1.48	1.97	2.89	1.87
24. Solution Appraisal	5.27	1.39	4.40	1.34	4.28	1.87	3.10	1.92	1.09	1.62	2.74	1.97
25. Operations Analysis	3.96	2.16	6.00	0.71	2.88	2.15	1.29	1.71	0.96	1.74	2.63	2.32
26. Technology Design	2.91	2.15	5.20	1.30	2.63	1.93	1.29	1.62	1.87	2.24	3.52	2.08
27. Equipment Selection	3.91	1.99	3.80	1.64	3.88	1.64	1.76	1.87	2.96	2.29	4.26	1.53
28. Installation	1.07	1.79	2.60	1.14	1.03	1.77	0.10	0.44	2.22	2.09	4.70	1.54
29. Programming	0.78	1.64	6.40	0.89	0.41	1.19	0.33	0.86	0.83	1.87	1.44	2.19
30. Testing	1.56	2.11	6.00	1.22	1.47	1.76	0.24	0.62	1.83	2.53	2.85	2.07
31. Operation Monitoring	0.78	1.48	2.00	1.22	2.97	2.46	0.38	0.74	2.22	2.45	4.07	2.00
32. Operation and Control	1.49	2.04	2.00	2.55	2.34	1.99	0.86	1.31	1.70	2.08	3.89	2.12
33. Product Inspection	2.73	2.27	2.80	0.45	2.47	1.83	0.81	1.25	2.04	2.44	3.19	2.18
34. Equipment Maintenance	1.09	1.83	1.60	1.52	1.72	1.87	2.38	1.91	3.17	2.41	5.07	1.38
35. Troubleshooting	1.98	2.44	6.20	0.84	3.13	2.11	1.24	1.48	2.96	2.55	4.96	1.29
36. Repairing	0.69	1.52	3.00	2.55	0.78	1.18	0.71	1.19	2.65	2.39	5.04	1.34
37. Visioning	4.18	2.00	3.40	2.07	2.19	1.93	1.67	1.80	2.78	2.00	3.44	2.01
38. Systems Perception	3.89	2.16	2.80	1.92	2.91	2.22	1.19	1.60	1.96	1.66	3.19	1.92
39. Identification of Downstream Consequences	4.67	1.80	2.60	2.61	3.19	2.18	1.10	1.48	2.26	2.32	2.67	2.29
40. Identification of Key Causes	5.18	1.37	4.00	1.22	4.03	2.16	2.33	1.68	2.04	2.18	3.33	1.92
41. Judgment and Decision Making	5.20	1.47	3.80	1.10	3.97	2.15	4.05	2.48	1.91	2.33	3.41	1.58

Table 3-12a (continued)

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Basic and Cross-Functional Skills

Descriptor	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
42. Systems Evaluation	4.76	1.57	3.40	1.52	2.69	1.97	0.90	1.37	1.74	2.03	2.74	2.19
43. Time Management	5.42	1.16	3.20	1.10	4.50	1.97	3.90	1.37	2.70	2.27	3.85	1.94
44. Management of Financial Resources	4.93	1.76	1.20	1.79	1.50	2.00	0.52	1.40	1.17	2.12	1.96	2.41
45. Management of Material Resources	4.50	1.80	1.40	1.67	3.28	2.11	0.90	1.64	1.87	2.44	3.37	2.39
46. Management of Personnel Resources	5.44	1.44	1.60	2.19	3.22	2.17	2.05	1.83	2.26	2.16	3.00	2.42

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 3-12b

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Jobs: Basic and Cross-Functional Skills

Descriptor	Jobs: General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Reading Comprehension	4.07	0.89	4.40	0.55	4.38	0.66	4.00	0.84	2.91	0.90	3.27	1.06
2. Active Listening	4.00	0.71	3.40	0.55	4.13	0.91	4.48	0.51	2.52	1.34	3.15	1.13
3. Writing	3.89	0.80	3.40	0.55	4.03	0.69	4.24	0.70	2.17	1.11	2.59	0.93
4. Speaking	4.09	0.70	3.00	0.71	3.91	1.12	4.24	0.77	2.39	1.16	2.93	1.00
5. Mathematics	3.43	0.91	3.60	0.89	3.44	1.11	2.33	0.80	2.17	1.30	2.96	1.13
6. Science	2.44	1.32	3.80	0.84	3.16	1.22	1.86	0.96	1.96	1.26	2.04	1.13
7. Critical Thinking	4.11	0.71	4.60	0.55	3.48	1.21	3.81	0.93	2.52	1.31	2.52	1.01
8. Active Learning	3.84	0.67	4.40	0.55	3.56	1.16	3.43	0.81	2.52	1.34	2.81	1.18
9. Learning Strategies	3.40	0.96	3.00	0.71	3.81	0.93	3.19	0.93	3.04	1.15	3.00	1.00
10. Monitoring	3.84	0.95	2.40	0.89	3.59	1.10	2.95	0.74	1.96	1.30	2.33	1.04
11. Social Perceptiveness	3.73	0.99	2.20	0.84	3.84	1.05	3.86	1.11	2.43	1.34	2.78	1.01
12. Coordination	3.80	1.08	3.40	0.89	3.28	1.08	3.57	0.81	2.39	1.41	3.22	0.93
13. Persuasion	3.64	0.88	2.40	0.89	3.38	0.98	3.52	0.87	2.13	1.01	2.48	1.16
14. Negotiation	3.67	1.00	2.40	0.89	3.03	1.15	3.95	0.80	2.13	1.18	2.59	1.22
15. Instructing	3.51	0.99	3.20	1.48	3.91	0.93	3.33	0.66	2.74	1.21	3.11	1.15
16. Service Orientation	3.44	1.06	2.20	0.84	3.72	1.11	3.50	1.12	2.30	1.11	2.70	1.03
17. Problem Identification	4.18	0.65	4.40	0.55	4.00	0.76	4.05	0.67	2.48	1.44	3.41	0.93
18. Information Gathering	3.93	0.75	3.80	1.30	3.72	0.99	3.81	0.87	2.70	1.22	3.11	1.15
19. Information Organization	3.51	1.08	4.00	1.22	3.31	1.15	3.19	1.08	2.65	1.30	2.67	1.04
20. Synthesis/ Reorganization	3.53	1.01	3.40	1.14	3.09	1.15	2.76	1.26	2.26	1.45	2.74	1.06
21. Idea Generation	3.76	0.83	4.00	1.22	2.97	1.03	2.95	0.74	2.00	1.13	3.07	0.92
22. Idea Evaluation	3.80	0.89	4.20	0.84	3.13	0.94	2.67	1.11	2.30	1.15	2.56	1.01

Table 3-12b (continued)
Descriptor Means and Standard Deviations on the Importance Scale on Six Example Occupations: Basic and Cross-Functional Skills

Descriptor	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
23. Implementation Planning	3.84	0.85	4.60	0.55	3.00	1.14	2.67	1.02	1.87	1.14	2.44	1.09
24. Solution Appraisal	3.96	0.88	3.60	0.89	3.31	1.18	2.57	1.12	1.70	1.02	2.48	1.12
25. Operations Analysis	3.13	1.24	4.60	0.55	2.53	1.19	1.71	1.01	1.52	0.99	2.48	1.31
26. Technology Design	2.42	1.23	3.60	0.89	2.42	1.04	1.57	0.81	2.00	1.17	2.81	1.27
27. Equipment Selection	3.00	1.13	3.20	1.48	3.03	0.97	1.86	0.91	2.74	1.29	3.63	0.97
28. Installation	1.53	0.99	2.00	0.71	1.59	1.04	1.00	0.00	2.43	1.20	3.70	1.03
29. Programming	1.42	0.94	5.00	0.00	1.28	0.73	1.05	0.22	1.43	0.99	1.70	1.14
30. Testing	1.80	1.12	4.60	0.55	1.94	1.05	1.05	0.22	2.13	1.52	2.74	1.16
31. Operation Monitoring	1.44	0.92	2.20	0.84	2.72	1.42	1.24	0.77	2.35	1.47	3.37	1.24
32. Operation and Control	1.78	1.13	2.00	1.41	2.38	1.18	1.48	0.98	2.22	1.41	3.00	1.33
33. Product Inspection	2.64	1.42	2.60	0.55	2.44	1.08	1.43	0.75	2.13	1.29	2.89	1.37
34. Equipment Maintenance	1.58	1.06	1.80	0.84	1.97	1.15	2.19	1.08	2.96	1.33	3.96	0.76
35. Troubleshooting	2.04	1.38	4.60	0.55	2.66	1.07	1.62	0.80	2.70	1.40	3.81	0.79
36. Repairing	1.33	0.83	2.80	1.30	1.44	0.72	1.33	0.73	2.65	1.37	3.81	0.88
37. Visioning	3.27	1.21	2.60	1.14	2.13	0.98	1.81	0.87	2.83	1.15	2.81	1.14
38. Systems Perception	3.04	1.30	2.20	1.10	2.53	1.16	1.62	0.97	2.39	1.23	2.81	1.21
39. Identification of Downstream Consequences	3.60	0.99	2.60	1.67	2.78	1.21	1.57	0.81	2.52	1.50	2.33	1.33
40. Identification of Key Causes	3.80	0.87	3.60	0.55	3.25	1.22	2.24	1.09	2.26	1.42	2.78	1.09
41. Judgment and Decision Making	3.91	0.82	3.20	0.84	3.22	1.18	3.29	1.38	2.04	1.30	2.78	0.93
42. Systems Evaluation	3.64	0.93	3.00	1.00	2.38	0.98	1.48	0.87	2.04	1.15	2.41	1.22

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Table 3-12b (continued)

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Occupations: Basic and Cross-Functional Skills

Descriptor	Occupations											
	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
43. Time Management	4.11	0.71	3.40	0.55	3.50	1.08	3.19	0.98	2.87	1.42	3.04	1.06
44 Management of Financial Resources	3.82	1.03	1.60	0.89	1.78	1.04	1.24	0.77	1.70	1.26	2.11	1.37
45. Management of Material Resources	3.41	1.01	1.80	0.84	2.72	1.22	1.48	0.98	2.04	1.36	2.70	1.30
46. Management of Personnel Resources	4.11	0.88	1.60	0.89	3.00	1.19	2.10	1.14	2.57	1.30	2.74	1.40

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 3-12c

Descriptor Means and Standard Deviations on the Job Entry Requirements Scale on Six Example Occupations: Basic and Cross-Functional Skills

	Occupations											
	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners (n=23)		Maintenance Repairers, General Utility (n=27)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Reading Comprehension	1.05	0.23	1.00	0.00	1.00	0.00	1.05	0.22	1.35	0.49	1.12	0.32
2. Active Listening	1.13	0.34	1.60	0.55	1.09	0.30	1.29	0.46	1.57	0.51	1.33	0.48
3. Writing	1.04	0.21	1.20	0.45	1.06	0.25	1.14	0.36	1.70	0.47	1.41	0.50
4. Speaking	1.11	0.32	1.60	0.55	1.19	0.40	1.33	0.48	1.52	0.51	1.37	0.49
5. Mathematics	1.13	0.34	1.00	0.00	1.13	0.34	1.52	0.51	1.65	0.49	1.30	0.47
6. Science	1.55	0.50	1.00	0.00	1.31	0.47	1.81	0.40	1.89	0.39	1.70	0.47
7. Critical Thinking	1.16	0.37	1.20	0.45	1.31	0.47	1.52	0.51	1.65	0.49	1.59	0.50
8. Active Learning	1.18	0.39	1.40	0.55	1.25	0.44	1.62	0.50	1.78	0.42	1.63	0.49
9. Learning Strategies	1.31	0.47	1.40	0.55	1.31	0.47	1.67	0.48	1.68	0.47	1.44	0.51
10. Monitoring	1.23	0.42	2.00	0.00	1.34	0.48	1.86	0.36	1.78	0.42	1.63	0.49
11. Social Perceptiveness	1.36	0.48	2.00	0.00	1.28	0.46	1.76	0.44	1.56	0.50	1.52	0.51
12. Coordination	1.29	0.46	1.60	0.55	1.47	0.51	1.76	0.44	1.70	0.47	1.52	0.51
13. Persuasion	1.42	0.50	2.00	0.00	1.53	0.51	1.86	0.36	1.78	0.42	1.78	0.42
14. Negotiation	1.31	0.47	2.00	0.00	1.50	0.51	1.81	0.40	1.83	0.39	1.67	0.48
15. Instructing	1.56	0.50	1.60	0.55	1.22	0.42	1.86	0.36	1.57	0.51	1.52	0.51
16. Service Orientation	1.42	0.50	1.80	0.45	1.31	0.47	1.76	0.44	1.91	0.29	1.52	0.51
17. Problem Identification	1.22	0.42	1.40	0.55	1.34	0.48	1.67	0.48	1.74	0.45	1.37	0.49
18. Information Gathering	1.38	0.49	1.80	0.45	1.31	0.47	1.81	0.40	1.74	0.45	1.63	0.49
19. Information Organization	1.49	0.51	1.40	0.55	1.47	0.51	1.90	0.30	1.78	0.42	1.70	0.47
20. Synthesis/ Reorganization	1.40	0.50	1.40	0.55	1.59	0.50	1.90	0.30	1.78	0.42	1.65	0.48
21. Idea Generation	1.33	0.49	1.60	0.55	1.56	0.50	1.90	0.30	1.96	0.21	1.59	0.50
22. Idea Evaluation	1.29	0.46	1.80	0.45	1.53	0.51	1.95	0.22	1.87	0.34	1.78	0.42

Table 3-12c (continued)

Descriptor Means and Standard Deviations on the Job Entry Requirements Scale on Six Example Occupations: Basic and Cross-Functional Skills

Descriptor	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners (n=23)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
23. Implementation Planning	1.27	0.45	1.80	0.45	1.56	0.50	2.00	0.00	1.91	0.29	1.70	0.47
24. Solution Appraisal	1.31	0.47	1.80	0.45	1.53	0.51	2.00	0.00	1.91	0.29	1.81	0.40
25. Operations Analysis	1.53	0.50	1.60	0.55	1.59	0.50	2.00	0.00	1.96	0.21	1.78	0.42
26. Technology Design	1.76	0.43	1.20	0.45	1.71	0.45	2.00	0.00	1.78	0.42	1.63	0.49
27. Equipment Selection	1.67	0.48	1.80	0.45	1.81	0.40	2.00	0.00	1.83	0.39	1.41	0.50
28. Installation	1.96	0.21	2.00	0.00	1.91	0.30	2.00	0.00	1.87	0.34	1.33	0.48
29. Programming	1.93	0.25	1.20	0.45	1.97	0.18	2.00	0.00	1.91	0.29	1.85	0.36
30. Testing	1.89	0.32	1.60	0.55	1.84	0.37	2.00	0.00	1.87	0.34	1.67	0.48
31. Operation Monitoring	1.91	0.29	2.00	0.00	1.72	0.46	1.95	0.22	1.78	0.42	1.63	0.49
32. Operation and Control	1.87	0.34	2.00	0.00	1.81	0.40	1.95	0.22	1.83	0.39	1.67	0.48
33. Product Inspection	1.60	0.50	2.00	0.00	1.78	0.42	2.00	0.00	1.83	0.39	1.56	0.51
34. Equipment Maintenance	1.93	0.25	2.00	0.00	1.81	0.40	2.00	0.00	1.78	0.42	1.33	0.48
35. Troubleshooting	1.78	0.42	1.60	0.55	1.69	0.47	2.00	0.00	1.78	0.42	1.41	0.50
36. Repairing	1.91	0.29	1.60	0.55	1.94	0.25	2.00	0.00	1.91	0.29	1.37	0.49
37. Visioning	1.49	0.51	2.00	0.00	1.81	0.40	2.00	0.00	1.78	0.42	1.52	0.51
38. Systems Perception	1.56	0.50	1.80	0.45	1.53	0.51	2.00	0.00	1.78	0.42	1.59	0.50
39. Identification of Downstream Consequences	1.41	0.49	1.60	0.55	1.66	0.48	1.90	0.30	1.70	0.47	1.74	0.45
40. Identification of Key Causes	1.38	0.49	1.80	0.45	1.53	0.51	1.95	0.22	1.91	0.29	1.74	0.45
41. Judgment and Decision Making	1.18	0.39	1.60	0.55	1.47	0.51	1.81	0.40	1.91	0.29	1.59	0.50
42. Systems Evaluation	1.40	0.50	1.80	0.45	1.72	0.46	2.00	0.00	1.87	0.34	1.70	0.47

Table 3-12c (continued)

Descriptor Means and Standard Deviations on the Job Entry Requirements Scale on Six Example Occupations: Basic and Cross-Functional Skills

Descriptor	Occupations											
	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners (n=23)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
43. Time Management	1.22	0.42	2.00	0.00	1.42	0.49	1.81	0.40	1.78	0.42	1.52	0.51
44. Management of Financial Resources	1.38	0.49	2.00	0.00	1.88	0.34	1.95	0.22	1.91	0.29	1.85	0.36
45. Management of Material Resources	1.39	0.49	2.00	0.00	1.78	0.42	2.00	0.00	1.87	0.34	1.67	0.48
46. Management of Personnel Resources	1.20	0.40	2.00	0.00	1.63	0.49	1.95	0.22	1.83	0.39	1.67	0.48

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 3-13

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for the Level Scale: Basic and Cross-Functional Skills

		Functions							
	Descriptor	F1	F2	F3	F4	F5	F6	$\Gamma\underline{F}^2$	η^2
1.	Reading Comprehension	-.02	.07	.04	.05	.30	-.01	.10	.26
2.	Active Listening	-.04	.04	.03	.04	.61	.08	.38	.25
3.	Writing	.06	.15	.05	-.05	.61	.12	.42	.35
4.	Speaking	.08	.04	.00	.16	.60	-.03	.40	.20
5.	Mathematics	.07	.15	.11	.07	.39	.08	.20	.23
6.	Science	.10	.16	.14	.70	.33	.12	.66	.37
7.	Critical Thinking	.02	.11	.04	.10	.61	.08	.40	.21
8.	Active Learning	.02	.20	.04	.17	.51	.08	.34	.23
9.	Learning Strategies	.09	.09	.03	.08	.28	.04	.10	.20
10.	Monitoring	-.05	.23	.07	.01	.49	.02	.30	.31
11.	Social Perceptiveness	-.03	.11	.08	.00	.51	-.02	.28	.25
12.	Coordination	.12	.09	.03	.02	.62	.04	.41	.21
13.	Persuasion	.10	.17	.07	.07	.68	.05	.51	.29
14.	Negotiation	.09	.26	.05	.06	.57	.08	.42	.31
15.	Instructing	.12	.09	.06	.15	.37	.04	.18	.21
16.	Service Orientation	.04	.13	.03	.04	.37	.04	.16	.18
17.	Problem Identification	.07	.09	.02	.07	.51	-.09	.29	.26
18.	Information Gathering	.10	.17	-.04	.06	.41	.07	.22	.26
19.	Information Organization	.07	.20	-.02	.05	.35	.25	.23	.20
20.	Synthesis/Reorganization	.08	.27	-.03	.02	.37	.11	.23	.26
21.	Idea Generation	.05	.23	.14	.02	.50	.17	.36	.31
22.	Idea Evaluation	.05	.35	.00	.09	.36	.12	.28	.29
23.	Implementation Planning	.05	.41	.01	.05	.44	.29	.45	.32
24.	Solution Appraisal	.09	.35	.05	.08	.37	.13	.30	.36
25.	Operations Analysis	.09	.46	.14	.09	.21	.31	.38	.25
26.	Technology Design	.26	.35	.08	.30	.12	.31	.40	.29
27.	Equipment Selection	.18	.21	.19	.15	.12	.11	.16	.23
28.	Installation	.64	.29	.21	.05	.07	.30	.63	.38
29.	Programming	.18	.20	.10	.04	.09	.74	.63	.20
30.	Testing	.25	.26	.24	.20	.06	.41	.40	.28
31.	Operation Monitoring	.17	.10	.79	.11	.09	.06	.68	.40
32.	Operation and Control	.11	.14	.62	-.05	.02	.11	.43	.25
33.	Product Inspection	.17	.23	.31	.05	.07	.04	.19	.20
34.	Equipment Maintenance	.35	.14	.36	.12	.10	.05	.31	.40
35.	Troubleshooting	.38	.21	.37	.25	.05	.22	.44	.31
36.	Repairing	.78	.20	.21	.04	.10	.15	.72	.41
37.	Visioning	.15	.58	.00	-.01	.11	.16	.40	.24
38.	Systems Perception	.16	.60	.11	.10	.06	.09	.42	.26
39.	Identification of Downstream Consequences	.08	.56	.12	.20	.09	.09	.39	.27

Table 3-13 (continued)

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for the Level Scale: Basic and Cross-Functional Skills

	Descriptor	Functions							
		F1	F2	F3	F4	F5	F6	ΓF^2	η^2
40.	Identification of Key Causes	.02	.43	.05	.10	.26	.00	.27	.29
41.	Judgment and Decision Making	.05	.42	.04	.08	.23	.05	.24	.33
42.	Systems Evaluation	.06	.60	.08	.08	.07	.15	.40	.33
43.	Time Management	.07	.29	.06	.01	.30	-.03	.18	.25
44.	Management of Financial Resources	.05	.65	.13	-.13	.29	.08	.55	.34
45.	Management of Material Resources	.14	.61	.14	.10	.18	.01	.45	.29
46.	Management of Personnel Resources	.09	.51	.06	-.04	.28	.05	.36	.34
	R_c	.81	.73	.65	.61	.60	.56		
	Percent of Variance	23	14	9	7	7	6		
	Eigenvalue	1.92	1.15	.73	.59	.56	.47		

Note. Statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.51, median = 12, harmonic mean = 9.01). F1 = Technical Repair; F2 = Systems Direction; F3 = Machine Production; F4 = Research and Development; F5 = Interactive Problem Solving; F6 = Computer Applications.

ΓF^2 = Sum of squared rotated standardized discriminant function coefficients across 6 functions.

η^2 = Variance in Skill Level Scale ratings accounted for by occupations.

The statistics "R_c" "Percent of Variance," and "Eigenvalue," were calculated based on the unrotated discriminant functions.

Table 3-14a

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Difference Between Jobs for the Level Scale: Basic and Cross-Functional Skills

Descriptor	Incumbent			Analyst						
	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
1. Reading Comprehension	4.42	0.89	.84	3.53	1.15	.94	7.77*	1.66	.81	1.22
2. Active Listening	4.28	0.95	.83	3.23	1.04	.93	8.04*	1.18	.71	1.66
3. Writing	3.82	1.07	.90	3.11	1.08	.94	5.77*	1.01	.77	1.02
4. Speaking	4.20	0.80	.77	3.13	1.14	.95	7.75*	2.02	.70	1.79
5. Mathematics	3.26	1.16	.82	2.72	1.14	.95	3.89*	1.04	.74	0.95
6. Science	1.53	1.35	.90	1.24	1.41	.96	2.15*	1.10	.84	0.67
7. Critical Thinking	3.68	1.02	.80	2.63	1.38	.95	7.19*	1.83	.78	1.84
8. Active Learning	3.62	1.14	.81	2.49	1.44	.96	7.85*	1.59	.81	1.96
9. Learning Strategies	3.83	0.91	.78	2.38	1.29	.94	9.73*	2.03	.73	2.85
10. Monitoring	3.26	1.19	.88	2.78	1.08	.93	4.18*	1.22	.83	0.67
11. Social Perceptiveness	3.62	1.08	.83	2.50	1.30	.96	6.82*	1.46	.68	2.16
12. Coordination	3.57	1.07	.80	2.56	1.43	.95	5.56*	1.80	.67	2.13
13. Persuasion	3.19	1.15	.86	1.64	1.16	.93	10.22*	1.00	.70	3.19
14. Negotiation	2.90	1.26	.88	1.46	1.11	.93	9.26*	1.29	.71	2.87
15. Instructing	3.78	1.08	.79	1.97	1.32	.92	9.07*	1.48	.53	4.61
16. Service Orientation	3.28	1.02	.75	2.49	1.09	.91	4.63*	1.14	.54	1.63
17. Problem Identification	4.16	1.08	.84	3.15	1.16	.94	7.04*	1.16	.72	1.70
18. Information Gathering	3.92	1.07	.84	2.96	1.23	.96	7.46*	1.32	.79	1.49
19. Information Organization	3.21	1.11	.78	2.95	1.09	.93	1.94	1.02	.73	0.70
20. Synthesis/ Reorganization	3.24	1.15	.84	2.13	1.11	.93	8.61*	1.06	.77	1.80
21. Idea Generation	3.33	1.26	.87	2.24	1.23	.95	7.60*	1.04	.77	1.87
22. Idea Evaluation	3.07	1.25	.86	2.31	1.25	.96	5.70*	1.00	.80	1.19
23. Implementation Planning	2.83	1.39	.88	2.04	1.35	.94	4.86*	1.06	.75	1.55
24. Solution Appraisal	3.02	1.40	.90	2.64	1.17	.95	2.86*	1.43	.82	0.76
25. Operations Analysis	2.02	1.37	.83	1.63	1.27	.92	2.62*	1.16	.78	0.90
26. Technology Design	1.76	1.40	.87	1.25	1.15	.95	3.20*	1.47	.75	1.11
27. Equipment Selection	2.57	1.32	.82	2.18	0.93	.89	3.02*	2.04	.82	0.73
28. Installation	1.28	1.54	.91	1.17	1.07	.86	0.63	2.06	.69	1.21
29. Programming	0.83	1.20	.78	0.37	1.06	.93	4.82*	1.28	.88	0.52
30. Testing	1.53	1.60	.86	1.19	1.25	.93	2.22*	1.63	.82	0.94
31. Operation Monitoring	1.69	1.75	.92	1.55	1.04	.91	0.72	2.81*	.81	1.16
32. Operation and Control	2.05	1.39	.84	2.14	0.79	.74	-0.46	3.07*	.63	1.13
33. Product Inspection	2.31	1.34	.78	2.40	0.81	.88	-0.56	2.71*	.72	0.86
34. Equipment Maintenance	1.67	1.63	.92	1.36	1.07	.91	1.75	2.32*	.78	1.14
35. Troubleshooting	2.25	1.74	.88	1.48	1.18	.93	4.41*	2.17*	.82	1.61
36. Repairing	1.33	1.49	.92	1.25	1.08	.90	0.44	1.89	.73	1.03
37. Visioning	2.34	1.15	.82	1.88	1.32	.94	2.38*	1.32	.59	1.43
38. Systems Perception	2.22	1.23	.84	2.00	1.25	.92	1.31	1.04	.65	1.09

Table 3-14a (continued)

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Difference Between Jobs for the Level Scale: Basic and Cross-Functional Skills

Descriptor	Incumbent M	Incumbent SD	Incumbent r_k	Analyst M	Analyst SD	Analyst r_k	t	F	r_{ia}	d^2
39. Identification of Downstream Consequences	2.19	1.13	.85	1.82	1.30	.93	2.30*	1.32	.71	1.00
40. Identification of Key Causes	3.17	1.17	.86	2.45	1.22	.93	5.34*	1.09	.78	1.14
41. Judgment and Decision Making	2.93	1.33	.89	2.51	1.25	.93	2.95*	1.13	.79	0.86
42. Systems Evaluation	2.02	1.36	.89	1.60	1.35	.94	2.79*	1.02	.78	0.95
43. Time Management	3.61	1.18	.83	2.19	1.19	.93	8.35*	1.00	.64	2.99
44. Management of Financial Resources	1.84	1.50	.89	1.37	1.42	.94	2.16*	1.12	.62	1.78
45. Management of Material Resources	1.94	1.29	.87	1.99	1.10	.92	-0.31	1.37	.69	0.89
46. Management of Personnel Resources	2.67	1.38	.89	1.56	1.54	.95	5.51*	1.24	.68	2.59

Note. Incumbent statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.51, median = 12, harmonic mean = 9.01). Analyst statistics are based on the same 35 occupations with Skills questionnaire responses from at least 6 analysts (mean number of analysts = 10.29, median = 12.0, harmonic mean = 8.66).

The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

The t statistic tests for differences in the incumbent and analyst group means.

The F statistic tests for differences in the incumbent and analyst group standard deviations.

The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.

The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.

*$p < .05$

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Table 3-14b

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Difference Between Jobs for the Level Scale: Basic and Cross-Functional Skills

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d
1. Reading Comprehension	3.65	0.61	.83	3.28	0.78	.86	4.39*	1.65	.77	0.38
2. Active Listening	3.63	0.56	.78	3.20	0.90	.89	3.29*	2.61*	.54	0.75
3. Writing	3.22	0.64	.87	3.07	0.82	.86	1.34	1.60	.64	0.41
4. Speaking	3.54	0.49	.75	3.39	1.02	.92	1.15	4.39*	.64	0.65
5. Mathematics	2.96	0.65	.74	2.77	0.97	.93	1.60	2.26*	.67	0.55
6. Science	1.88	0.82	.90	1.68	0.96	.96	1.99	1.36	.80	0.37
7. Critical Thinking	3.12	0.70	.81	2.48	1.19	.95	4.76*	2.86*	.75	1.05
8. Active Learning	3.01	0.67	.79	2.27	1.01	.94	6.46*	2.27*	.75	0.99
9. Learning Strategies	3.12	0.50	.71	2.11	0.96	.93	9.07*	3.62*	.76	1.46
10. Monitoring	2.81	0.65	.83	2.69	0.73	.79	1.39	1.26	.70	0.30
11. Social Perceptiveness	3.06	0.61	.76	2.82	1.14	.94	1.69	3.48*	.70	0.73
12. Coordination	2.99	0.63	.75	2.67	1.12	.92	2.01	3.12*	.54	0.97
13. Persuasion	2.65	0.68	.85	1.70	0.81	.91	8.78*	1.40	.64	1.30
14. Negotiation	2.62	0.69	.84	1.59	0.75	.92	11.14*	1.18	.72	1.34
15. Instructing	3.18	0.57	.71	1.99	1.04	.93	8.09*	3.34*	.55	2.15
16. Service Orientation	2.86	0.67	.73	2.81	1.13	.93	0.30	2.86*	.47	0.99
17. Problem Identification	3.45	0.62	.79	3.04	0.81	.88	3.85*	1.70	.65	0.54
18. Information Gathering	3.25	0.72	.83	2.90	0.91	.89	3.73*	1.57	.79	0.42
19. Information Organization	2.79	0.65	.76	2.87	0.82	.87	-0.66	1.58	.61	0.44
20. Synthesis/ Reorganization	2.79	0.60	.78	2.01	0.74	.86	8.33*	1.49	.68	0.90
21. Idea Generation	2.79	0.69	.86	2.09	0.89	.93	6.52*	1.68	.71	0.88
22. Idea Evaluation	2.67	0.72	.83	2.14	0.94	.95	4.98*	1.71	.75	0.65
23. Implementation Planning	2.54	0.84	.88	2.18	1.04	.92	2.91*	1.55	.71	0.66
24. Solution Appraisal	2.68	0.76	.86	2.48	0.80	.87	1.99	1.11	.70	0.39
25. Operations Analysis	2.06	0.79	.82	1.83	0.89	.92	2.32*	1.27	.76	0.40
26. Technology Design	1.92	0.75	.84	1.62	0.84	.95	2.61*	1.25	.64	0.54
27. Equipment Selection	2.36	0.77	.81	2.16	0.83	.91	2.43*	1.16	.80	0.29
28. Installation	1.69	0.88	.92	1.51	0.81	.90	1.42	1.19	.61	0.57
29. Programming	1.49	0.78	.82	1.16	0.67	.96	5.47*	1.36	.89	0.23
30. Testing	1.85	0.95	.87	1.57	0.87	.92	2.46*	1.20	.74	0.51
31. Operation Monitoring	1.97	0.94	.90	1.78	0.98	.91	1.56	1.09	.71	0.56
32. Operation and Control	2.13	0.80	.80	2.27	0.88	.80	-1.08	1.21	.56	0.63
33. Product Inspection	2.34	0.75	.77	2.56	0.68	.82	-1.80	1.22	.49	0.56
34. Equipment Maintenance	1.95	0.96	.93	1.66	0.94	.94	2.44*	1.05	.71	0.59
35. Troubleshooting	2.27	1.01	.88	1.65	0.87	.93	5.18*	1.35	.73	0.87
36. Repairing	1.75	0.85	.91	1.47	0.84	.95	2.32*	1.01	.64	0.58
37. Visioning	2.31	0.63	.78	1.88	0.90	.92	3.30*	2.03	.54	0.76
38. Systems Perception	2.27	0.68	.79	1.87	0.89	.92	3.10*	1.73	.56	0.71

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Table 3-14b (continued)

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Difference Between Jobs for the Level Scale: Basic and Cross-Functional Skills

Descriptor	Incumbent M	Incumbent SD	Incumbent r_k	Analyst M	Analyst SD	Analyst r_k	t	F	r_{ia}	d
39. Identification of Downstream Consequences	2.22	0.65	.84	1.77	0.86	.93	4.59*	1.74	.74	0.52
40. Identification of Key Causes	2.74	0.66	.84	2.27	0.88	.90	4.39*	1.78	.69	0.62
41. Judgment and Decision Making	2.70	0.79	.86	2.44	1.01	.91	2.25*	1.64	.73	0.58
42. Systems Evaluation	2.09	0.75	.87	1.73	0.87	.92	3.54*	1.34	.74	0.47
43. Time Management	3.20	0.67	.81	2.25	0.94	.90	7.03*	1.96	.55	1.53
44. Management of Financial Resources	2.10	0.90	.87	1.69	0.86	.93	3.01*	1.09	.58	0.81
45. Management of Material Resources	2.09	0.73	.85	2.09	0.70	.82	0.03	1.12	.58	0.41
46. Management of Personnel Resources	2.57	0.80	.86	1.86	1.15	.96	4.69*	2.05	.63	1.30

Note. Incumbent statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.26, median = 12.5, harmonic mean = 9.01). Analyst statistics are based on the same 35 occupations with Skills questionnaire responses from at least 6 analysts (mean number of analysts = 10.29, median = 12.0, harmonic mean = 8.66).

The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupations.

The t statistic tests for differences in the incumbent and analyst group means.

The F statistic tests for differences in the incumbent and analyst group standard deviations.

The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.

The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.

*$p < .05$

Table 3-15

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Basic and Cross-Functional Skills

Descriptor	Incumbent			Analyst			
	M	SD	r_k	M	SD	r_k	t
1. Reading Comprehension	0.96	0.07	0.50	0.99	0.04	0.48	-1.80
2. Active Listening	0.92	0.12	0.69	0.98	0.05	0.24	-2.78*
3. Writing	0.91	0.12	0.73	0.98	0.07	0.66	-3.28*
4. Speaking	0.92	0.10	0.53	0.98	0.07	0.48	-3.05*
5. Mathematics	0.85	0.17	0.70	0.94	0.13	0.69	-3.12*
6. Science	0.43	0.29	0.87	0.50	0.32	0.84	-1.70
7. Critical Thinking	0.83	0.14	0.62	0.90	0.11	0.27	-2.83*
8. Active Learning	0.81	0.17	0.64	0.90	0.13	0.53	-3.61*
9. Learning Strategies	0.90	0.14	0.54	0.88	0.15	0.52	0.58
10. Monitoring	0.77	0.20	0.81	0.97	0.06	0.17	-6.87*
11. Social Perceptiveness	0.86	0.15	0.61	0.88	0.21	0.81	-0.60
12. Coordination	0.80	0.17	0.64	0.92	0.15	0.65	-4.14*
13. Persuasion	0.78	0.19	0.73	0.75	0.25	0.75	0.89
14. Negotiation	0.76	0.19	0.68	0.68	0.27	0.77	2.06*
15. Instructing	0.87	0.14	0.58	0.73	0.24	0.67	3.16*
16. Service Orientation	0.78	0.18	0.66	0.91	0.20	0.83	-3.09*
17. Problem Identification	0.89	0.13	0.62	0.99	0.03	0.31	-4.68*
18. Information Gathering	0.90	0.13	0.69	0.98	0.07	0.66	-4.01*
19. Information Organization	0.77	0.18	0.72	0.95	0.10	0.57	-5.97*
20. Synthesis/ Reorganization	0.82	0.18	0.78	0.87	0.18	0.70	-2.35*
21. Idea Generation	0.80	0.19	0.70	0.88	0.12	0.40	-3.11*
22. Idea Evaluation	0.76	0.19	0.74	0.90	0.11	0.37	-5.25*
23. Implementation Planning	0.70	0.22	0.78	0.81	0.20	0.67	-4.00*
24. Solution Appraisal	0.76	0.23	0.80	0.95	0.10	0.59	-5.27*
25. Operations Analysis	0.51	0.26	0.78	0.66	0.21	0.60	-3.69*
26. Technology Design	0.47	0.31	0.84	0.60	0.30	0.79	-2.45*
27. Equipment Selection	0.63	0.25	0.78	0.88	0.14	0.43	-6.71*
28. Installation	0.33	0.32	0.87	0.52	0.26	0.65	-3.86*
29. Programming	0.23	0.24	0.63	0.13	0.21	0.77	3.13*
30. Testing	0.37	0.32	0.83	0.55	0.27	0.74	-4.64*
31. Operation Monitoring	0.43	0.32	0.84	0.75	0.22	0.63	-7.91*
32. Operation and Control	0.58	0.25	0.68	0.84	0.12	0.00	-7.35*
33. Product Inspection	0.60	0.25	0.71	0.92	0.10	0.29	-8.25*
34. Equipment Maintenance	0.43	0.32	0.84	0.65	0.26	0.72	-4.90*
35. Troubleshooting	0.53	0.27	0.75	0.68	0.23	0.66	-4.66*
36. Repairing	0.36	0.31	0.83	0.57	0.26	0.66	-4.67*
37. Visioning	0.64	0.20	0.61	0.75	0.18	0.49	-3.41*
38. Systems Perception	0.60	0.21	0.64	0.80	0.17	0.44	-6.05*
39. Identification of Downstream Consequences	0.58	0.22	0.72	0.74	0.21	0.61	-4.26*

Table 3-15 (continued)

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Basic and Cross-Functional Skills

Descriptor	Incumbent M	Incumbent SD	Incumbent r_k	Analyst M	Analyst SD	Analyst r_k	t
40. Identification of Key Causes	0.76	0.20	0.69	0.89	0.10	0.10	-4.89*
41. Judgment and Decision Making	0.74	0.22	0.75	0.91	0.10	0.15	-5.52*
42. Systems Evaluation	0.53	0.26	0.77	0.67	0.24	0.67	-3.79*
43. Time Management	0.85	0.17	0.75	0.92	0.11	0.38	-2.90*
44. Management of Financial Resources	0.46	0.27	0.83	0.52	0.29	0.76	-1.09
45. Management of Material Resources	0.52	0.27	0.84	0.86	0.17	0.61	-9.22*
46. Management of Personnel Resources	0.67	0.21	0.71	0.55	0.32	0.83	2.19*

Note. Incumbent statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents=18.51, median=12, harmonic mean=9.01). Analyst statistics are based on the same 35 occupations with Skills questionnaire responses from at least 6 analysts (mean number of analysts=10.29, median=12.0, harmonic mean=8.66). The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
The t statistic tests for differences in the incumbent and analyst group means.
*p < .05

Table 3-16

Principal Components Analysis Pattern Matrix for the Analyst Level Scale: Basic and Cross-Functional Skills

	Descriptor	Factor F1	F2	Communality
1.	Reading Comprehension	.84	.05	.71
2.	Active Listening	.87	-.28	.84
3.	Writing	.93	-.03	.86
4.	Speaking	.93	-.14	.88
5.	Mathematics	.55	.35	.42
6.	Science	.37	.72	.65
7.	Critical Thinking	.93	.24	.92
8.	Active Learning	.92	.28	.92
9.	Learning Strategies	.88	.05	.79
10.	Monitoring	.94	.11	.90
11.	Social Perceptiveness	.78	-.44	.80
12.	Coordination	.94	-.02	.89
13.	Persuasion	.89	-.16	.82
14.	Negotiation	.89	-.16	.82
15.	Instructing	.87	.03	.75
16.	Service Orientation	.60	-.57	.68
17.	Problem Identification	.86	.37	.87
18.	Information Gathering	.89	.09	.80
19.	Information Organization	.83	.06	.69
20.	Synthesis/Reorganization	.88	.24	.84
21.	Idea Generation	.94	.26	.95
22.	Idea Evaluation	.95	.25	.95
23.	Implementation Planning	.95	.13	.92
24.	Solution Appraisal	.92	.30	.94
25.	Operations Analysis	.76	.52	.85
26.	Technology Design	.30	.80	.74
27.	Equipment Selection	.40	.84	.86
28.	Installation	.08	.84	.71
29.	Programming	.31	.48	.32
30.	Testing	.24	.92	.89
31.	Operation Monitoring	-.20	.88	.82
32.	Operation and Control	-.06	.78	.61
33.	Product Inspection	.42	.77	.76
34.	Equipment Maintenance	-.35	.79	.75
35.	Troubleshooting	.02	.95	.90
36.	Repairing	-.32	.81	.77
37.	Visioning	.95	.19	.94
38.	Systems Perception	.94	.17	.91
39.	Identification of Downstream Consequences	.94	.17	.92
40.	Identification of Key Causes	.93	.21	.90

Table 3-16 (continued)
Principal Components Analysis Pattern Matrix for the Analyst Level Scale: Basic and Cross-Functional Skills

	Descriptor	Factor F1	F2	Communality
41.	Judgment and Decision Making	.94	.14	.90
42.	Systems Evaluation	.94	.14	.90
43.	Time Management	.91	-.01	.82
44.	Management of Financial Resources	.77	-.24	.66
45.	Management of Material Resources	.86	.18	.77
46.	Management of Personnel Resources	.91	.01	.83
	Eigenvalue	27	10	
	Percent of Variance	59.65	21.13	

Note. N = 35. The correlation matrix was based on means calculated at the job level. F1 = Cognitive and Organizational Skills, F2 = Technical Skills. These loadings are based on an orthogonal varimax rotation.

Table 3-17a

Comparison of Level Scale Ratings for Occupations With Different Educational Requirements: Basic and Cross-Functional Skills

	High School (n = 19)		Post-Secondary (n = 16)			
Descriptor	M	SD	M	SD	t	F
1. Reading Comprehension	3.87	0.74	5.06	0.56	-5.41*	1.71
2. Active Listening	3.81	0.86	4.82	0.76	-3.68*	1.29
3. Writing	3.14	0.85	4.62	0.69	-5.67*	1.53
4. Speaking	3.73	0.72	4.75	0.47	-5.02*	2.33
5. Mathematics	2.70	1.08	3.92	0.89	-3.64*	1.47
6. Science	0.76	0.60	2.44	1.44	-4.35*	5.77*
7. Critical Thinking	2.96	0.61	4.54	0.70	-7.04*	1.32
8. Active Learning	2.84	0.71	4.53	0.83	-6.38*	1.39
9. Learning Strategies	3.33	0.75	4.43	0.71	-4.45*	1.12
10. Monitoring	2.57	0.96	4.08	0.89	-4.81*	1.16
11. Social Perceptiveness	3.17	0.88	4.15	1.08	-2.90*	1.51
12. Coordination	2.87	0.82	4.40	0.66	-6.10*	1.52
13. Persuasion	2.49	0.92	4.01	0.81	-5.16*	1.29
14. Negotiation	2.32	0.83	3.58	1.37	-3.21*	2.73*
15. Instructing	3.24	0.96	4.42	0.85	-3.84*	1.27
16. Service Orientation	2.88	0.65	3.76	1.19	-2.65*	3.32*
17. Problem Identification	3.44	0.84	5.01	0.59	-6.49*	2.00
18. Information Gathering	3.19	0.83	4.79	0.55	-6.80*	2.32
19. Information Organization	2.62	0.81	3.92	1.00	-4.16*	1.51
20. Synthesis/ Reorganization	2.49	0.79	4.13	0.81	-6.01*	1.05
21. Idea Generation	2.46	0.90	4.35	0.75	-6.78*	1.45
22. Idea Evaluation	2.29	0.79	4.01	1.03	-5.44*	1.70
23. Implementation Planning	1.97	0.73	3.86	1.28	-5.26*	3.09*
24. Solution Appraisal	2.17	0.83	4.04	1.26	-5.09*	2.31
25. Operations Analysis	1.23	0.61	2.95	1.45	-4.42*	5.57*
26. Technology Design	0.98	0.74	2.68	1.45	-4.25*	3.79*
27. Equipment Selection	1.90	1.02	3.36	1.22	-3.81*	1.42
28. Installation	0.83	1.13	1.83	1.80	-1.93	2.52
29. Programming	0.48	0.43	1.25	1.65	-1.80	14.80*
30. Testing	0.94	1.02	2.23	1.88	-2.45*	3.39*
31. Operation Monitoring	1.41	1.58	2.02	1.93	-1.01	1.50
32. Operation and Control	1.79	1.25	2.37	1.51	-1.22	1.46
33. Product Inspection	1.81	1.21	2.90	1.27	-2.57*	1.10
34. Equipment Maintenance	1.35	1.40	2.05	1.84	-1.25	1.74
35. Troubleshooting	1.52	1.16	3.11	1.94	-2.86*	2.80*
36. Repairing	0.89	1.13	1.85	1.73	-1.92	2.35
37. Visioning	1.91	0.92	2.84	1.21	-2.53*	1.73
38. Systems Perception	1.66	0.87	2.90	1.27	-3.33*	2.13

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Table 3-17a (continued)
Comparison of Level Scale Ratings for Occupations With Different Educational Requirements: Basic and Cross-Functional Skills

Descriptor	High School (n = 19) M	High School (n = 19) SD	Post-Secondary (n = 16) M	Post-Secondary (n = 16) SD	t	F
39. Identification of Downstream Consequences	1.64	0.73	2.84	1.21	-3.49*	2.76*
40. Identification of Key Causes	2.46	0.88	4.00	0.89	-5.15*	1.01
41. Judgment and Decision Making	2.08	0.83	3.94	1.08	-5.64*	1.69
42. Systems Evaluation	1.30	0.77	2.88	1.43	-3.96*	3.48*
43. Time Management	2.90	0.85	4.45	0.95	-5.05*	1.25
44. Management of Financial Resources	1.22	1.09	2.57	1.61	-2.83*	2.18
45. Management of Material Resources	1.41	1.09	2.57	1.26	-2.88*	1.34
46. Management of Personnel Resources	2.06	0.96	3.39	1.49	-3.07*	2.39

Note. Incumbent statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.51, median = 12, harmonic mean = 9.01). Nineteen occupations had educational requirements of high school or less; 16 required some post-secondary training.
The t statistic tests for differences in the low and high educational requirement group means.
The F statistic tests for differences in the low and high educational requirment group standard deviations.
*$p < .05$

Table 3-17b

Comparison of Level Scale Ratings for General Office Clerks in Organizations Rated as High-Performance or Not High-Performance: Basic and Cross-Functional Skills

Descriptor	Not High-Performance (n = 18) M	SD	High-Performance (n = 20) M	SD	t	F
1. Reading Comprehension	4.22	1.52	4.10	1.48	0.25	1.05
2. Active Listening	3.89	1.64	3.60	1.67	0.54	1.04
3. Writing	3.17	1.58	3.45	1.73	-0.53	1.20
4. Speaking	2.89	1.97	3.95	1.39	-1.90	2.01
5. Mathematics	2.56	2.12	2.70	1.81	-0.22	1.37
6. Science	0.17	0.51	0.35	0.99	-0.73	3.77*
7. Critical Thinking	2.33	2.09	3.30	2.13	-1.41	1.04
8. Active Learning	2.72	2.22	2.60	2.01	0.18	1.22
9. Learning Strategies	2.72	1.71	3.09	2.02	-0.61	1.40
10. Monitoring	1.67	1.57	2.40	2.09	-1.23	1.77
11. Social Perceptiveness	2.11	1.91	2.95	1.93	-1.35	1.02
12. Coordination	2.00	2.06	3.05	1.88	-1.64	1.20
13. Persuasion	1.39	1.82	2.35	2.03	-1.54	1.24
14. Negotiation	1.00	1.33	2.10	1.94	-2.05	2.13
15. Instructing	3.62	1.68	3.00	2.03	1.03	1.46
16. Service Orientation	2.11	2.03	3.55	2.28	-2.06*	1.26
17. Problem Identification	3.50	1.38	3.80	1.91	-0.56	1.92
18. Information Gathering	3.39	1.79	3.70	1.72	-0.55	1.08
19. Information Organization	2.17	2.31	2.85	2.16	-0.94	1.14
20. Synthesis/ Reorganization	2.33	1.14	2.85	1.81	-1.06	2.52
21. Idea Generation	1.33	1.68	2.10	1.68	-1.40	1.00
22. Idea Evaluation	2.33	1.53	2.80	1.59	-0.72	1.08
23. Implementation Planning	0.78	1.40	1.80	1.99	-1.85	2.02
24. Solution Appraisal	2.11	1.57	2.55	1.79	-0.81	1.30
25. Operations Analysis	1.00	1.71	1.40	2.01	-0.66	1.38
26. Technology Design	0.00	0.00	0.35	0.88	-1.79	0.00
27. Equipment Selection	1.44	2.06	1.85	2.08	-0.60	1.02
28. Installation	0.44	1.42	0.35	0.93	0.24	2.33
29. Programming	0.28	0.75	0.40	1.27	-0.36	2.87*
30. Testing	0.50	1.54	0.35	1.09	0.34	2.00
31. Operation Monitoring	0.50	1.47	0.75	1.74	-0.48	1.40
32. Operation and Control	1.67	1.41	1.85	1.60	-0.38	1.29
33. Product Inspection	0.89	1.37	1.95	2.11	-1.85	2.37
34. Equipment Maintenance	0.61	1.14	1.05	1.93	-0.86	2.87*
35. Troubleshooting	1.00	2.09	1.25	1.77	-0.40	1.39
36. Repairing	0.39	0.92	0.85	1.46	-1.18	2.52
37. Visioning	1.61	1.61	1.20	1.64	0.78	1.04
38. Systems Perception	1.44	1.65	1.35	1.84	0.17	1.24

Table 3-17b (continued)

Comparison of Level Scale Ratings for General Office Clerks in Organizations Rated as High-Performance or Not High-Performance: Basic and Cross-Functional Skills

Descriptor	Not High-Performance (n = 18) M	SD	High-Performance (n = 20) M	SD	t	F
39. Identification of Downstream Consequences	1.00	1.33	0.90	1.55	0.21	1.36
40. Identification of Key Causes	1.22	1.73	1.70	1.81	-0.83	1.09
41. Judgment and Decision Making	1.11	1.37	1.80	2.09	-1.21	2.33
42. Systems Evaluation	0.89	1.41	1.25	1.77	-0.70	1.58
43. Time Management	2.61	2.40	3.20	2.46	-0.75	1.05
44. Management of Financial Resources	0.78	1.59	1.55	2.01	-1.32	1.60
45. Management of Material Resources	0.22	0.55	1.35	2.06	-2.36*	14.03*
46. Management of Personnel Resources	1.22	1.40	1.37	1.72	-0.29	1.51

Note. Statistics are based on Skills questionnaire responses from 20 incumbents in 10 organizations scoring in the upper quartile on a composite of organizational performance-related factor scores (high-performance), and 18 incumbents in 9 organizations scoring in the lower quartile (not high-performance).

The t statistic tests for differences in the group means.

The F statistic tests for differences in the group standard deviations.

*p < .05

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Table 3-17c

Comparison of Level Scale Ratings for First Line Supervisors, Clerical/Administrative in Organizations Rated as High-Performance or Not High-Performance: Basic and Cross-Functional Skills

Descriptor	Not High-Performance (n = 15) M	SD	High-Performance (n = 15) M	SD	t	F
1. Reading Comprehension	5.33	0.82	4.40	1.12	2.61*	1.87
2. Active Listening	5.60	0.74	5.27	1.03	1.02	1.94
3. Writing	4.86	0.83	5.13	1.06	-0.79	1.63
4. Speaking	5.13	0.99	4.80	0.86	0.98	1.33
5. Mathematics	3.47	1.73	3.13	1.06	0.64	2.66
6. Science	1.53	1.64	0.53	1.36	1.82	1.45
7. Critical Thinking	4.67	1.05	4.20	1.37	1.05	1.70
8. Active Learning	4.47	1.60	3.67	1.76	1.30	1.21
9. Learning Strategies	4.20	1.90	4.33	1.18	-0.23	2.59
10. Monitoring	4.40	1.55	4.80	1.26	-0.77	1.51
11. Social Perceptiveness	5.00	1.07	4.73	1.62	0.53	2.29
12. Coordination	4.80	0.94	4.40	2.32	0.62	6.09*
13. Persuasion	4.80	0.77	4.20	1.57	1.33	4.16*
14. Negotiation	4.60	1.06	3.87	1.88	1.31	3.15*
15. Instructing	4.81	1.14	3.80	1.47	2.10*	1.66
16. Service Orientation	4.47	1.46	3.47	2.13	1.50	2.13
17. Problem Identification	5.13	1.19	3.53	2.07	2.60*	3.03*
18. Information Gathering	5.27	1.22	4.37	1.34	1.90	1.21
19. Information Organization	4.80	1.32	3.20	2.04	2.55*	2.39
20. Synthesis/ Reorganization	4.73	1.44	4.13	1.06	1.30	1.85
21. Idea Generation	5.00	1.07	4.33	1.59	1.35	2.21
22. Idea Evaluation	4.67	1.11	3.60	1.68	2.05	2.29
23. Implementation Planning	4.67	1.23	4.13	1.36	1.13	1.22
24. Solution Appraisal	4.53	1.19	3.80	2.08	1.18	3.06*
25. Operations Analysis	3.80	2.31	2.53	2.33	1.50	1.02
26. Technology Design	1.87	2.13	1.53	2.03	0.44	1.10
27. Equipment Selection	3.00	2.36	2.20	2.27	0.95	1.08
28. Installation	1.33	1.91	1.07	1.98	0.37	1.07
29. Programming	1.07	2.05	0.73	1.28	0.53	2.57
30. Testing	1.80	2.43	1.00	1.69	1.05	2.07
31. Operation Monitoring	1.53	2.13	1.27	1.83	0.37	1.35
32. Operation and Control	1.80	1.57	2.20	1.70	-0.67	1.17
33. Product Inspection	3.27	1.94	2.67	2.26	0.78	1.36
34. Equipment Maintenance	1.33	2.13	1.53	2.13	-0.26	1.00
35. Troubleshooting	2.13	2.26	1.93	2.34	0.24	1.07
36. Repairing	1.20	1.90	1.47	1.85	-0.39	1.05
37. Visioning	3.93	1.49	2.67	1.88	2.05	1.59
38. Systems Perception	3.73	2.12	3.47	2.29	0.33	1.17

Table 3-17c (continued)
Comparison of Level Scale Ratings for First Line Supervisors. Clerical/Administrative in Organizations Rated as High-Performance or Not High-Performance: Basic and Cross-Functional Skills

Descriptor	Not High-Performance (n = 15) M	SD	High-Performance (n = 15) M	SD	t	F
39. Identification of Downstream Consequences	4.07	1.98	3.20	2.24	1.12	1.28
40. Identification of Key Causes	4.87	1.41	3.87	1.68	1.77	1.47
41. Judgment and Decision Making	5.13	1.41	4.00	1.65	2.03	1.37
42. Systems Evaluation	4.60	1.99	2.53	1.85	2.95*	1.16
43. Time Management	5.13	1.19	5.07	1.83	0.12	2.36
44. Management of Financial Resources	4.00	2.56	3.13	2.10	1.01	1.49
45. Management of Material Resources	3.93	2.15	2.60	1.76	1.85	1.49
46. Management of Personnel Resources	5.33	1.59	5.27	1.44	0.12	1.22

Note. Statistics are based on Skills questionnaire responses from 15 incumbents in 10 organizations scoring in the upper quartile on a composite of organizational performance-related factor scores (high-performance), and 15 incumbents in 8 organizations scoring in the lower quartile (not high-performance).
The t statistic tests for differences in the group means.
The F statistic tests for differences in the group standard deviations.
*p < .05

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Chapter 4

Knowledges:

Evidence for the Reliability and Validity of the Measures

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Occupational knowledge is an important element in the understanding and description of virtually all occupations in the workplace. The study of occupational knowledge can provide important information for a variety of activities in the domain of work, including training, career counseling, selection and person/job matching. While knowledge is, by definition, domain-specific, the job-relevant knowledges taxonomy was developed to be domain-specific yet still broad enough to be useful in describing and categorizing a variety of different occupations. This chapter briefly describes the development of a taxonomy of job-required knowledges and its associated measurement system as well as the results from the initial O*NET data collection effort. In this chapter, we begin by briefly reviewing the development of the knowledges taxonomy and its measures. (A complete account of the conceptual background, previous research on the knowledge domain, and the development process has been presented in a

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previous report; see Fleishman, Costanza, Marshall-Mies, Wetrogan, Uhlman, 1995). Next, we describe the results obtained with the knowledge taxonomy and measurement system, when these were used to describe occupations in the present O*NET study. Finally, we discuss some of the implications of these results on further development of the O*NET system.

Knowledge is defined as a collection of discrete but related facts, information, and principles about a certain domain. Knowledge is acquired through formal education or training, or accumulated through specific experiences. The fact that these pieces of information are organized into a coherent structure is critical to this definition. Further, some knowledges are more general than others in that they are important to successful performance in a greater variety of jobs in the economy. Other knowledges are more specific and apply to a narrower range of occupations.

Therefore, in developing a taxonomy of knowledges for describing job requirements, it was important to deal with the issue of the specificity level needed to provide a comprehensive but parsimonious taxonomic system. Ideally, one would strive to make uniform the level of specificity of the knowledge constructs, so that they are broad enough to cover multiple domains, but not so encompassing that they are of limited use as components of a knowledge taxonomy.

Background

The knowledges used in the O*NET data collection effort evolved from an earlier effort by Costanza and Fleishman (1992) that attempted to describe and measure a wide variety of job-relevant knowledge areas. The intent of this effort was to identify, define, classify, and create a measurement system for job knowledge areas that in turn could be used in any of a variety of job-related activities. The original development effort and the additional steps taken to adapt the knowledge scales for the present effort are summarized below.

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Taxonomy

In the previous work by Costanza and Fleishman (1992), original knowledges were developed using a four step process. First, a broad literature search was conducted to find previously identified job knowledges. Unfortunately, much of the literature has focused on the nature of the structures, and the processes involved in developing and analyzing knowledge, rather than on taxonomies of knowledges themselves. While several existing taxonomies (e.g., Prediger, 1989; Peterson, 1992) provided some initial possible candidate knowledges, it was apparent that an empirical approach to developing the taxonomy might be more appropriate and pragmatic. Accordingly, the approach of analyzing descriptions from as many occupations as possible and looking for tasks and/or behaviors that were representative of underlying knowledges was adopted. Not surprisingly, a particularly useful source of occupation descriptions, in which the most occupations were explicitly identified and described, was the Department of Labor's Dictionary of Occupational Titles (DOT; Department of Labor, 1991).

Therefore, the second step was to thoroughly review the DOT and to extract from the occupation descriptions an initial list of job knowledges. Each occupation description in the DOT was read and examined and any knowledges that were listed or implied in the tasks described were extracted. This analysis of the DOT occupation descriptions yielded 68 qualitatively different knowledges. Other research efforts (e.g., Prediger, 1989; McKinney & Greer, 1985; Campbell, Ford, Rumsey, Pulakos, Borman, Felker, De Vera, & Riegelhaupt, 1990; Fleishman, 1992) were again reviewed to identify additional knowledges, and candidates were added to the list. The list was checked for omissions, ambiguities, or redundancies and combined into a preliminary taxonomy of 86 knowledges. Once the list of knowledges had been developed, prototype task examples indicating high, medium, and low amounts of the knowledge were generated using the occupation descriptions from which the knowledges came.

At this stage, it became clear that the level of specificity still varied somewhat across the knowledges. Further, it appeared that the knowledges seemed to be grouped around several broader, superordinate areas. Hence, the third step in the development process consisted of a search to identify existing taxonomies of job families or job groups into which the knowledges could be categorized. By grouping the knowledges into larger categories based on similarity, the specificity issue could be addressed to improve the usefulness of the taxonomy. This effort yielded seven superordinate categories--artistic/creative, business/administrative, mechanical/ skilled trades, outdoor work, professional, scientific, and service sector--which appeared to capture many of the proposed knowledges. The initial knowledges were sorted into these seven categories and again reviewed for completeness, ambiguity, and reasonableness. As a result of this review, the knowledges were consolidated into 52 knowledges.

Step four consisted of the identification and development of task examples to help in the rating of the levels of the job knowledges required for different occupations and tasks. The format for developing rating scales for the 52 knowledges followed that developed by Fleishman (1975a, b; 1992), for rating ability requirements (Fleishman & Quaintance, 1984), and Fleishman & Mumford (1988). The list of sample tasks developed during the DOT review was revised and shortened and a survey of the tasks for the 52 remaining knowledges was developed. Nineteen raters completed a survey in which they were asked to make two determinations about each task for a given knowledge: 1) if the task required any amount of the knowledge; and, if so, 2) on a scale of 1 to 7, how much of the knowledge is required for performance of the task. The results of this rating process yielded high reliabilities (.89 to .98), a good range of means with low standard deviations, allowing for accurate task anchoring, and a consensus that several of the knowledges should be combined. This resulted in the final list of 49 knowledges (two were combined and one was deleted based on rater feedback). Based on the task ratings, anchors with high reliabilities, appropriate (high, medium, low) means and small standard deviations were chosen to anchor each of the scales. The scales were incorporated into the Fleishman Job Analysis Survey (F-JAS) (Fleishman, 1992; Costanza & Fleishman, 1992) as part of this job analysis system.

At this stage in their development, the 49 knowledge scales from the F-JAS were used in several efforts to describe and understand job performance. One study of 75 occupations involved 18 of the knowledge scales (Hauke, Costanza, Baughman, Mumford, Stone, Threlfall, & Fleishman, 1995). In this effort, a major governmental agency was interested in validating the key selection measures used by the agency for entry-level positions. The inclusion of the knowledge scales substantially improved the prediction, overall quality, and parsimony of both the occupation description and of an effort to cluster occupations according to ability and knowledge requirements. In another effort, the knowledge scales were used in a study of several State Police jobs (Trooper, Corporal, Sergeant, Lieutenant). Again, interrater reliabilities for knowledge profiles were from .90 to .95 when 23 raters were used (Wetrogan, Uhlman, & Fleishman, 1995) and the knowledge profiles obtained helped differentiate the occupations. Based on the above, it was concluded that the initial development effort had produced a potentially reliable and useful taxonomy for describing and analyzing occupation requirements.

Sample and Measures

For the present project, the 49 knowledge scales were initially pre-tested by DOT project staff on a sample of job incumbents from approximately 30 occupations. This pilot

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administration and subsequent feedback from the Occupational Analysis Field Centers (OAFCs) found that while the scales evidenced sufficient reliability, there was room for improvement in the taxonomy and rating scales. Accordingly, the knowledges were systematically reviewed and edited, and the knowledges, the measurement scales, and the instructions for completing these scales were also revised to maximize their usefulness for the present effort and to improve their overall reliability and validity. To accomplish this, the extant literature was again reviewed, the knowledges, knowledge clusters, and rating scales were revised, as were the rating scales, and knowledge specialty areas were identified and incorporated into the scales. These steps are briefly described below.

Several new sources in the literature were identified, although as before, they did not provide a direct list of knowledges. Among these sources were the SCANS list of skills needed for employment (Peterson, 1992) and the list of competencies in the Multipurpose Occupational Systems Analysis Inventory--Close-ended (MOSAIC) (Corts & Gowing, 1992). While these systems are broader in definition than is desired for the current effort, a mapping of these skills and competencies against the knowledge taxonomy confirmed that no major knowledges had been omitted in the taxonomy.

Next, the knowledges and knowledge clusters were revised. The goal was to develop a more parsimonious set of knowledges classified into broader clusters using the pilot data as a guide. One means of establishing the content validity of the knowledge classification scheme was to compare the original classification with that created using an independent methodology. An appropriate and convenient comparison was to the National Occupational Information Coordinating Committee (NOICC) hierarchical clustering of 244 National Units of Analysis (NUAs). This clustering hierarchy provides a mechanism for matching job market demand and institutional supply data gathered at the state level by State Occupational Information Coordinating Committees (SOICC).

Although there were some differences, the NOICC data and the knowledges taxonomy were similar in terms of the numbers and content of knowledge clusters and knowledges. A direct comparison of the knowledges and NOICC structures provided additional information related to the comprehensiveness and level of specificity of the knowledges. Each of the knowledges was mapped onto the NOICC groups. This effort demonstrated that the knowledges covered all areas covered by the NOICC system. The differences between the two that did manifest themselves were carefully reviewed. Based on this evaluation, the information gleaned from the new literature review, and the desire to reduce demands on raters, several of the 49 knowledges were combined. The result was the final list of 33 knowledges. These knowledges are listed in Figure 4-1. Within each of these 33 knowledges, job specialty requirements were identified and listed.

Responses from the pilot administration also indicated that the knowledges differed in their applicability across occupations. That is, some of the knowledges appeared to be applicable to a broader range of occupations, whereas other knowledges seemed to apply to a narrower range of occupations. Therefore, a decision was made to organize the scales in a more meaningful way. Another review and ratings by an independent panel led to a rearrangement of the scales, such that more general cross-occupational knowledges appear first, followed by the more occupation-specific knowledges. This ensured that the raters would be more likely to encounter knowledges relevant to their jobs earlier in the survey.

In revising the scales, the improvements in the rating scales were pursued while trying to maintain the integrity of the original development process. Another independent panel reviewed

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and then edited each knowledge rating scale including the knowledge definition, the high and low level descriptors, and the task anchors. In addition to revising the knowledge scale content, the editing process was designed to increase the scales' clarity and make the reading level more appropriate for incumbents whose jobs require less demanding reading levels and cognitive skills. Scale anchors were checked and, if necessary, replaced to make them less esoteric and more readily identifiable by different incumbent populations. Other anchors were reviewed to ensure that they reflected sufficient amounts of the knowledge required and did not appear trivial to job incumbents. This completed the revision and modification process of the knowledge scales for use in the O*NET data collection. As noted above, job knowledge specialty areas were identified and administered to the job incumbents, but those data were not analyzed at this stage in the project.

Both incumbents and analysts were asked to make two ratings for each of the job knowledges. First, they were asked to rate the <u>level</u> of the knowledge required for the job, using a one to seven scale. They were given a "Does not apply" option whereby they could rate a particular knowledge zero if no level was required. Second, the raters were asked to rate the <u>importance</u> of the knowledge for job performance, using a one to five scale. If the raters responded "zero" to the level question, they were instructed to skip the importance rating. The ratings were gathered using the scaling format developed earlier by Fleishman (1975b) and described elsewhere (Fleishman & Quaintance, 1984; Fleishman & Mumford, 1991; Fleishman et al., 1995). For each knowledge, the scale provided a construct definition, clarification statements defining high and low knowledge levels requirements, and task anchors (as developed and described above) at different points on the scale. An example of one of the knowledge rating scales is presented in Figure 4-2. Note that respondents were asked to indicate the relevance of each of several job specialty requirements if they had rated the general knowledge area as relevant; however, those data are not analyzed here.

In the initial data collection effort, two sets of judges were used to provide ratings on the knowledges for a variety of occupations. The first sample included job incumbents from 80 occupations. These occupations were selected using a stratified random sampling procedure designed to represent over 770 occupations and 45% of the employed U.S. population. Because of the desire for reliability and stability of the ratings, only occupations for which at least four (4) incumbents provided ratings were used. This criteria resulted in a final sample of 649 incumbents from 33 of the occupations. These 33 occupations are listed in Figure 4-3.

The second set of judges consisted of occupational analysts provided by the OAFCs. In this sample, at least six analysts were asked to rate the knowledge requirements for each of the 80 occupations. Because of the limited number of occupations represented in the first sample, analyses were carried out only on the analysts' ratings for the same 33 occupations represented in the incumbent sample. The final number of analysts ratings was 324, although in many cases, analysts rated more than one occupation each.

Results

Descriptive Statistics

Table 4-1 presents the means, standard deviations, standard error of measurements, and interclass correlations for both the level and importance scales for the 33 knowledges. Because these results are averaged across 33 occupations, only broad patterns of responses can be interpreted. For example, the knowledges with the three highest level ratings, Clerical (Descriptor #2) (M = 3.30), English Language (Descriptor #24) (M = 3.18), and Mathematics (Descriptor #14) (M = 2.93), are all more general knowledge areas that might apply to a wide variety of government or public service jobs. These three were also rated the highest of importance (M = 2.83, 2.98, and 2.82 respectively). On the other hand, those knowledges receiving the lowest ratings were some of the more esoteric ones such as Fine Arts (Descriptor #26) (M = .58), Food Production (Descriptor #8) (M = .68), and History and Archeology (Descriptor #27) (M = .71) that might be expected to be necessary for only a few specific occupations. These results provide the first evidence that the knowledges were acting as intended; that is, tapping relatively domain-specific knowledge areas that might help better differentiate among occupations. This point is further supported by the relatively high standard deviations for the seven-point level and five point importance scale, indicating a broad range of responses for most of the knowledges. The average SD for level was almost two (SD = 1.94) and for importance was over one (SD = 1.11).

Reliability

The intraclass correlations (reliabilities) in Table 4-1 reflect the general agreement found among the job incumbents across occupations. The majority of the reliabilities for level and importance were above .80 (minimum = .37, maximum = .95) and those that exhibited unusually low reliabilities were also the same ones that had the lowest mean ratings, such as Food Production (Descriptor #8) (r_k = .54, level) and Fine Arts (Descriptor #26) (r_k = .63, importance). Given these relatively high overall reliabilities, it is not surprising that the standard error of measurement results were reasonable, with almost all being below 1.0 for level ratings and .75 for importance ratings.

Table 4-2 shows the reliability estimates for each knowledge and rating, for one and 30 raters. The results here are consistent with the observed (k-rater) reliabilities; one-rater reliabilities are mostly in the .20s and .30s, the exceptions being those relatively low-rated knowledges such as Foreign Language (Descriptor #25) (r_k = .05). The reliabilities for 30 raters were consistently in the .80s and .90s.

Scoring

In an effort to assess whether the scale itself had any impact on the ratings, reliability estimates were calculated on the incumbent data for three variations of the level scale: one (low) to seven (high), zero (not relevant) to seven (high), and zero (not relevant) to one (relevant). The results of this analysis are presented in Table 4-3. In general the reliabilities were relatively high regardless of the scale type used. However, one interesting finding from this analysis was that for several of the knowledges with especially low mean ratings and reliabilities (e.g., Food Production [Descriptor #8], Foreign Language [Descriptor #25], and Fine Arts [Descriptor #26]), the reliabilities increased substantially when the alternate scales were used. For example, the reliability of the level ratings on Food Production (Descriptor #8) was .54 with the zero to seven scale, but .81 with one to seven and was still .71 with zero-one. It appears that the raters were in relatively more disagreement as to whether or not these knowledges were relevant at all than about their appropriate level, if they thought it was relevant. This suggests that we might need to be cautious in the use of these less common knowledge areas given their somewhat lower reliabilities.

Analyses of Variance

Table 4-5 shows the overall agreement among incumbents, when calculated across all occupations and knowledges, based on the analysis of variance (ANOVA) results shown in Tables 4-4a and 4-4b. This reliability was similar for both level and importance ratings (r_k = .85 and .86, respectively). Again, the Spearman-Brown formula was used to estimate the reliability for one and 30 raters with the results for both scale types also similar--.40 and .39 for one rater and .95 and .94 for 30 raters. Overall, these numbers suggest that given a sufficient number of raters, all of the knowledge scales can be reliably rated by incumbents from a wide variety of occupations.

The ANOVA results from Tables 4-4a and 4-4b add further indications that the knowledges do serve to help differentiate occupations. Both level and importance demonstrated significant differences between and within occupations across knowledges. For example, the level scale showed significant differences across occupations ($F = 3.79$, $p < .05$), within occupations across knowledges ($F = 66.50$, $p \leq .01$), and for the interaction between the two ($F = 6.90$, $p < .05$). The importance scale evidenced similar results with differences across occupations ($F = 3.46$, $p < .05$), across knowledges within occupations ($F = 70.91$, $p < .01$), and the interaction between the two ($F = 6.74$, $p < .05$), all significant. This pattern continued when the knowledges were aggregated to the higher level of 10 broad groupings by using the simple mean scores on the 33 descriptors combined into the ten higher-order categories (see Figure 4-1). Tables 4-6a and 4-6b show that, once again, both the level and importance scales showed significant differences between and within occupations and for the interaction between occupations and knowledges. Table 4-7 shows that the reliabilities for these higher level groupings are similar to those for the individual scales.

Descriptor and Scale Relationships

In order to further assess what relationships existed among the knowledge areas, correlations were run across occupations for both the level and importance scales at both the occupational and individual levels. A summarization of the correlations among the scales across descriptors and across occupations is presented in Table 4-8. These mean correlations are substantial: .95 for descriptors across occupations and .90 for occupations across descriptors.

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The correlations of descriptors within scales are presented in Tables 4-9a, 4-9b, 4-10a, and 4-10b. While the 33 by 33 matrices in these tables are a bit overwhelming, some interesting findings shine through. The occupation-level analysis in Table 4-9a of the level scale data shows that Administration and Management (Descriptor #1) was, as expected, highly correlated with the other knowledges in its a priori "cluster" of Business and Management, including Economics and Accounting (Descriptor #3) ($r = .66$) and Personnel and Human Resources (Descriptor #6) ($r = .84$), as well as with other conceptually related areas such as English Language (Descriptor #24) ($r = .71$), necessary for managerial communication, and Legal, Government, and Jurisprudence ($r = .52$). There also appeared to be an engineering "group" with Engineering and Technology (Descriptor #10) highly correlated with Design (Descriptor #11) ($r = .80$), Building and Construction (Descriptor #12) ($r = .75$), and Mathematics (Descriptor #14) ($r = .59$). Several other groupings emerged including one representing the Arts and Humanities cluster, where Foreign Language (Descriptor #25) and Fine Arts (Descriptor #26) were highly related ($r = .76$) as were English Language (Descriptor #24) and Philosophy and Theology (Descriptor #28) ($r = .69$). Overall, the level correlations seemed to support the a priori clusters grouping related knowledges together. The importance scale correlations were less systematic, although there were some similar patterns of correlations, especially in the Engineering and Technology (Descriptor #10) cluster and the Math and Science cluster.

The second interesting finding here is that there were almost no significant negative relationships among the knowledges. For example, one might have expected that when a job requires a very high level of Mathematical or Mechanical (Descriptor #13) knowledge, that other areas such as Fine Arts (Descriptor #26) or Philosophy and Theology (Descriptor #28) might be rated significantly lower. In fact, these relationships, as well as others like them, were generally in the .05 to .10 range, non-significant to be sure, but not negative either.

Tables 4-10a and 4-10b present the individual-level correlations, computed on a sample of four incumbents from each occupation (in order to balance the impact of each occupation on the matrix). Although the focus of the analyses reported in this chapter is on the usefulness and accuracy of the measure for occupational description, these tables are included for the reader's convenience.

Factor Structure

A factor analysis was conducted on the knowledges, both to see if the a priori groupings would be repeated empirically and to add additional information about the interpretation of the occupation description process. The knowledges were entered into a principal components analysis and the resulting scree plot and eigenvalues suggested that seven components/factors should be retained. These can be seen in Table 4-11. While there were fewer factors than a priori clusters, the final components were very clean and interpretable. The first factor was marked by Geography (Descriptor #20) ($r = .88$), Fine Arts (Descriptor #26) ($r = .86$), History and Archeology (Descriptor #27) ($r = .84$), English Language (Descriptor #24) ($r = .55$), and Foreign Language (Descriptor #25) ($r = .74$), among others. Accordingly, it was called arts and humanities. The second factor was equally identifiable and was termed science and technology by virtue of high loadings on Mechanical (Descriptor #13) ($r = .93$), Engineering and Technology (Descriptor #10) ($r = .92$), Physics (Descriptor #15) ($r = .74$), Chemistry (Descriptor #16) ($r = .63$), along with several other related knowledge areas. The principle knowledges for the third factor were Public Safety and Security (Descriptor #29) ($r = .86$) and Law, Government, and Jurisprudence (Descriptor #30) ($r = .86$), hence making it a law enforcement factor. Additionally, several other knowledges that might reasonably be expected to contribute to law enforcement also showed high loadings. These included elements of this work such as Sociology and Anthropology (Descriptor #19) (r = .62), Psychology (Descriptor #18) (r = .68), and Therapy and Counseling (Descriptor #22) (r = .44). This echoes the findings reported earlier regarding the mean level ratings for certain knowledges among Police Patrol Officers (see Table 4-12a).

The fourth factor was a clerical factor and was marked by high loadings for Clerical (Descriptor #2) (r = .81), English Language (Descriptor #24) (r = .67), Computers (r = .56), and Administration and Management (Descriptor #1) (r = .56), all relevant to various aspects of Clerical (Descriptor #2) work. The next factor was also clearly identifiable by its markers including Biology (Descriptor #17) (r = .94), Medicine and Dentistry (Descriptor #21) (r = .81), and Chemistry (Descriptor #16) (r = .72) as a medical factor. Interestingly, Education and Training (Descriptor #23) also loaded relatively highly on the factor (r = .45), suggesting that the medical personnel surveyed may have had some educational responsibilities as part of their jobs. Factor six was similar to factor four, except that it seemed to represent broader areas of administrative and managerial activities and therefore was named business administration. Knowledge areas here included Sales and Marketing (Descriptor #4) (r = .94), Customer and Personal Service (Descriptor #5) (r = .71), Economics and Accounting (Descriptor #3) (r = .57), Personnel and HR (r = .55), along with Administration and Management (Descriptor #1) (r = .50). The final factor was a little unusual with its one very high positive loading, Computers and Electronics (Descriptor #9) (r = .65), and one very high negative loading, Food Production (Descriptor #8) (r = -.77). Despite changes in technology, Food Production (Descriptor #8), the growing, producing, and preparation of food, remains a relatively "low-tech" domain, populated by many traditional, manual, or mechanical processes. Thus, as a knowledge area, Food

Production (Descriptor #8)can be seen as rather opposite to the high-tech areas of Computers and Electronics (Descriptor #9). For this reason, this factor was deemed high technology. In sum, the factors were able to account for 85% of the variance and produced clear and identifiable factors to describe the occupations of interest herein.

Occupation Differences

As noted above, the knowledges were designed to be relatively domain-specific. Therefore, by examining the descriptive statistics for specific occupations (as opposed to the averaged results in Table 4-1), we should begin to see that differentiation becomes apparent. Given the above, the results presented in Table 4-12a are most interesting. Means and standard deviations were calculated on the level scale for six occupations selected as examples; these included: (1) General Managers and Top Executives, (2) Computer Programmers, (3) Registered Nurses, (4) Police Patrol Officers, (5) Janitors and Cleaners, and (6) Maintenance Repairers, General Utility. The results support the specificity of the knowledge scales. For example, the knowledge area Administration and Management (Descriptor #1) showed an expectedly high mean for managers ($\underline{M} = 4.84$) and a low mean for Janitors ($\underline{M} = .88$). General Managers' jobs were also rated higher on knowledge requirements such as Personnel and Human Resources (Descriptor #6) ($\underline{M} = 4.52$), Customer and Personal Service (Descriptor #5) ($\underline{M} = 4.66$), and Economics and Accounting (Descriptor #3) ($\underline{M} = 3.94$). On the other hand, General Managers' jobs were rated low on the level of knowledge required for History and Archeology (Descriptor #27) ($\underline{M} = 1.00$) and Fine Arts (Descriptor #26) ($\underline{M} = .50$), both knowledge areas that most managers would be unlikely to need.

Computer Programmers rated high in the knowledge requirements one might expect, with Computers and Electronics (Descriptor #9) receiving the highest rating ($\underline{M} = 6.56$), with no other job greater than 3.2. The Mathematics (Descriptor #14) requirement rating was also highest (M = 4.67) for this job. Computers and Electronics (Descriptor #9) knowledge requirements were rated low for Maintenance Repairers (M = 1.61) and Janitors (M = 1.08). Nurses showed an expected pattern, with incumbents in these positions rating the knowledge requirements of Medicine and Dentistry (Descriptor #21) (M = 4.91), Psychology (M = 5.77), and Therapy and Counseling (Descriptor #22) (M = 4.50) highest. Interestingly, Police Officers also rated the requirement for Psychology (Descriptor #18) very high (M = 4.68) along with English Language (Descriptor #24) (M = 4.05), and, as expected, very high ratings for the levels of Public Safety and Security (Descriptor #29) (M = 5.79) and Law, Government, and Jurisprudence (Descriptor #30) (M = 5.00). These ratings reflect the primary activities of Police Officers in enforcing the law, and in mediating disputes and handling difficult, tense, and dangerous situations.

The Janitors' ratings were characterized by low ratings on almost all the knowledges including Design (Descriptor #11) (M = 1.77) and Mechanical (Descriptor #13) (M = 1.69), although the standard deviations were generally a bit higher than for the other example occupations. Maintenance Repairers rated the apparently most relevant knowledge, Mechanical (Descriptor #13) (M = 4.31), highest, along with the highest, but still moderate, ratings for Building and Construction (Descriptor #12) (M = 3.86), Design (Descriptor #11) (M = 2.72), and Engineering and Technology (M = 2.80). As with the overall ratings shown in Table 4-1, certain knowledges were rated very low by all six example jobs reflecting the relative rarity of these knowledge requirements among the sample occupations studied. These knowledges included areas such as Food Production (Descriptor #8), Fine Arts (Descriptor #26), and History and Archeology (Descriptor #27).

Table 4-12b shows the ratings obtained from incumbents using the importance scale applied to 33 knowledges for the same six jobs. The results here generally support those obtained from the level scale. This is to be expected given that the two scales were found to correlate at .90 across descriptors within jobs, and .95 across jobs within descriptors (see Table 4-8). Again, each occupation rated the same knowledges rated highest on level as most important. For example, Managers rated Administration and Management (Descriptor #1) ($\underline{M}$ = 4.04), Computer Programmers rated Computers and Electronics (Descriptor #9) ($\underline{M}$ = 4.67), Police rated Public Safety and Security ($\underline{M}$ = 4.53), and Maintenance Repairers judged Mechanical (Descriptor #13) ($\underline{M}$ = 3.31) as most important, respectively.

Discriminant Analyses

Having examined the descriptive statistics for the knowledges and a sample of occupations, we ran a series of multivariate analyses to better understand the overall pattern of relationships of the knowledge measures. Table 4-13 shows the results of the first of these: a discriminant function analysis. Here, the knowledges were used to discriminate among the occupations to see which knowledge areas were useful in differentiation. While most discriminant function analyses produce functions with multiple indicators, the present effort produced an unusual, though not surprising, result. As intimated by the above results, it was again found that the knowledges were successful in finding discrete differences between the 33 occupations in the sample. In fact, the results showed that the first 11 significant functions were marked by only one knowledge each. For example, the first function was characterized by only Clerical (Descriptor #2) knowledge ($\underline{r}$ = .93), the second by only Sales and Marketing (Descriptor #4) ($\underline{r}$ = .84), the third by only Public Safety and Security (Descriptor #29) ($\underline{r}$ = .84), and so on. In fact, among the first 11 functions, the next highest loading besides the primary one (where the average loading was .80) for each function was only .23. Accordingly, the functions were named for their unique identifying knowledge. This unique finding lead to correct classification into their occupations of 55% of the incumbents. The conclusion is that the knowledges seemed to be acting as designed; as unique, relatively domain-specific markers of one aspect of occupation description.

Convergence With Analysts' Ratings

As noted above, we were able to obtain ratings on the knowledges from both job incumbents and occupational analysts. This parallel data collection allowed for comparisons between the incumbent and occupational analyst responses. Overall, the results of these analyses allow us to come to similar conclusions about the occupations represented and the knowledge requirements. However, there are several differences and unique findings that are worth reporting. Most importantly, the analysts and the incumbents were generally in agreement with regards to their ratings assigned to the abilities. The average correlation across knowledges between the groups was .65 for both level and importance. This indicates that the two groups were in general agreement on the level and importance of the various knowledges across occupations.

As for specifics, Tables 14a and 14b shows a summary of the means, standard deviations, reliabilities, and several comparisons between the two set of respondent's ratings for the level and importance scale. There are several findings that emerge when examining these tables. First, for the level scale, the analysts tended to provide more reliable ratings ($\underline{M}_{analysts}$ = .86 vs. $\underline{M}_{incum.}$ = .76) despite the fact that there were fewer of them ($\underline{M}_{analysts}$ = 9.81 vs. $\underline{M}_{incum.}$ = 19.66) rating the target occupations relative to the number of incumbents. Nonetheless, both analysts' and incumbents' reliabilities were sufficiently high for the intended purposes.

The second finding is that there were a number of significant differences in both the mean ratings and the variance of those ratings between the two groups of raters. Overall, 20 of the t-tests showed significant differences as did 21 of the F variance tests. While for the most part the incumbents tended to rate the knowledges higher than did the analysts, there were several scales, including the levels of Mechanical (Descriptor #13) ($\underline{t}(971) = -6.51$) and Law, Government, and Jurisprudence (Descriptor #30) ($\underline{t}(971) = -5.11$) knowledge required where the analysts provided higher ratings. In general, however, the incumbents' ratings tended to be less than one-half a standard deviation higher than the analysts. Furthermore, the d^2 statistics show that the averaged, absolute mean score difference was generally about one point on the seven-point scale (using the square root of the mean d^2 as the indicator) and about .5 to .75 points on the five-point importance scale.

We ran a principal components analysis of the analyst data, using the same assumptions and rotation that had been used with the incumbent data. It was hoped that the comparison between the two solutions, based on analyst and incumbents, respectively, would shed some further light on the relationship between the ratings provided by these two groups. The results of this analysis are presented in Table 4-16, and, in general, the two groups' factors were relatively similar except for differences in the order in which the factors appeared. The first analyst factor was termed General Management, as it included the Business Administration knowledges along with several others. Specifically, this factor was marked by Personnel and HR ($\underline{r} = .88$), Administration and Management (Descriptor #1) ($\underline{r} = .87$), and Economics and Accounting (Descriptor #3) ($\underline{r} = .84$), as was the incumbent's factor. However, the analysts' factor also added English Language (Descriptor #24) ($\underline{r} = .72$) and Education and Training (Descriptor #23) ($\underline{r} = .69$), among others, making it a slightly broader representation of managerial knowledges. The second analyst factor was a narrower version of the incumbent's Science and Technology, here called Engineering, most prominently marked by Engineering and Technology (Descriptor #10) ($r = .91$), Physics (Descriptor #15) ($r = .91$), and Design (Descriptor #11) ($r = .84$). Analyst factor three continued the "not quite the same" trend with a broader version of the incumbent's Medicine factor. This grouping, called Allied Health Services included the Medicine and Dentistry (Descriptor #21) ($r = .95$), Biology (Descriptor #17) ($r = .86$), and Chemistry (Descriptor #16) ($r = .66$), but also added the Therapy and Counseling (Descriptor #22) ($r = .80$) and Psychology (Descriptor #18) ($r = .52$) knowledge areas.

The next factor was very similar to the Law Enforcement incumbent factor with similar markers such as Public Safety and Security (Descriptor #29) ($r = .60$) and Law, Government, and Jurisprudence (Descriptor #30) ($r = .56$), but it too was slightly broader with Geography (Descriptor #20) ($r = .82$) and Customer and Personal Service (Descriptor #5) ($r = .42$) loadings, along with no fewer than seven other knowledges with loadings above .30 (the cutoff for inclusion). Factor six, High Technology, was similar as well to an incumbent factor with high positive loadings on Computers and Electronics (Descriptor #9) ($r = .72$), Telecommunications (Descriptor #31) ($r = .65$), and negatively on Food Production (Descriptor #8) ($r = -.80$). Once again, there were a number of other knowledges loading highly including Transportation (Descriptor #33) ($r = .80$), Clerical (Descriptor #2) ($r = .57$) and Communications and Media (Descriptor #32) ($r = .32$). The final analyst factor was termed Clerical (Descriptor #2) and was notable for high positive loadings on English Language (Descriptor #24) ($r = .93$) and Clerical (Descriptor #2) ($r = .44$) and high negative loadings on Building and Construction (Descriptor #12) ($r = -.56$) and Mechanical (Descriptor #13) ($r = -.42$). This Clerical (Descriptor #2) factor

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was therefore described by both the presence of Clerical (Descriptor #2) knowledge areas and the extreme lack of certain outdoor and/or physical knowledge areas.

The above results suggest that, although the analysts seemed to provide more reliable ratings, their responses were a bit less cogent in terms of the relationships among the knowledges for the given set of occupations. For example, many of the analyst factors were less "clean" than were the incumbents', with sometimes extraneous or only tangentially related knowledges appearing on a factor. Further, the analysts' factor solution showed more loadings below .50 (34 for analysts vs. 26 for incumbents) and more negative loadings (10 vs. 4), suggesting that the analysts had a less clear picture of how the knowledges were related to each other within the given set of occupations. While the above is only a qualitative assessment, it does provide some evidence for both the general similarity of the incumbent and analysts ratings (the similar means and factor structures). At the same time there is some evidence that these two groups differed somewhat in their specific perceptions of the knowledge requirements for the rated occupations.

To see if analyst and incumbent ratings differed depending on the scale coding, means, standard deviations, reliabilities, and t-tests were calculated for each ability using the relevant/not relevant (zero-one) coding scheme. The results of this analysis are presented in Table 4-15 and show that analyst and incumbent ratings are fairly similar, even under this rescoring scheme.

Conclusions

The results reviewed here suggest that the proposed taxonomy of job-related knowledges is a useful descriptive and interpretative tool for trying to understand and measure the types and levels of various knowledges required in a wide variety of occupations. The Knowledge Requirements Taxonomy and measurement system described herein is based on an extension of the ability requirements approach developed by Fleishman and his colleagues (see Fleishman &

Quaintance, 1984; Fleishman, 1975, 1991; Fleishman & Mumford, 1991). This methodology has been used to develop constructs and associated measurement scales exhibiting high reliability, internal validity, and external validity. The knowledge scales were created beginning with a review of the cognitive, vocational, training, and job analysis literatures. Knowledge categories were broadened, narrowed, altered, or discarded based on the review, ratings, and comments of multiple professional psychologists. Task anchored measurement scales were also developed empirically so that the task anchors represented different levels of a particular knowledge and had high reliability with regard to their positions on the scales. Special attention was given to making the scales readable, understandable, and "user friendly."

The present study confirms that the knowledge scales developed have high reliabilities when used with job incumbents or with occupational analysts and further establishes their utility in describing and understanding worker performance for multiple jobs. The scales also appear useful in meaningfully classifying occupations in terms of the underlying knowledges needed to perform them. As part of the Department of Labor's new Occupational Information System, the knowledge taxonomy and measurement system should make an important contribution in the understanding of worker characteristics required to successfully perform a very wide variety of job tasks.

The inclusion of occupational specialty data with each rating scale in this study should allow linkage of the knowledges to other national occupational and educational databases. The present study showed how such linkages could be developed with the National Occupational Information Coordinating Committee (NOICC) clustering structure. This linkage provides a mechanism for matching job market demand and institutional supply data gathered by State Occupational Information Coordinating Committees (SOICC) with knowledge requirements.

Future work should be directed at examining these linkages more closely. The positive results obtained thus far are encouraging for further applications of these scales to define the knowledge requirements of a wide variety of occupations.

Some specific methodological results have implications for future development and application. The reliabilities of the scales with a relatively limited sample of occupations and number of incumbents within occupation indicates that even higher reliabilities would result with larger samples. Also, the high correlations obtained between "level of knowledge" and "importance of the knowledge" scales across occupations indicates that one scale might suffice. The "level" scale appears to be more appropriate for most anticipated uses. The knowledges in the taxonomy were effective in describing a wide variety of occupations. Thus, mean ratings of knowledge requirements, on the whole, were low across many occupations, but high for specific occupations. As a set, the knowledge scales were shown to cover the requirements for the whole range of occupations, from top management to janitors. Also, the multiple revision process followed captured a broad range of knowledges at a relatively similar level of specificity.

The knowledge content, structure, and scales should prove useful in areas such as job analysis, person/job matching, job training and retraining, career/occupational counseling, vocational interest assessment, and the development of job families. Used in concert with existing taxonomies of work-related abilities, skills, and competencies, the knowledge scales will help us to more completely and accurately describe and understand the world at work.

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Figure 4-1
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
Business and Management		
1. Administration & Management	Knowledge of principles and processes involved in business and organizational planning, coordination, and execution. This includes strategic planning, resource allocation, manpower modeling, leadership techniques, and production methods.	High - Managing a $10 million company. Low - Signing a pay voucher.
2. Clerical	Knowledge of administrative and clerical procedures and systems such as word processing systems, filing and records management systems, stenography and transcription, forms design principles, and other office procedures and terminology.	High - Organizing a storage system for company forms. Low - Filing letters alphabetically.
3. Economics and Accounting	Knowledge of economic and accounting principles and practices, the financial markets, banking, and the analysis and reporting of financial data.	High - Keeping a major corporation's financial records. Approving a multi-million dollar loan to a real estate developer. Low - Answering billing questions from credit card customers.
4. Sales and Marketing	Knowledge of principles and methods involved in showing, promoting, and selling products or services. This includes marketing strategies and tactics, product demonstration and sales techniques, and sales control systems.	High - Developing a marketing plan for a nationwide phone system. Low - Selling cakes at a bake sale.

Figure 4-1 (continued)
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
5. Customer and Personal Service	Knowledge of principles and processes for providing customer and personal services including needs assessment techniques, quality service standards, alternative delivery systems, and customer satisfaction evaluation techniques.	High - Responding to a citizen's request for assistance after a major natural disaster. Low - Processing customer dry-cleaning drop-off.
6. Personnel and Human Resources	Knowledge of policies and practices involved in personnel/human resources functions. This includes recruitment, selection, training, and promotion regulations and procedures; compensation and benefits packages; labor relations and negotiation strategies; and personnel information systems.	High - Designing a new personnel selection and promotion system for the Army. Low - Filling out a medical claim form.
Manufacturing and Production		
7. Production and Processing	Knowledge of inputs, outputs, raw materials, waste, quality control, costs, and techniques for maximizing the manufacture and distribution of goods.	High - Managing a food processing plant. Low - Putting a computer back into its packing materials.
8. Food Production	Knowledge of techniques and equipment for planting, growing, and harvesting of food for consumption including crop rotation methods, animal husbandry, and food storage/handling techniques.	High - Running a 100,000 acre farm. Low - Keeping an herb box in the kitchen.

Figure 4-1 (continued)
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
Engineering and Technology		
9. Computers and Electronics	Knowledge of electric circuit boards, processors, chips, and computer hardware and software, including applications and programming.	High - Creating a program to scan computer disks for viruses. Low - Operating a VCR to watch a pre-recorded training tape.
10. Engineering and Technology	Knowledge of equipment, tools, mechanical devices, and their uses to produce motion, light, power, technology, and other applications.	High - Designing an efficient and clean power plant. Low - Installing a door lock.
11. Design	Knowledge of design techniques, principles, tools and instruments involved in the production and use of precision technical plans, blueprints, drawings, and models.	High - Developing detailed design plans for a new high rise office complex. Low - Drawing a straight line 4 3/16 inches long.
12. Building and Construction	Knowledge of materials, methods, and the appropriate tools to construct objects, structures, and buildings.	High - Building a high rise office tower. Low - Sawing a board in half.
13. Mechanical	Knowledge of machines and tools, including their designs, uses, benefits, repair, and maintenance.	High - Overhauling an airplane jet engine. Low - Replacing the filters in a furnace.

Figure 4-1 (continued)
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
Mathematics and Science		
14. Mathematics	Knowledge of numbers, their operations, and interrelationships including arithmetic, algebra, geometry, calculus, statistics, and their applications.	High - Deriving a complex mathematical equation. Low - Adding two numbers.
15. Physics	Knowledge and prediction of physical principles, laws, and applications including air, water, material dynamics, light, atomic principles, heat, electric theory, earth formations, and meteorological and related natural phenomena.	High - Designing a cleaner burning gasoline engine. Low - Using a crowbar to pry open a box.
16. Chemistry	Knowledge of the composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.	High - Developing a safe commercial cleaner. Low - Using a common household bug spray.
17. Biology	Knowledge of plant and animal living tissue, cells, organisms, and entities, including their functions, interdependencies, and interactions with each other and the environment.	High - Isolating and identifying a microscopic virus. Low - Feeding domestic animals.

Figure 4-1 (continued)
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
18. Psychology	Knowledge of human behavior and performance, mental processes, psychological research methods, and the assessment and treatment of behavioral and affective disorders.	High - Treating a person with a severe mental illness. Low - Monitoring several children on a playground.
19. Sociology and Anthropology	Knowledge of group behavior and dynamics, societal trends and influences, cultures, their history, migrations, ethnicity, and origins.	High - Developing a new theory about the development of early civilizations. Low - Identifying two cultures in a story as being different.
20. Geography	Knowledge of various methods for describing the location and distribution of land, sea, and air masses including their physical locations, relationships, and characteristics.	High - Developing a map of the world showing mountains, deserts, and rivers. Low - Knowing the capital of the United States.
Health Services		
21. Medicine and Dentistry	Knowledge of the information and techniques needed to diagnose and treat injuries, diseases, and deformities. This includes symptoms, treatment alternatives, drug properties and interactions, and preventive health-care measures.	High - Performing open-heart surgery. Low - Using a small bandage.

Figure 4-1 (continued)
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
22. Therapy and Counseling	Knowledge of information and techniques needed to rehabilitate physical and mental ailments and to provide career guidance including alternative treatments, rehabilitation equipment and its proper use, and methods to evaluate treatment effects.	High - Counseling an abused child. Low - Putting ice on a sprained ankle.
Education and Training		
23. Education and Training	Knowledge of instructional methods and training techniques including curriculum design principles, learning theory, group and individual teaching techniques, design of individual development plans, and test design principles.	High - Designing a training program for new employees. Low - Showing someone how to bowl.
Arts and Humanities		
24. English Language	Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.	High - Teaching a college English class. Low - Writing a thank-you note.
25. Foreign Language	Knowledge of the structure and content of a foreign (non-English) language including the meaning and spelling of words, rules of composition and grammar, and pronunciation.	High - Providing spoken translation of a political speech while listening to it at a international meeting. Low - Saying "please" and "thank-you" in a foreign language.

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Figure 4-1 (continued)
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
26. Fine Arts	Knowledge of theory and techniques required to produce, compose, and perform works of music, dance, visual arts, drama, and sculpture.	High - Composing a symphony. Low - Attending a popular music concert.
27. History and Archeology	Knowledge of past historical events and their causes, indicators, and impact on particular civilizations and cultures.	High - Determining the age of bones for placing them in the fossil history. Low - Taking a class in U.S. history.
28. Philosophy and Theology	Knowledge of different philosophical systems and religious, including their basic principles, values, ethics, ways of thinking, customs, and practices, and their impact on human culture.	High - Comparing the teachings of major philosophers. Low - Watching a TV program on family values.
Law and Public Safety		
29. Public Safety and Security	Knowledge of weaponry, public safety, and security operations, rules, regulations, precautions, prevention, and the protection of people, data, and property.	High - Commanding a military operation. Low - Using a seatbelt.
30. Law, Government and Jurisprudence	Knowledge of law, legal codes, court procedures, precedents, government regulations, executive orders, agency rules, and the democratic political process.	High - Being a judge in a federal court. Low - Registering to vote in a national election.

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Figure 4-1 (continued)
Descriptions and Definitions of Knowledges

Construct Label	Operational Definition	Level Scale
Communications		
31. Telecommunications	Knowledge of transmission, broadcasting, switching, control, and operation of telecommunication systems.	High - Developing a new, world-wide telecommunication network. Low - Dialing a phone.
32. Communications and Media	Knowledge of media production, communication, and dissemination techniques and methods including alternative ways to inform and entertain via written, oral, and visual media.	High - Producing a combined TV, radio, and newspaper campaign to inform the public about world hunger. Low - Writing a thank you note.
Transportation		
33. Transportation	Knowledge of principles and methods for moving people or goods by air, sea, or road, including their relative costs, advantages, and limitations.	High - Controlling air traffic at a major airport. Low - Taking a train to work.

Figure 4-2

Example Page from Knowledges Questionnaire

1. Administration and Management

Knowledge of planning, coordination, and execution of business functions, resource allocation, and production.

Level

What level of this knowledge is needed to perform this job?

7 — Requires knowledge of high-level business administration such as being the CEO of a major industrial company.

6 — *Manage a $10 million company.*

5 — *Administer a large retirement and nursing care facility.*

Monitor progress of a project to ensure timely completion.

4

3

Plan an effective staff meeting.

2 — *Sign a pay voucher.*

1 — Requires knowledge of basic management such as monitoring a group filling out job applications.

NR Not relevant at all for performance on this job.

Importance

How important is this knowledge to performance on this job?

Not Important	Somewhat Important	Important	Very Important	Extremely Important
1	2	3	4	5

Job Specialty Requirements

Which of the following specialties are relevant to this job? (Mark "R" for Relevant and "NR" for Not Relevant.)

R NR Business Administration

R NR Construction Management

R NR Engineering, Mathematical, and Sciences Management

R NR Food Service and Lodging Management

R NR Medical Service Management

R NR Personnel and Human Resource Management

R NR Public Administration

Other(s) ______________________
(Please specify)

Figure 4-3
Thirty-Three Occupations With Four or More Incumbents Completing the Knowledges Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	8
19005	General Managers & Top Executives	50
22114	Chemical Engineers	4
25105	Computer Programmers	9
27311	Recreation Workers	6
31303	Teachers, Preschool	5
31305	Teachers, Elementary School	7
32502	Registered Nurses	22
32902	Medical & Clinical Laboratory Technologists	4
49008	Salespersons, Except Scientific & Retail	11
49011	Salespersons, Retail	20
49021	Stock Clerks, Sales Floor	9
49023	Cashiers	23
51002	First Line Supervisors, Clerical/Administrative	58
53905	Teachers' Aides & Assistants, Clerical	4
55108	Secretaries	83
55305	Receptionists & Information Clerks	13
55338	Bookkeeping, Accounting, & Auditing Clerks	28
55347	General Office Clerks	83
61005	Police & Detective Supervisors	12
63014	Police Patrol Officers	19
65008	Waiters & Waitresses	14
65026	Cooks, Restaurant	6
65038	Food Preparation Workers	32
66008	Nursing Aides, Orderlies, & Attendants	18
67005	Janitors & Cleaners	26
85119	Other Machinery Maintenance Mechs	4
85132	Maintenance Repairers, General Utility	36
87902	Earth Drillers, Except Oil & Gas	5
92974	Packaging & Filling Machine Operators	10
97102	Truck Drivers	7
97111	Bus Drivers, Schools	9

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Table 4-1

Descriptive Statistics across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Knowledges

	Variable							
	Level				Importance			
Descriptor	M	SD	SEM[a]	r_k[b]	M	SD	SEM	r_k
1. Admin. and Mgmt.	2.35	2.16	.76	.88	2.51	1.45	.50	.87
2. Clerical	3.30	2.55	.57	.95	2.83	1.45	.37	.93
3. Economics and Acct.	1.82	2.21	.87	.84	2.09	1.33	.54	.83
4. Sales and Marketing	1.41	2.10	.75	.87	1.81	1.22	.42	.87
5. Cust. and Pers. Svc	2.75	2.48	1.11	.80	2.63	1.47	.71	.76
6. Personnel and HR	2.17	2.25	.95	.82	2.27	1.36	.61	.79
7. Production and Proc.	1.21	2.08	1.13	.70	1.64	1.13	.60	.71
8. Food Production	.68	1.70	1.15	.54	1.35	.88	.49	.68
9. Computers and Elect.	2.43	2.06	.85	.83	2.50	1.36	.53	.84
10. Engineering and Tech.	1.10	2.00	.98	.76	1.57	1.07	.49	.78
11. Design	1.14	2.03	1.22	.63	1.56	1.06	.66	.60
12. Building and Constr.	1.06	2.09	.90	.81	1.53	1.08	.43	.84
13. Mechanical	1.21	2.04	.79	.85	1.60	1.06	.73	.87
14. Mathematics	2.93	1.82	.76	.82	2.82	1.14	.51	.79
15. Physics	.91	1.82	.91	.75	1.46	.95	.44	.78
16. Chemistry	1.21	2.00	.82	.83	1.66	1.13	.46	.83
17. Biology	.87	1.92	.84	.81	1.44	1.02	.41	.83
18. Psychology	2.49	2.38	.84	.88	2.35	1.36	.51	.85
19. Sociology and Anthro.	1.22	1.89	.79	.82	1.60	1.01	.42	.82
20. Geography	1.31	1.98	1.22	.62	1.65	1.04	.62	.64
21. Medicine and Dent.	1.17	2.02	.86	.82	1.73	1.27	.46	.86
22. Therapy and Couns.	1.39	2.13	.82	.85	1.77	1.20	.46	.84
23. Education and Trn.	2.30	2.31	1.00	.81	2.23	1.28	.55	.81
24. English Language	3.18	2.01	.78	.85	2.98	1.23	.53	.81
25. Foreign Language	.86	1.71	1.36	.37	1.41	.84	.63	.43
26. Fine Arts	.58	1.52	1.04	.53	1.28	.75	.45	.63
27. History and Archeol.	.71	1.61	.92	.67	1.35	.86	.45	.72
28. Philosophy and The.	.99	1.75	.87	.75	1.49	.93	.45	.76
29. Public Safety and Sec.	1.71	2.11	.76	.87	2.10	1.35	.54	.83
30. Law, Govt., and Jurisp.	1.54	2.05	.82	.84	1.90	1.24	.49	.84
31. Telecommunications	1.42	1.73	1.25	.47	2.08	1.15	.77	.55
32. Comm and Media	1.72	1.88	1.06	.68	2.00	1.13	.70	.61
33. Transportation	1.02	1.67	1.00	.64	1.57	.97	.57	.65

Note. Statistics are based on 33 occupations with Knowledges questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.66, median = 11.00, harmonic mean = 9.18).

Table 4-1 (continued)
Descriptive Statistics across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Knowledges

[a]This estimate of the standard error of measurement was calculated as $\underline{SEM} = \underline{SD} * \sqrt{(1 - r_k)}$.
[b]This estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

Table 4-2
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Knowledges

Descriptor	Level r_1 [a]	Level r_{30} [b]	Importance r_1	Importance r_{30}
1. Admin and Mgmt.	.39	.95	.39	.95
2. Clerical	.62	.98	.56	.97
3. Economics and Acct.	.32	.94	.31	.93
4. Sales and marketing	.37	.95	.39	.95
5. Cust. and Pers. Svc	.26	.91	.22	.90
6. Personnel and HR	.29	.92	.26	.91
7. Production and Proc.	.17	.86	.18	.87
8. Food Production	.09	.76	.16	.85
9. Computers and Elect.	.30	.93	.33	.94
10. Engineering and Tech.	.22	.89	.25	.91
11. Design	.13	.82	.12	.80
12. Building and Constr.	.28	.92	.31	.93
13. Mechanical	.33	.94	.38	.95
14. Mathematics	.29	.93	.26	.91
15. Physics	.21	.89	.25	.91
16. Chemistry	.31	.93	.31	.93
17. Biology	.27	.92	.31	.93
18. Psychology	.39	.95	.35	.94
19. Sociology and Anthro.	.29	.93	.30	.93
20. Geography	.13	.81	.14	.83
21. Medicine and Dent.	.28	.92	.36	.94
22. Therapy and Couns.	.33	.94	.33	.94
23. Education and Trn.	.28	.92	.28	.92
24. English Language	.33	.94	.28	.92
25. Foreign Language	.05	.61	.06	.67
26. Fine Arts	.09	.75	.14	.82
27. History and Archeol.	.15	.84	.19	.87
28. Philosophy and The.	.21	.89	.23	.90
29. Public Safety and Sec.	.37	.95	.31	.93
30. Law, Govt., and Jurisp.	.32	.93	.32	.93
31. Telecommunications	.07	.70	.10	.76
32. Comm. and Media	.16	.85	.12	.80
33. Transportation	.14	.82	.14	.83

Note. Reliability estimates are based on a 33 occupations with Knowledges questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.66, median = 11.00, harmonic mean = 9.18). Decimals are omitted.

Table 4-2 (continued)
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Knowledges

[a]Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judges ratings across occupations: ICC(1,1) = [BMS-WMS]/[BMS+(k+1)WMS] (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
[b]Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

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Table 4-3

Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Knowledges

	Type of Scale and Recoding Applied				
	Level			Importance	
Descriptor	r_a	r_b	r_c	r_a	r_b
1. Admin. and Mgmt.	88	83	83	87	92
2. Clerical	95	85	89	93	96
3. Economics and Acct.	84	77	83	83	84
4. Sales and Marketing	87	88	83	87	84
5. Cust. and Pers. Svc.	80	83	67	76	83
6. Personnel and HR	82	84	78	79	85
7. Production and Proc.	70	87	64	71	79
8. Food Production	54	81	71	68	62
9. Computers and Elect.	83	86	81	84	84
10. Engineering and Tech.	76	68	76	78	84
11. Design	63	75	66	60	76
12. Building and Constr.	81	81	82	83	92
13. Mechanical	85	85	80	87	93
14. Mathematics	82	60	79	79	81
15. Physics	75	78	80	78	84
16. Chemistry	83	72	79	83	89
17. Biology	81	46	82	83	85
18. Psychology	88	71	69	85	91
19. Sociology and Anthro.	82	72	80	82	89
20. Geography	62	67	69	63	44
21. Medicine and Dent.	82	71	80	86	92
22. Therapy and Couns.	85	82	84	84	89
23. Education and Trn.	81	80	72	81	83
24. English Language	85	62	80	81	84
25. Foreign Language	37	85	57	43	48
26. Fine Arts	53	85	63	63	41
27. History and Archeol.	67	87	67	71	66
28. Philosophy and The.	75	91	76	76	87
29. Public Safety and Sec.	87	88	70	83	82
30. Law, Govt., and Jurisp.	84	75	82	84	82
31. Telecommunications	47	84	60	54	52
32. Comm. and Media	68	91	68	60	67
33. Transportation	64	90	61	64	57

Note. Reliability estimates are based on 33 occupations with Knowledge questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.66, median = 11.00, harmonic mean = 9.18). Reliability estimates stipulated as r_a were calculated using the full eight point scale for level, and retaining all of the data for the importance scale. Reliability estimates stipulated as r_b were calculated using a reduced seven point scale for level, and excluding the data for importance scale where the rater marked "NR" on the level scale. Reliability estimates stipulated

Table 4-3 (continued)
Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Knowledges

as r_c were calculated using binary coded scale for level (relevant/not relevant). Decimals are omitted.

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Table 4-4a

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Knowledges

Source of Variation	SS	df	MS	F
Occupations	6204.22	32	193.88	3.79*
S(Occupations)	31547.65	616	51.21	
Knowledge	3898.36	32	121.82	66.50*
Knowledge x Occupations	12951.47	1024	12.65	6.90*
Knowledge x S(Occupations)	36113.58	19712	1.83	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.

$^*p<.05$

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Table 4-4b

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Knowledges

Source of Variation	SS	df	MS	F
Occupations	3411.72	32	106.62	3.46*
S(Occupations)	18969.68	616	30.79	
Knowledge	3610.51	32	112.83	70.91*
Knowledge x Occupations	10980.07	1024	10.72	6.74*
Knowledge x S(Occupations)	31365.54	19712	1.59	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.

*$p<.05$

Table 4-5
Interrater Agreement Coefficients for Each Scale Type: Knowledges

Scale Type	Number of Raters on Each Variable r_k	r_1	r_{30}
Level	.86	.40	.95
Importance	.85	.39	.94

Note. Interater agreement coefficient estimates are based on 33 occupations with Knowledges questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.66, median = 11.00, harmonic mean = 9.18). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Descriptor x Occupations" terms from tables 4-4a and 4-4b as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimated for reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation.

Table 4-6a

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Knowledges

Source of Variation	SS	df	MS	F
Occupations	1976.30	32	61.76	3.74*
S(Occupations)	10159.97	616	16.49	
Aggregate	532.55	9	59.17	59.97*
Aggregate x Occupations	1937.30	288	6.73	6.82*
Aggregate x S(Occupations)	5470.09	5544	.99	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.

*p<.05

Table 4-6b

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Knowledges

Source of Variation	SS	df	MS	F
Occupations	1141.40	32	35.67	3.53*
S(Occupations)	6221.37	616	10.10	
Aggregate	428.86	9	47.65	54.28*
Aggregate x Occupations	1731.58	288	6.01	6.85*
Aggregate x S(Occupations)	4866.65	5544	.88	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.

*$p < .05$

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Table 4-7

Interrater Agreement Coefficients for Aggregate Descriptors for Each Scale Type: Knowledges

Scale Type	Number of Raters on Each Variable r_k	r_1	r_{30}
Level	.85	.39	.94
Importance	.85	.39	.94

Note. Interrater agreement coefficients estimates are based on 33 occupations with Knowledges questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.66, median = 11.0, harmonic mean = 9.18). Full sample interrater agreement coefficients (r_k)were obtained by considering the "Aggregate x Occupations" term from Tables 4-6a and 4-6b as true variance. Error variance was defined as the "Aggregate x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability esitmates, where k is the harmonic mean of the number of raters for each occupation.

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Table 4-8
Means and Standard Deviations of Correlations Between the Level and Importance Scales Across Occupations and Descriptors: Knowledges

Scale	Level			Importance		
	n[a]	M	SD	n	M	SD
Level	---	---	---	33	.90	.21
Importance	33	.95	.04	---	---	---

Note. All correlations were calculated based on the mean of ratings assigned by raters for a given occupation, descriptor, and scale. Level-Importance Means above the diagonal were calculated by taking the level scale means on a given occupation for all descriptors, correlating them with importance scale means, for that occupation, and then averaging them with the correlations for other occupations. Level-Importance means below the diagonal were calculated by taking the level scale means for a given descriptor for all occupations, correlating them with importance scale means, for that descriptor, and averaging them with correlations for other descriptors. Other means in the table were calculated in a similar manner.
[a]Number of correlations averaged, not number of observations on which correlations were calculated.

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Table 4-9a

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Admin. and Mgmt	--										
2. Clerical	34	--									
3. Economics and Acct.	66	48	--								
4. Sales and Marketing	46	03	48	--							
5. Cust. and Pers. Svc	40	25	30	65	--						
6. Personnel and HR	85	40	69	43	54	--					
7. Production and Proc.	36	-09	35	20	-17	18	--				
8. Food Production	01	-31	18	-06	04	12	39	--			
9. Computers and Elect.	49	47	27	08	06	22	06	-44	--		
10. Engineering and Tech.	33	-07	17	-12	-39	--	67	08	42	--	
11. Design	47	-09	36	06	-32	21	63	21	39	80	--
12. Building and Constr.	31	-19	37	12	-38	18	63	35	97	75	85
13. Mechanical	27	-18	24	-01	-32	15	64	30	16	65	81
14. Mathematics	64	35	46	29	19	44	32	-22	74	59	48
15. Physics	30	-08	09	-16	-19	16	57	18	24	76	62
16. Chemistry	26	-09	02	-02	-10	18	46	-01	25	70	47
17. Biology	15	05	-18	40	27	20	02	-04	11	06	-12
18. Psychology	56	23	28	14	40	53	11	-12	32	07	14
19. Sociology and Anthro.	59	17	34	13	36	57	08	08	23	01	19
20. Geography	25	20	19	06	28	19	08	09	15	-01	15
21. Medicine and Dent.	20	01	-06	11	23	35	02	03	06	17	-03
22. Therapy and Couns.	45	10	23	09	29	50	14	42	-02	-08	14
23. Education and Trn.	71	20	25	25	41	62	26	07	29	12	23
24. English Language	74	55	39	16	39	63	17	07	48	08	23
25. Foreign Language	38	-05	24	12	27	45	20	65	-14	-01	22
26. Fine Arts	30	06	15	04	20	27	17	59	-08	-06	24
27. History and Archeol.	30	14	15	-01	14	25	09	12	19	15	23
28. Philosophy and The.	57	15	33	24	42	60	08	14	09	-01	17

Table 4-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Public Safety and Sec.	39	-03	08	-13	07	39	23	17	02	29	26
30. Law, Govt., and Jurisp.	52	22	30	07	26	54	09	-22	31	20	19
31. Telecommunications	39	02	23	06	-01	16	20	-02	45	43	60
32. Comm and Media	67	45	45	26	42	56	20	-14	51	17	25
33. Transportation	34	01	14	12	14	24	31	29	-13	28	25

Table 4-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Knowledges

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Building and Constr.	--										
13. Mechanical	90	--									
14. Mathematics	41	46	--								
15. Physics	69	76	54	--							
16. Chemistry	55	72	58	82	--						
17. Biology	-08	15	29	41	66	--					
18. Psychology	02	04	33	25	31	40	--				
19. Sociology and Anthro.	12	03	26	30	16	28	83	--			
20. Geography	19	08	20	38	--	18	53	72	--		
21. Medicine and Dent.	11	27	32	37	68	78	48	33	11	--	
22. Therapy and Couns.	12	06	04	22	09	30	69	87	65	42	--
23. Education and Trn.	12	16	45	45	40	61	69	74	50	42	65
24. English Language	03	-02	45	26	07	23	64	76	58	14	65
25. Foreign Language	28	20	08	28	04	11	38	66	59	28	81
26. Fine Arts	27	16	--	36	09	28	27	53	63	17	73
27. History and Archeol.	29	21	34	61	36	40	53	73	85	31	65
28. Philosophy and The.	20	06	24	31	22	32	79	93	65	47	86
29. Public Safety and Sec.	26	26	09	33	24	05	57	63	36	25	50
30. Law, Govt., and Jurisp.	15	15	36	28	33	24	75	72	40	36	42
31. Telecommunications	52	44	47	30	24	-15	40	39	41	13	28
32. Comm and Media	18	08	60	38	28	30	77	70	27	27	59
33. Transportation	39	33	14	41	19	04	21	33	46	20	43

Table 4-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Knowledges

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Education and Trn.	--										
24. English Language	80	--									
25. Foreign Language	47	52	--								
26. Fine Arts	58	55	76	--							
27. History and Archeol.	62	55	55	68	--						
28. Philosophy and The.	72	69	66	56	71	--					
29. Public Safety and Sec.	44	45	44	17	36	61	--				
30. Law, Govt., and Jurisp.	56	55	27	02	41	69	79	--			
31. Telecommunications	18	29	37	17	33	35	36	43	--		
32. Comm and Media	74	81	39	42	73	75	39	62	44	--	
33. Transportation	30	33	48	46	35	45	42	14	22	26	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 4-9b

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Admin. and Mgmt	--										
2. Clerical	25	--									
3. Economics and Acct.	60	49	--								
4. Sales and Marketing	42	01	39	--							
5. Cust. and Pers. Svc	27	24	29	59	--						
6. Personnel and HR	80	41	60	28	32	--					
7. Production and Proc.	32	-12	16	20	-23	11	--				
8. Food Production	-03	-03	-06	-04	-04	04	30	--			
9. Computers and Elect.	39	51	20	-07	06	22	01	-39	--		
10. Engineering and Tech.	21	-08	-07	-13	-36	06	59	0	39	--	
11. Design	41	-11	09	01	-33	14	62	33	24	75	--
12. Building and Constr.	27	-16	19	16	-30	06	51	25	05	68	77
13. Mechanical	16	---	-02	-01	-29	12	49	18	21	82	60
14. Mathematics	39	29	25	16	22	26	20	-20	70	44	16
15. Physics	21	-09	-20	-21	-14	06	40	14	26	66	52
16. Chemistry	09	-07	-24	-10	-12	12	37	0	19	67	30
17. Biology	02	06	-29	-07	20	12	-03	02	16	10	-14
18. Psychology	48	06	14	02	38	37	-03	10	14	-16	04
19. Sociology and Anthro.	52	05	17	01	23	43	01	15	07	-14	19
20. Geography	17	13	-03	-11	19	-02	0	09	14	-06	18
21. Medicine and Dent.	08	11	-22	-04	07	33	-01	03	0	20	-04
22. Therapy and Couns.	34	04	12	-07	09	34	12	37	-09	-08	27
23. Education and Trn.	53	08	01	04	24	44	16	01	28	06	15
24. English Language	59	43	27	03	36	49	-09	-13	45	-22	03
25. Foreign Language	29	04	10	06	17	38	10	60	-24	-13	27
26. Fine Arts	24	03	09	0	16	12	16	64	-05	0	42
27. History and Archeol.	26	13	03	-14	16	10	01	13	16	0	24
28. Philosophy and The.	57	06	20	15	14	49	09	13	0	-03	24

Table 4-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Public Safety and Sec.	26	-14	-17	-24	-13	26	18	13	-12	16	27
30. Law, Govt., and Jurisp.	47	14	16	-08	01	50	14	-26	28	22	12
31. Telecommunications	36	42	27	-10	-23	24	23	-37	46	41	31
32. Comm and Media	66	46	39	10	26	51	15	-29	51	12	24
33. Transportation	19	-05	-13	02	-01	07	30	27	-18	25	39

Table 4-9b (continued)
Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Knowledges

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Building and Constr.	--										
13. Mechanical	78	--									
14. Mathematics	18	38	--								
15. Physics	50	64	46	--							
16. Chemistry	42	76	46	73	--						
17. Biology	-11	30	35	54	69	--					
18. Psychology	-08	-14	11	25	09	31	--				
19. Sociology and Anthro.	-02	-14	-03	27	01	22	87	--			
20. Geography	11	-02	10	49	05	26	63	69	--		
21. Medicine and Dent.	-01	35	13	35	66	74	29	26	03	--	
22. Therapy and Couns.	08	0	-16	24	09	26	74	87	60	40	--
23. Education and Trn.	-04	14	32	55	40	69	66	67	51	41	54
24. English Language	-29	-33	28	09	-13	19	65	68	51	0	49
25. Foreign Language	14	05	-17	22	-05	12	51	65	52	30	72
26. Fine Arts	26	15	0	41	07	29	48	55	61	17	68
27. History and Archeol.	11	-01	16	57	15	37	59	74	88	13	68
28. Philosophy and The.	21	06	02	30	21	29	72	85	55	46	83
29. Public Safety and Sec.	13	15	-19	29	18	04	51	63	44	25	54
30. Law, Govt., and Jurisp.	06	17	18	28	37	24	54	61	28	36	41
31. Telecommunications	34	33	32	14	26	-13	18	17	16	11	15
32. Comm and Media	03	-04	29	27	17	20	59	66	49	16	53
33. Transportation	27	17	-13	35	10	03	25	31	42	20	36

Table 4-9b (continued)
Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Knowledges

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Education and Trn.	--										
24. English Language	66	--									
25. Foreign Language	33	28	--								
26. Fine Arts	47	30	72	--							
27. History and Archeol.	63	56	49	66	--						
28. Philosophy and The.	59	52	61	47	63	--					
29. Public Safety and Sec.	40	33	46	19	33	58	--				
30. Law, Govt., and Jurisp.	53	51	16	-08	30	62	69	--			
31. Telecommunications	02	22	0	-11	08	30	29	50	--		
32. Comm and Media	62	77	19	22	65	63	29	59	47	--	
33. Transportation	18	06	41	44	26	36	51	03	08	04	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 4-10a

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Admin. and Mgmt	--										
2. Clerical	35	--									
3. Economics and Acct.	55	45	--								
4. Sales and Marketing	48	22	51	--							
5. Cust. and Pers. Svc	43	33	32	54	--						
6. Personnel and HR	63	38	46	42	54	--					
7. Production and Proc.	33	13	29	36	20	29	--				
8. Food Production	19	12	18	36	25	34	52	--			
9. Computers and Elect.	33	46	28	20	18	26	29	10	--		
10. Engineering and Tech.	29	10	25	22	08	28	52	24	36	--	
11. Design	28	15	25	30	12	29	60	40	39	74	--
12. Building and Constr.	27	09	34	32	0	25	53	35	29	72	78
13. Mechanical	24	13	29	27	03	18	56	24	34	66	64
14. Mathematics	52	40	43	34	60	41	42	25	57	44	47
15. Physics	27	18	22	18	22	41	50	24	26	68	60
16. Chemistry	28	17	15	19	15	33	37	12	36	60	50
17. Biology	27	17	05	14	33	33	26	23	21	23	22
18. Psychology	54	20	38	29	38	43	23	11	31	23	21
19. Sociology and Anthro.	40	17	18	21	33	46	34	33	37	32	40
20. Geography	29	25	21	31	31	31	28	32	28	31	46
21. Medicine and Dent.	33	15	19	31	26	51	14	22	23	29	28
22. Therapy and Couns.	41	12	22	25	30	44	33	48	19	32	40
23. Education and Trn.	61	29	23	34	41	57	36	42	36	27	36
24. English Language	54	45	32	37	38	51	30	38	43	19	31
25. Foreign Language	36	22	28	36	24	42	43	53	28	23	39
26. Fine Arts	26	18	15	33	19	35	35	51	20	18	48
27. History and Archeol.	24	23	12	19	20	34	30	30	26	22	30
28. Philosophy and The.	41	21	14	22	39	50	23	21	25	15	24

Table 4-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Public Safety and Sec.	36	09	18	16	31	46	27	24	13	38	34
30. Law, Govt., and Jurisp.	52	17	27	33	31	49	28	24	32	36	41
31. Telecommunications	30	20	26	34	09	23	29	29	50	45	65
32. Comm and Media	51	29	34	35	42	54	27	15	38	24	32
33.Transportation	32	22	17	21	26	42	31	28	23	23	25

Table 4-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Knowledges

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Building and Constr.	--										
13. Mechanical	80	--									
14. Mathematics	43	46	--								
15. Physics	58	57	50	--							
16. Chemistry	57	60	49	68	--						
17. Biology	13	25	35	39	54	--					
18. Psychology	21	17	39	31	44	41	--				
19. Sociology and Anthro.	32	26	40	40	42	44	64	--			
20. Geography	43	32	39	40	41	36	49	61	--		
21. Medicine and Dent.	30	26	41	44	66	57	49	47	42	--	
22. Therapy and Couns.	37	29	30	39	38	43	58	72	53	47	--
23. Education and Trn.	31	23	51	35	43	51	55	59	45	50	57
24. English Language	21	14	52	33	30	35	46	51	50	39	48
25. Foreign Language	36	26	31	31	27	33	34	48	47	46	50
26. Fine Arts	36	25	27	35	34	36	34	62	60	46	63
27. History and Archeol.	22	18	27	42	34	43	43	66	57	39	53
28. Philosophy and The.	16	12	31	31	30	45	56	74	52	34	57
29. Public Safety and Sec.	33	21	22	35	38	26	44	50	51	38	45
30. Law, Govt., and Jurisp.	36	26	37	33	48	43	61	70	60	52	56
31. Telecommunications	59	45	46	32	41	18	31	40	55	37	31
32. Comm and Media	19	16	39	41	39	34	62	58	48	51	45
33. Transportation	27	29	35	43	31	30	37	34	50	27	37

Table 4-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Knowledges

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Education and Trn.	--										
24. English Language	70	--									
25. Foreign Language	52	53	--								
26. Fine Arts	52	55	61	--							
27. History and Archeol.	49	54	55	74	--						
28. Philosophy and The.	55	52	48	56	67	--					
29. Public Safety and Sec.	46	39	39	33	37	49	--				
30. Law, Govt., and Jurisp.	58	52	44	52	58	60	66	--			
31. Telecommunications	40	40	47	45	36	28	42	50	--		
32. Comm and Media	56	58	47	50	59	61	50	60	42	--	
33. Transportation	41	39	34	37	36	41	39	31	38	44	--

Note. N = 140 (4 incumbents selected at random from each of 35 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 4-10b

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Admin. and Mgmt.	--										
2. Clerical	36	--									
3. Economics and Acct.	46	46	--								
4. Sales and Marketing	44	18	47	--							
5. Cust. and Pers. Svc.	32	26	33	54	--						
6. Personnel and HR	51	33	42	34	42	--					
7. Production and Proc.	29	10	26	31	16	20	--				
8. Food Production	12	08	16	22	19	24	42	--			
9. Computers and Elect.	19	43	24	14	17	17	22	13	--		
10. Engineering and Tech.	20	12	11	22	06	19	48	22	33	--	
11. Design	32	16	18	31	14	26	56	39	30	63	--
12. Building and Constr.	22	11	27	37	0	12	44	28	26	65	67
13. Mechanical	18	16	18	22	01	12	43	21	34	63	48
14. Mathematics	36	40	40	18	28	35	28	14	50	21	27
15. Physics	22	11	09	12	15	27	39	26	20	58	47
16. Chemistry	25	24	09	20	15	34	24	13	36	53	39
17. Biology	20	17	02	12	23	24	16	23	27	26	21
18. Psychology	45	23	35	28	38	41	16	20	21	12	16
19. Sociology and Anthro.	34	21	14	18	31	40	29	35	28	24	40
20. Geography	28	29	20	25	27	25	27	32	28	24	46
21. Medicine and Dent.	33	27	14	21	26	52	17	28	22	28	33
22. Therapy and Couns.	37	20	17	15	25	35	23	42	16	20	41
23. Education and Trn.	47	24	16	24	28	45	29	29	36	28	38
24. English Language	41	34	26	25	38	35	12	19	39	09	27
25. Foreign Language	34	31	26	29	20	31	32	50	26	17	43
26. Fine Arts	25	13	15	29	19	25	30	44	26	17	51
27. History and Archeol.	21	17	11	12	15	18	25	25	27	12	35
28. Philosophy and The.	40	21	19	22	30	38	24	26	25	15	30

Table 4-10b (continued)
Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Knowledges

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Public Safety and Sec.	33	08	15	13	21	35	18	20	03	24	31
30. Law, Govt., and Jurisp.	44	11	18	23	23	38	26	18	30	35	36
31. Telecommunications	14	26	21	15	07	20	22	14	50	42	47
32. Comm and Media	40	25	28	26	36	40	20	12	29	19	30
33. Transportation	29	22	17	20	26	44	33	36	20	19	27

Table 4-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Knowledges

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Building and Constr.	--										
13. Mechanical	69	--									
14. Mathematics	16	33	--								
15. Physics	41	47	35	--							
16. Chemistry	45	52	36	54	--						
17. Biology	10	33	38	44	56	--					
18. Psychology	14	09	29	32	40	38	--				
19. Sociology and Anthro.	30	21	27	39	43	41	62	--			
20. Geography	35	25	33	43	39	38	46	57	--		
21. Medicine and Dent.	24	34	28	44	65	59	45	47	34	--	
22. Therapy and Couns.	33	22	17	31	43	37	63	67	52	50	--
23. Education and Trn.	23	22	42	40	44	54	52	56	46	45	50
24. English Language	13	05	37	24	20	21	42	44	40	25	38
25. Foreign Language	32	27	21	28	37	33	33	52	46	46	45
26. Fine Arts	34	23	19	41	41	38	45	62	56	38	58
27. History and Archeol.	17	13	27	42	28	43	45	64	59	28	47
28. Philosophy and The.	17	12	26	29	36	45	62	79	50	39	63
29. Public Safety and Sec.	22	19	09	30	31	19	41	45	38	37	43
30. Law, Govt., and Jurisp.	30	27	22	32	51	37	50	63	48	49	51
31. Telecommunications	39	38	28	17	39	19	26	36	36	21	27
32. Comm and Media	13	15	32	33	32	26	57	51	40	42	47
33. Transportation	14	19	30	47	25	30	42	40	49	33	34

Table 4-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Individual-Level Data): Knowledges

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Education and Trn.	--										
24. English Language	53	--									
25. Foreign Language	40	35	--								
26. Fine Arts	51	43	56	--							
27. History and Archeol.	52	46	50	75	--						
28. Philosophy and The.	52	45	46	58	69	--					
29. Public Safety and Sec.	33	29	36	32	26	48	--				
30. Law, Govt., and Jurisp.	53	39	32	46	47	62	52	--			
31. Telecommunications	27	31	23	32	25	35	27	46	--		
32. Comm and Media	45	49	33	41	49	61	44	51	41	--	
33. Transportation	38	23	32	36	30	35	35	23	28	44	--

Note. N = 140 (4 incumbents selected at random from each of 35 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 4-11

Principal Components Analysis Pattern Matrix for the Level Scale: Knowledges (loadings over .30)

Descriptor	F1	F2	F3	F4	F5	F6	F7	Communality
	Factor							
1. Admin. and Mgmt.	.21	.34	.40	.56	.05	.50	.02	.88
2. Clerical	.06	-.16	.02	.82	-.04	.04	.19	.73
3. Economics and Acct.	.09	.30	.14	.50	-.25	.58	-.01	.76
4. Sales and Marketing	.02	.02	-.05	-.00	.02	.95	.07	.91
5. Cust. & Pers. Svc.	.22	-.39	.12	.18	.23	.71	-.00	.80
6. Personnel and HR	.14	.12	.46	.51	.14	.55	-.20	.87
7. Production Proc.	.02	.75	.04	.14	.02	.12	-.28	.67
8. Food Production	.36	.27	-.09	-.14	-.09	-.00	-.78	.84
9. Computers and Elect.	.02	.26	.06	.56	.04	.03	.66	.82
10. Engineering and Tech.	-.11	.92	.10	.11	.13	-.16	.13	.94
11. Design	.14	.89	.10	.10	-.17	.03	.08	.87
12. Building and Constr.	.19	.92	.03	-.13	-.06	.12	-.04	.91
13. Mechanical	.03	.94	.04	-.09	.18	-.01	-.06	.92
14. Mathematics	.09	.53	.02	.46	.28	.29	.46	.87
15. Physics	.33	.74	.05	.08	.43	-.20	.04	.89
16. Chemistry	.01	.64	.12	-.01	.72	-.05	.14	.96
17. Biology	.19	-.04	.02	.09	.95	.00	.02	.94
18. Psychology	.41	-.02	.68	.21	.29	.17	.21	.83
19. Sociology and Anthro	.68	-.01	.63	.20	.11	.14	.06	.93
20. Geography	.89	.03	.16	.05	-.00	.01	.22	.86
21. Medicine and Dent.	.13	.10	.29	-.11	.81	.15	-.00	.80
22. Therapy and Counsel	.76	-.02	.44	.10	.13	.11	-.27	.88
23. Education and Train.	.51	.10	.36	.42	.46	.21	-.04	.82
24. English Language	.55	.03	.37	.68	.05	.12	.01	.91
25. Foreign Language	.75	.14	.26	-.03	-.03	.19	-.39	.83
26. Fine Arts	.86	.11	-.11	.14	.10	.04	-.34	.92
27. History and Archeol.	.84	.16	.15	.13	.27	-.12	.18	.89
28. Philosophy and Theol.	.66	.01	.60	.10	.20	.25	-.02	.91
29. Public Safety	.22	.22	.86	-.00	.01	-.13	-.14	.88
30. Law, Govt., & Juris.	.16	.10	.86	.18	.16	.08	.25	.90
31. Telecomm.	.35	.50	.34	-.09	-.25	.07	.46	.77
32. Comm. and Media	.59	.11	.36	.46	.17	.23	.35	.90
33. Transportation	.46	.32	.15	-.05	.01	.13	-.25	.42
Percent of Variance	35	16	11	8	6	5	3	
Eigenvalue	11.71	5.32	3.57	2.70	2.12	1.65	1.09	

Note. N = 33. The correlation matrix was based on means calculated at the occupation level. F1 = Arts & Humanities, F2 = Science & Technology, F3 = Law Enforcement, F4 = Clerical, F5 = Medicine, F6 = Business Administration, F7 = High Technology. These loadings are based on an orthogonal varimax rotation.

Table 4-12a

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Knowledges

Descriptor	General Managers & Top Executives (n=50) M	SD	Computer Programmers (n=9) M	SD	Registered Nurses (n=22) M	SD	Police Patrol Officers (n=19) M	SD	Janitors & Cleaners[a] (n=26) M	SD	Maintenance Repairers, General Utility (n=36) M	SD
1. Administration and Mgmt.	4.84	1.27	3.33	1.32	2.68	1.52	2.05	1.99	.88	1.95	1.89	2.11
2. Clerical	3.16	2.24	2.89	2.26	2.68	1.99	2.68	1.63	1.19	2.04	1.42	1.84
3. Economics and Acct.	3.94	2.10	.33	1.00	1.00	1.66	.84	1.57	.96	2.07	1.06	1.82
4. Sales and Marketing	3.31	2.25	1.56	1.33	1.86	2.05	.47	1.22	1.00	2.12	.81	1.69
5. Customer and Pers. Svc.	4.66	2.05	1.89	1.27	3.18	2.91	3.74	2.84	1.35	1.96	1.44	1.95
6. Personnel and HR	4.52	1.53	1.44	1.59	2.36	2.13	2.21	2.35	1.32	2.11	1.92	2.32
7. Production and Processing	2.12	2.34	.33	.71	1.00	1.93	.58	1.43	.50	1.53	1.53	2.22
8. Food Production	.54	1.39	.00	.00	.73	1.80	.37	1.12	1.08	2.35	1.42	2.41
9. Computers and Elect.	3.18	1.69	6.56	.73	2.82	1.84	2.94	1.99	1.08	2.08	1.61	1.84
10. Engineering and Tech.	1.88	2.24	2.33	2.40	1.18	2.06	.89	1.33	1.15	1.89	2.80	2.35
11. Design	2.12	2.34	2.00	2.87	1.09	2.16	1.05	1.39	1.77	2.69	2.72	2.41
12. Building and Constr.	1.56	2.23	.00	.00	1.14	2.21	.32	1.00	1.76	2.61	3.86	2.15
13. Mechanical	1.94	2.31	.44	1.01	1.05	1.84	.89	1.41	1.96	2.39	4.31	2.11
14. Mathematics	4.08	1.12	4.67	1.22	3.55	1.14	2.32	1.34	1.69	2.29	2.58	1.98
15. Physics	1.34	2.02	.44	.88	1.50	2.11	.94	1.08	.65	1.57	2.42	2.17
16. Chemistry	1.82	2.17	.11	.33	3.18	2.17	.95	1.31	1.60	2.08	2.56	2.21
17. Biology	1.34	2.18	.00	.00	3.68	2.75	.58	1.07	.92	2.15	.91	1.92
18. Psychology	4.28	2.24	1.44	1.88	5.77	.87	4.68	1.49	1.23	2.29	1.67	2.14
19. Sociology and Anthro.	2.52	2.21	.67	1.12	3.09	2.16	2.68	1.57	.73	1.66	.75	1.65
20. Geography	2.16	2.26	.56	1.13	1.59	2.40	2.11	1.45	1.15	2.44	.89	2.07
21. Medicine and Dentistry	1.40	2.20	.11	.33	4.91	1.06	1.47	1.22	1.19	2.42	1.31	2.04
22. Therapy and Counseling	2.62	2.30	.33	.71	4.50	1.41	1.89	1.66	1.08	2.28	1.28	1.99

Table 4-12a (continued)

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Knowledges

Descriptor	General Managers & Top Executives (n=50)		Computer Programmers (n=9)		Registered Nurses (n=22)		Police Patrol Officers (n=19)		Janitors & Cleaners[a] (n=26)		Maintenance Repairers, General Utility (n=36)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
23. Education and Training	3.72	2.04	2.33	2.12	4.05	2.26	2.84	2.06	1.88	2.45	2.33	2.41
24. English Language	4.20	1.18	4.22	.83	4.36	1.59	4.05	1.22	2.12	2.36	2.08	1.87
25. Foreign Language	1.57	1.95	.44	1.01	1.41	2.17	1.42	1.43	.96	2.09	.83	1.96
26. Fine Arts	.50	1.39	.22	.67	1.32	2.15	.00	.00	1.00	2.08	.81	1.94
27. History and Archeology	1.00	1.80	.22	.67	1.45	2.06	.63	1.16	.62	1.77	1.06	2.00
28. Philosophy and Theology	1.72	1.93	.00	.00	3.23	2.02	1.89	1.91	.65	1.62	.94	1.72
29. Public Safety and Security	2.04	2.13	.22	.44	2.23	2.33	5.79	.79	1.85	2.13	2.67	2.04
30. Law, Govt., and Jurisp.	2.78	1.89	.00	.00	2.59	2.22	5.00	1.11	1.27	2.44	1.11	1.95
31. Telecommunications	1.96	1.96	2.22	2.33	1.82	1.89	2.21	1.13	1.42	2.52	1.67	1.93
32. Comm. and Media	2.86	1.81	1.89	1.54	2.91	2.14	1.74	1.63	.64	1.38	1.42	2.03
33. Transportation	1.72	1.74	.56	1.13	1.77	2.25	1.11	1.49	.92	2.06	1.21	1.86

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 4-12b

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Occupations: Knowledges

Descriptor	General Managers & Top Executives (n=50)		Computer Programmers (n=9)		Registered Nurses (n=22)		Police Patrol Officers (n=19)		Janitors & Cleaners[a] (n=26)		Maintenance Repairers, General Utility (n=36)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Administration and Mgmt.	4.04	.88	2.89	1.27	2.86	1.28	2.11	1.20	1.36	.89	2.14	1.36
2. Clerical	2.59	1.23	2.50	1.32	2.48	1.14	2.53	1.07	1.73	1.22	1.92	1.13
3. Economics and Acct.	3.16	1.25	1.22	.67	1.59	.91	1.42	.90	1.50	1.07	1.67	1.10
4. Sales and Marketing	2.74	1.31	1.67	.71	1.95	1.05	1.26	.73	1.52	1.06	1.47	1.03
5. Customer and Pers. Svc.	3.46	1.23	2.11	1.05	2.68	1.59	2.84	1.46	2.00	1.30	1.86	1.15
6. Personnel and HR	3.52	1.07	2.11	1.54	2.27	1.28	2.26	1.33	1.69	1.19	2.00	1.26
7. Production and Processing	2.02	1.19	1.11	.33	1.41	.73	1.32	.75	1.27	.83	1.64	1.05
8. Food Production	1.26	.72	1.00	.00	1.36	.85	1.21	.63	1.38	.94	1.69	1.19
9. Computers and Elect.	2.84	1.17	4.67	1.00	2.41	1.05	2.53	.96	1.46	.90	2.00	1.24
10. Engineering and Tech.	1.94	1.20	2.22	1.30	1.59	.96	1.47	.77	1.65	1.06	2.64	1.36
11. Design	1.90	1.15	2.11	1.54	1.55	1.01	1.47	.77	1.81	1.30	2.42	1.30
12. Building and Constr.	1.70	1.09	1.00	.00	1.50	.91	1.11	.32	1.96	1.37	3.22	1.33
13. Mechanical	1.92	1.14	1.33	.71	1.55	1.01	1.42	.69	2.00	1.23	3.31	1.19
14. Mathematics	3.24	.85	3.78	.83	3.18	.80	2.21	.92	1.81	.98	2.50	1.13
15. Physics	1.64	1.05	1.22	.44	1.82	1.14	1.42	.61	1.35	.80	2.28	1.16
16. Chemistry	1.80	.99	1.00	.00	2.91	1.34	1.58	.96	2.23	1.48	2.33	1.20
17. Biology	1.59	1.07	1.00	.00	3.05	1.59	1.21	.42	1.42	.95	1.44	1.05
18. Psychology	3.20	1.37	1.56	.88	4.05	.79	3.47	1.02	1.62	1.17	1.78	1.05
19. Sociology and Anthro.	2.22	1.25	1.22	.67	2.59	1.30	2.47	1.07	1.32	.73	1.31	.71
20. Geography	1.86	.99	1.11	.33	1.77	1.19	2.16	.96	1.50	1.07	1.53	1.18
21. Medicine and Dentistry	1.78	1.31	1.22	.67	4.36	.66	2.11	1.05	1.69	1.32	1.81	1.21
22. Therapy and Counseling	2.30	1.28	1.11	.33	3.62	.84	2.26	1.15	1.81	1.52	1.81	1.26

Table 4-12b (continued)

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Occupations: Knowledges

Descriptor	General Managers & Top Executives (n=50)		Computer Programmers (n=9)		Registered Nurses (n=22)		Police Patrol Officers (n=19)		Janitors & Cleaners[a] (n=26)		Maintenance Repairers, General Utility (n=36)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
23. Education and Training	2.84	1.11	2.11	1.17	3.18	1.26	2.58	1.17	1.88	1.14	2.17	1.32
24. English Language	3.37	.80	3.56	.53	3.41	.96	3.53	.77	2.27	1.43	2.31	1.24
25. Foreign Language	1.73	1.01	1.11	.33	1.59	.96	1.84	.76	1.31	.79	1.36	.96
26. Fine Arts	1.22	.62	1.00	.00	1.68	1.13	1.00	.00	1.50	.99	1.42	1.00
27. History and Archeology	1.40	.78	1.11	.33	1.77	1.15	1.21	.42	1.27	.78	1.47	1.00
28. Philosophy and Theology	1.80	.97	1.00	.00	2.82	1.14	1.84	.96	1.35	.85	1.44	.81
29. Public Safety and Security	2.04	1.19	1.22	.67	2.29	1.42	4.53	.70	2.12	1.34	2.66	1.43
30. Law, Govt., and Jurisp.	2.48	1.27	1.00	.00	2.57	1.18	4.00	.75	1.62	1.17	1.61	1.13
31. Telecommunications	2.18	1.04	2.11	1.27	2.32	1.13	2.44	.76	1.88	1.24	1.92	1.16
32. Comm. and Media	2.49	1.07	2.22	1.20	2.55	1.10	1.95	.97	1.60	1.13	1.66	1.01
33. Transportation	1.72	.88	1.33	.71	2.00	1.15	1.68	1.00	1.48	1.06	1.79	1.19

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 4-13

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for the Level Scale: Knowledges

Descriptor	Functions												
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	r_F^2	η^2
1. Administration and Mgmt.	.12	.13	.07	.07	.07	.04	.05	.05	.07	.16	.04	.10	.29
2. Clerical	.93	.05	.01	.03	.02	.03	.04	.00	.04	.10	.01	.88	.50
3. Economics and Acct.	.14	.18	.03	.09	.07	.05	.06	.09	.11	.85	.04	.82	.24
4. Sales and Marketing	.06	.84	.03	.13	.04	.07	.05	.07	.06	.17	.03	.77	.28
5. Customer and Pers. Svc.	.06	.10	.05	.02	.04	.02	.03	.02	.08	.07	.03	.01	.20
6. Personnel and HR	.13	.12	.10	.07	.06	.05	.08	.07	.08	.12	.07	.10	.22
7. Production and Processing	.04	.16	.09	.17	.06	.09	.06	.16	.09	.12	.06	.13	.14
8. Food Production	.06	.19	.08	.77	.09	.15	.12	.10	.08	.11	.10	.72	.10
9. Computers and Electornics	.22	.06	.06	.08	.05	.07	.08	.09	.09	.09	.05	.10	.23
10. Engineering and Tech.	.00	.13	.11	.14	.08	.08	.06	.28	.06	.09	.06	.16	.17
11. Design	.03	.14	.11	.12	.07	.07	.10	.23	.07	.07	.06	.13	.12
12. Building and Construction	.04	.12	.15	.16	.09	.10	.12	.33	.09	.11	.08	.23	.21
13. Mechanical	.00	.07	.11	.07	.08	.08	.07	.85	.08	.09	.07	.78	.25
14. Mathematics	.14	.09	.09	.09	.04	.08	.07	.13	.09	.15	.07	.11	.22
15. Physics	.00	.07	.14	.10	.04	.12	.10	.25	.08	.05	.05	.13	.17
16. Chemistry	.02	.07	.13	.09	.07	.14	.17	.21	.13	.06	.09	.16	.23
17. Biology	.06	.11	.09	.17	.08	.74	.22	.13	.09	.07	.13	.70	.21
18. Psychology	.06	.07	.13	.07	.12	.07	.11	.10	.80	.13	.15	.75	.29
19. Sociology and Anthro.	.02	.07	.13	.09	.11	.12	.12	.16	.19	.03	.11	.15	.22
20. Geography	.09	.14	.15	.15	.13	.14	.12	.09	.10	.11	.11	.17	.11
21. Medicine and Dentistry	.07	.08	.12	.13	.09	.21	.75	.10	.13	.09	.16	.72	.21
22. Therapy and Counseling	.02	.06	.13	.13	.15	.15	.19	.13	.23	.07	.69	.67	.25
23. Education and Training	.06	.07	.10	.09	.09	.08	.07	.08	.12	.08	.08	.10	.21
24. English Language	.12	.06	.11	.05	.09	.06	.05	.05	.10	.05	.06	.10	.25
25. Foreign Language	.05	.16	.11	.15	.08	.12	.14	.10	.06	.14	.14	.16	.07
26. Fine Arts	.06	.18	.11	.19	.16	.18	.17	.10	.09	.08	.14	.22	.09
27. History and Archeology	.02	.09	.12	.14	.13	.15	.13	.10	.09	.11	.11	.14	.13

Table 4-13 (continued)

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for the Level Scale: Knowledges

Descriptor	Functions												
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	$\Gamma\underline{F}^2$	η^2
28. Philosophy and Theology	.06	.10	.14	.11	.18	.19	.15	.01	.11	.13	.25	.23	.17
29. Public Safety and Security	.02	.04	.84	.07	.13	.07	.09	.12	.12	.04	.08	.78	.28
30. Law, Govt. & Jurisp.	.05	.07	.20	.11	.72	.09	.10	.13	.17	.11	.15	.68	.24
31. Telecommunications	.13	.08	.13	.07	.12	.09	.09	.13	.10	.06	.05	.11	.08
32. Comm. and Media	.05	.09	.14	.06	.10	.07	.10	.04	.11	.08	.10	.10	.14
33. Transportation	.08	.08	.14	.08	.11	.12	.09	.11	.10	.08	.08	.11	.12
$\underline{R}_c$	.78	.75	.68	.66	.62	.59	.52	.49	.48	.43	.41		
Percent of Variance	20	16	11	9	8	6	5	4	4	3	2		
Eigenvalue	1.65	1.30	.90	.77	.65	.54	.38	.33	.30	.23	.20		

Note. Statistics are based on 33 occupations with Knowledges questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 13.0, harmonic mean = 9.65). F1 = Clerical, F2 = Sales & Marketing, F3 = Public Safety and Security, F4 = Food Production, F5 = Law, Government and jurisprudence, F6 = Biology, F7 = Medicine & Dentistry, F8 = Mechanical, F9 = Psychology, F10 = Economics and Accounting, F11 = Therapy and Counseling. Percent of "grouped" cases correctly classified: 55.16%

$\Gamma\underline{F}^2$ = Sum of squared rotated correlations across eleven functions

η^2 = Variance in Knowledge Level Scale ratings accounted for by occupations.

The statistics "$\underline{R}_c$," "Percent of Variance," and "Eigenvalue," were calculated based on the unrotated discriminant functions.

Table 4-14a

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Level Scale: Knowledges

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
1. Admin. and Mgmt.	2.35	2.16	.88	1.90	1.85	.96	3.41*	1.37	.69	1.43
2. Clerical	3.30	2.55	.95	2.80	1.64	.94	3.71*	2.43*	.77	.83
3. Economics and Acct.	1.82	2.21	.84	1.75	1.65	.96	.56	1.79	.62	1.20
4. Sales and Marketing	1.41	2.10	.87	1.38	1.62	.94	.31	1.67	.77	.82
5. Cust. and Pers. Svc.	2.75	2.48	.80	2.86	1.79	.85	-.84	1.93	.54	1.44
6. Personnel and HR	2.17	2.25	.82	1.61	1.70	.95	4.27*	1.74	.61	1.34
7. Production and Proc.	1.21	2.08	.70	.96	1.48	.85	2.18*	1.97	.70	.86
8. Food Production	.68	1.70	.54	.37	.90	.84	3.71*	3.60*	.33	.74
9. Computers and Elect.	2.43	2.06	.83	2.01	1.51	.85	3.58*	1.87	.81	.63
10 Engineering and Tech.	1.10	2.00	.76	1.25	1.39	.92	-1.37	2.06*	.84	.43
11. Design	1.14	2.03	.63	.79	1.39	.84	3.15*	2.12*	.62	.87
12. Building and Constr.	1.06	2.09	.81	.61	1.23	.89	4.17*	2.86*	.63	1.28
13. Mechanical	1.21	2.04	.85	2.03	1.73	.95	-6.51*	1.38	.84	.96
14. Mathematics	2.93	1.82	.82	2.52	1.26	.94	4.07*	2.11*	.56	1.23
15. Physics	.91	1.82	.75	1.12	1.27	.92	-2.09*	2.04*	.79	.48
16. Chemistry	1.21	2.00	.83	1.43	1.62	.96	-1.87	1.53	.75	1.00
17. Biology	.87	1.92	.81	1.07	1.54	.96	-1.72	1.55	.86	.47
18. Psychology	2.49	2.38	.88	2.14	1.61	.90	2.70*	2.18*	.71	1.08
19. Sociology and Anthro.	1.22	1.89	.82	1.30	1.18	.86	-.84	2.58*	.78	.41
20. Geography	1.31	1.98	.62	1.35	1.28	.88	-.47	2.37*	.61	.70
21. Medicine and Dent.	1.17	2.02	.82	1.11	1.35	.95	.56	2.24*	.79	.66
22. Therapy and Couns.	1.39	2.13	.85	1.24	1.57	.88	1.27	1.83	.66	1.12
23. Education and Trn.	2.30	2.31	.81	2.17	1.99	.96	.94	1.35	.72	1.41
24. English Language	3.18	2.01	.85	2.73	1.19	.95	4.37*	2.86*	.59	1.02
25. Foreign Language	.86	1.71	.37	.64	.83	.77	2.72*	4.23*	.20	.64
26. Fine Arts	.58	1.52	.53	.40	.87	.89	2.35*	3.07*	.52	.58
27. History and Archeol.	.71	1.61	.67	.72	1.10	.74	-.08	2.16*	.76	.36
28. Philosophy and The.	.99	1.75	.75	.70	.99	.68	3.28*	3.15*	.63	.58
29. Public Safety and Sec.	1.71	2.11	.87	2.09	1.37	.92	-3.41*	2.39*	.79	.70
30. Law, Govt., and Jurisp.	1.54	2.05	.84	2.11	1.39	.87	-5.11*	2.17*	.70	.96
31. Telecommunications	1.42	1.73	.47	1.23	.96	.73	2.21*	3.24*	.13	.79
32. Comm. and Media	1.72	1.88	.68	1.88	1.28	.88	-1.57	2.14*	.58	.63
33. Transportation	1.02	1.67	.64	1.30	1.35	.90	-2.84*	1.54	.60	.72

Note. Incumbent statistics based on 33 occupations with Knowledge questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.66, median = 11, harmonic mean = 9.18). Analyst statistics are based on the same 33 occupations with Knowledge questionnaire responses from at least 6 analysts (mean number of analysts = 9.81, median = 12, harmonic mean = 8.30).

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Table 4-14a (continued)

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Level Scale: Knowledges

The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: $ICC(1,k) = [BMS-WMS]/BMS$ (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
The t statistic tests for differences in the incumbent and analyst group means.
The F statistic tests for differences in the incumbent and analyst group standard deviations.
The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.
The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.
$^* p < .05$

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Table 4-14b

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Importance Scale: Knowledges

Descriptor	Incumbent			Analyst						
	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
1. Admin. and Mgmt.	2.51	1.45	.88	2.28	1.49	.96	2.25*	1.06	.69	.77
2. Clerical	2.83	1.45	.93	2.86	1.32	.94	-.31	1.22	.72	.67
3. Economics and Acct.	2.09	1.33	.83	2.14	1.29	.96	-.56	1.07	.70	.59
4. Sales and Marketing	1.81	1.22	.88	1.90	1.26	.95	-1.06	1.06	.79	.39
5. Cust. and Pers. Svc.	2.63	1.47	.76	3.25	1.47	.86	-6.17*	1.00	.42	1.39
6. Personnel and HR	2.27	1.36	.79	1.81	1.22	.95	5.26*	1.25	.65	.68
7 .Production and Proc.	1.64	1.13	.71	1.54	1.02	.89	1.29	1.22	.66	.43
8. Food Production	1.35	.88	.69	1.25	.79	.83	1.77	1.25	.40	.27
9 .Computers and Elect.	2.50	1.36	.85	2.17	1.18	.86	3.95*	1.33	.76	.35
10. Engineering and Tech.	1.57	1.07	.78	1.72	1.10	.93	-2.05*	1.06	.88	.18
11. Design	1.56	1.06	.60	1.30	.72	.90	4.64*	2.19*	.58	.35
12. Building and Constr.	1.53	1.08	.84	1.32	.83	.92	3.34*	1.67	.66	.38
13. Mechanical	1.60	1.06	.87	2.23	1.33	.96	-7.46*	1.56	.74	.84
14. Mathematics	2.82	1.14	.79	3.02	1.07	.88	-2.63*	1.13	.42	.63
15. Physics	1.46	.95	.78	1.62	.99	.90	-2.43*	1.08	.68	.33
16. Chemistry	1.66	1.13	.83	1.85	1.20	.95	-2.46*	1.11	.72	.52
17. Biology	1.44	1.02	.83	1.62	1.19	.96	-2.31*	1.37	.78	.41
18. Psychology	2.35	1.36	.86	2.40	1.22	.88	-.52	1.24	.69	.40
19. Sociology and Anthro.	1.60	1.01	.83	1.70	.95	.86	-1.52	1.13	.85	.11
20. Geography	1.65	1.04	.64	1.81	1.10	.92	-2.25*	1.12	.61	.42
21. Medicine and Dent.	1.73	1.27	.86	1.72	1.28	.96	.07	1.01	.78	.56
22. Therapy and Couns.	1.77	1.20	.85	1.72	1.15	.90	.57	1.09	.59	.56
23. Education and Trn.	2.23	1.28	.81	2.42	1.44	.95	-2.05*	1.27	.73	.69
24. English Language	2.98	1.23	.81	3.31	1.06	.91	-4.27*	1.34	.74	.49
25. Foreign Language	1.41	.84	.43	1.19	.51	.53	4.97*	2.74*	.33	.20
26. Fine Arts	1.28	.75	.64	1.24	.65	.89	.89	1.34	.59	.20
27. History and Archeol.	1.35	.86	.72	1.22	.62	.90	2.73*	1.89	.67	.25
28. Philosophy and The.	1.49	.93	.77	1.30	.67	.60	3.67*	1.90	.38	.27
29. Public Safety and Sec.	2.10	1.35	.84	2.55	1.23	.89	-5.15*	1.21	.76	.45
30. Law, Govt., and Jurisp.	1.90	1.24	.84	2.30	1.20	.91	-4.80*	1.07	.71	.49
31. Telecommunications	2.08	1.15	.54	1.95	1.01	.87	1.75	1.30	.44	.39
32. Comm. and Media	2.00	1.13	.61	2.32	1.13	.79	-4.17*	1.01	.59	.36
33. Transportation	1.57	.97	.65	1.85	1.20	.92	-3.61*	1.53	.59	.57

Note. Incumbent statistics based on 33 occupations with Knowledge questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.66, median = 11, harmonic mean = 9.18). Analyst statistics are based on the same 33 occupations with Knowledge questionnaire

Table 4-14b (continued)

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Importance Scale: Knowledges

responses from at least 6 analysts (mean number of analysts = 9.81, median = 12, harmonic mean = 8.30).

The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

The t statistic tests for differences in the incumbent and analyst group means.

The F statistic tests for differences in the incumbent and analyst group standard deviations.

The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.

The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.

*$p < .05$

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Table 4-15

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Knowledges

	Incumbent			Analyst			
Descriptor	M	SD	r_k	M	SD	r_k	t
1. Admin. and Mgmt.	.62	.49	.83	.69	.46	.74	-2.30*
2. Clerical	.72	.45	.89	.93	.26	.54	-7.64*
3. Economics and Acct.	.49	.50	.83	.67	.47	.87	-5.39*
4. Sales and Marketing	.37	.48	.83	.56	.50	.77	-5.50*
5. Cust. and Pers. Svc.	.64	.48	.67	.85	.36	.78	-7.05*
6. Personnel and HR	.57	.50	.78	.60	.49	.68	-1.04
7. Production and Proc.	.30	.46	.64	.40	.49	.68	-3.30*
8. Food Production	.16	.37	.71	.20	.40	.84	-1.50
9. Computers and Elect.	.66	.47	.81	.77	.42	.50	-3.47*
10. Engineering and Tech.	.29	.45	.76	.60	.49	.74	-9.75*
11. Design	.29	.45	.66	.33	.47	.38	-1.40
12. Building and Constr.	.24	.42	.82	.30	.46	.82	-2.25*
13. Mechanical	.31	.46	.80	.80	.40	.53	-16.11*
14. Mathematics	.84	.37	.79	.97	.16	.32	-6.34*
15. Physics	.26	.44	.80	.60	.49	.80	-11.05*
16. Chemistry	.33	.47	.79	.61	.49	.82	-8.58*
17. Biology	.21	.41	.82	.47	.50	.82	-8.57*
18. Psychology	.60	.49	.69	.78	.41	.76	-5.67*
19. Sociology and Anthro.	.35	.48	.80	.65	.48	.64	-9.29*
20. Geography	.38	.49	.69	.64	.48	.75	-7.94*
21. Medicine and Dent.	.34	.47	.80	.54	.50	.76	-6.14*
22. Therapy and Couns.	.37	.48	.84	.49	.50	.83	-3.64*
23. Education and Trn.	.59	.49	.72	.72	.45	.74	-4.20*
24. English Language	.83	.38	.80	.98	.12	.15	-7.24*
25. Foreign Language	.27	.44	.57	.46	.50	.77	-6.00*
26. Fine Arts	.16	.37	.63	.21	.41	.88	-1.79
27. History and Archeol.	.20	.40	.67	.35	.48	.51	-5.08*
28. Philosophy and The.	.28	.45	.76	.45	.50	.34	-5.57*
29. Public Safety and Sec.	.51	.50	.70	.86	.34	.47	-11.47*
30. Law, Govt., and Jurisp.	.43	.50	.82	.83	.38	.62	-12.70*
31. Telecommunications	.62	.49	.60	.73	.44	.52	-3.63*
32. Comm. and Media	.55	.50	.68	.80	.40	.68	-7.63*
33. Transportation	.35	.48	.61	.62	.49	.72	-8.49*

Note. Incumbent statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.51, median = 12, harmonic mean = 9.01). Analyst statistics are based on the same 35 occupations with Skills questionnaire responses from at least 6 analysts (mean number of analysts = 10.29, median = 12.0, harmonic mean = 8.66).

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Table 4-15 (continued)
Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Knowledges

The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: $ICC(1,k) = [BMS-WMS]/BMS$ (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
The t statistic tests for differences in the incumbent and analyst group means.
$^{*}p < .05$

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Table 4-16

Principal Components Analysis Pattern Matrix for the Analyst Level Scale: Knowledges

Descriptor	Factor F1	F2	F3	F4	F5	F6	F7	Communality
1. Admin. and Mgmt.	.88	.10	.15	.27	.14	.00	-.05	.89
2. Clerical	.37	-.38	-.08	-.14	-.08	.57	.44	.84
3. Economics and Acct.	.84	-.04	-.19	-.19	.06	.12	.19	.83
4. Sales and Marketing	.67	-.08	-.36	.25	.01	-.27	.02	.71
5. Cust. and Pers. Svc.	.43	-.58	.27	.42	.23	-.06	-.15	.85
6. Personnel and HR	.88	-.09	.13	-.04	.06	-.07	-.20	.85
7. Production Proc.	.30	.66	-.24	-.19	.02	-.46	.13	.83
8. Food Production	.13	-.13	-.03	.14	-.17	-.81	.14	.75
9. Computers and Elect.	.40	.13	-.06	.07	-.32	.72	.20	.85
10. Engineering and Tech.	.00	.91	.13	-.21	.08	.05	-.18	.94
11. Design	.17	.84	-.16	.12	-.10	.16	-.02	.81
12. Building and Constr.	.01	.56	-.24	.03	-.07	-.04	-.57	.70
13. Mechanical	-.42	.65	.01	-.33	.03	-.03	-.43	.88
14. Mathematics	.71	.45	-.07	.18	-.16	.31	.29	.94
15. Physics	-.22	.92	.20	.01	.13	-.06	.00	.95
16. Chemistry	-.05	.66	.66	.00	-.08	-.09	.09	.89
17. Biology	.04	.22	.86	.18	-.15	-.08	.20	.89
18. Psychology	.60	-.21	.53	.39	.28	.04	-.08	.92
19. Sociology and Anth.	.44	-.15	.34	.64	.44	.10	-.09	.94
20. Geography	.06	.07	.00	.43	.82	.10	.25	.94
21. Medicine and Dent.	-.03	-.14	.95	.04	.04	.08	-.06	.93
22. Therapy and Counsel.	.27	-.14	.80	.39	.14	.11	-.07	.91
23. Education and Train.	.70	.00	.28	.55	-.02	.05	-.11	.88
24. English Language	.72	.00	.30	.35	-.07	.38	.22	.92
25. Foreign Language	.39	-.21	.40	.49	.46	-.17	.11	.84
26. Fine Arts	.04	-.18	-.07	.80	-.12	-.26	-.15	.79
27. History and Archeol.	.08	.07	.16	.85	.15	.14	.19	.83
28. Philosophy and Theol.	.35	-.06	.30	.75	.33	.02	.02	.88
29. Public Safety	.27	.22	.45	-.02	.60	.03	-.36	.81
30. Law, Govt., and Juris.	.66	.00	.38	.06	.57	.03	.08	.90
31. Telecommunications	.24	-.22	.07	.12	.45	.65	.06	.75
32. Comm. and Mdia	.80	-.16	.07	.29	.04	.32	.10	.87
33. Transportation	-.08	-.02	-.20	.01	.82	.04	-.10	.74
Percent of Variance	33	15	13	9	8	6	3	
Eigenvalue	10.83	5.10	4.20	2.79	2.53	1.89	1.07	

Note. The correlation matrix was based on means calculated at the occupation level. F1 = General Management, F2 = Engineering, F3 = Allied Health Services, F4 = Art and Humanities, F5 = Law Enforcement/Public Safety, F6 = High Technology, F7 = Clerical. These loadings are based on an orthogonal varimax rotation.

Chapter 5

Education, Training, Experience, and Licensure/Certification: Evidence for the Reliability and Validity of Measures

Lance E. Anderson

American Institutes for Research

Education, training, experience, and licensure/certification are all types of information that describe the preparation needed before entering an occupation. They are ways of acquiring, or demonstrating the acquisition of knowledges and skills. As such, this information has traditionally been of great interest to career and vocational counselors, vocational rehabilitation counselors, job seekers, and employers.

Education, training, and experience are commonly recognized as mechanisms for acquiring general knowledge and basic skills (Halpern, 1994). For this reason, they have and will continue to have a significant role in the selection of employees (Dye & Reck, 1988; Monahan & Muchinsky, 1983). Workers need to be increasingly better prepared to deal with the growing complexities of the workplace brought on by tumultuous changes in technology and realization of a global economy (Goldstein & Gilliam, 1990). Therefore, education, training, and experience, as ways of acquiring knowledge and skills, will likely become more important in the future. In recognition of this, various programs have been initiated at a federal level to increase the link between education and the knowledges and skills needed to succeed in the workplace (e.g., Secretary's Commission on Achieving Necessary Skills (SCANS), DOL, 1991). Employers are also spending more money on training, likely due to the growing complexity of the workplace and the waning number of new entrants into the workforce (Cascio & Zammuto, 1987).

As education, training, and experience become recognized as more important, licensure/certification programs will become more prevalent. Scholars and blue-ribbon commissions appointed by the government and Congress (e.g., Dertouzos, Lester, & Solow, 1989; U.S. Congress, Office of Technology Assessment, 1990) agree that licensure/certification of employees is important to the high performance workplace.

The O*NET occupational information system provides information on occupations for descriptors pertaining to education, training, experience, and licensure/certification. In this chapter, we review the available evidence for the usefulness of these descriptors, beginning with the reliability and validity of the measures used in the initial O*NET data collection effort. We also examine the implications of these findings for refinement and extension of the O*NET content model. Before turning to the relevant data however, we first review the various taxonomies and the procedures used to collect information about education, training, experience, and licensure/certification.

Background

Taxonomies

O*NET measures within each of these domains are based on a set of taxonomies proposed by Anderson (1995). These taxonomies were based in general on an examination of the needs of various potential users of the O*NET, an examination of available taxonomies that exist relevant to these domains, and a review of methods commonly used by researchers to collect this type of information.

Education

Our review of DOT user surveys (Westat, 1993; Campion, M., Gowing, M., Lancaster, A., & Pearlman, K. , 1994) indicated that the following information is important to users regarding education and training:

- the amount of education needed to enter the occupation, including the degrees and certificates required; and
- the type of education needed to enter the occupation, including
  - course major, or instructional program, and
  - coursework, or courses in certain subject areas.

Next, we explored the literature for taxonomies relevant to the user needs. Although there are various education-oriented taxonomies described in the literature (e.g., Bloom, 1956; Gagne, 1985), we found one set of taxonomies relevant to user needs. This set of taxonomies is called the Classification of Instructional Programs (CIP; U.S. Department of Education, 1990).

The CIP provides classifications of education by type and amount. The "amount" taxonomy found in the CIP classifies education into categories such as high school, undergraduate, and graduate. The "type" taxonomy found in the CIP classifies education according to major area of study (e.g., Library Science [Descriptor #2u], Construction Trades [Descriptor #2k], Engineering [Descriptor #2m]). This taxonomy was designed to include all academic and occupation-specific instructional programs. These taxonomies not only address both kinds of user needs, they are also crosswalked to the current DOT and the Occupational

Employment Statistics job families. Therefore, we created O*NET measures for both taxonomies.

We also needed a taxonomy to describe coursework/subjects required for occupations. We developed this taxonomy based on a survey of courses taught by teachers (National Center for Education Statistics, 1993) and an examination of college coursework catalogs.

Training/Experience

This taxonomy includes the various types of occupation-related training and experiences. These types included Related Work Experience (Descriptor #7a), On-Site or In-Plant Training (Descriptor #7b), On-the Job Training (Descriptor #7c), and apprenticeships (Descriptor #7d). Related work experience (Descriptor #7a) refers to experience in related jobs. Acceptable performance in some jobs requires a certain amount of experience in related jobs. For example, many managerial occupations require a particular number of years of experience in a related technical job. On-Site or In-Plant Training (Descriptor #7b), On-the Job Training (Descriptor #7c), and apprenticeships (Descriptor #7d) refer to training experiences that occur in the work context. On-Site or In-Plant Training (Descriptor #7b) is organized classroom study required and provided by an employer. On-the Job Training (Descriptor #7c) is when an individual serves as a learner or trainee on the job under the instruction of a more experienced worker (DOL, 1991). Finally, apprenticeships (Descriptor #7d) are training experiences that require one or more years of On-the-Job Training (Descriptor #7c) through work experience supplemented by related instruction. Such experience is often required before one can be considered a qualified and skilled worker (DOL, 1991).

Licensure/Certification

The following ways of classifying licensure/certification programs were identified as potentially most useful to O*NET users:

- name of the license/certificate relevant to the occupation,
- criteria that must be satisfied to obtain the license/certificate, and
- entities that require the license.

The first two types of information focus on identifying the name of the license/certificate relevant to the occupation, and then determining the basic requirements needed to achieve and retain licensure/certification. This data would be of obvious interest to career/vocational counselors. The last type of information acknowledges that a license/certificate may be required by law, the employer, or a union or professional organization.

Sample and Measures

A detailed description of the procedures used to measure education, training, experience and licensure/certification requirements within the O*NET system has been provided by Anderson (1995). We used a variety of measurement scales and item types to tap the various constructs. Our goal was to collect reliable information on these constructs in a manner that would place the least burden on the respondent. Thus, we attempted to write items in simple, exact language.

The item types and measurement scales are listed by descriptor in Figure 5-1.

The sample consisted of incumbents, or people working in the occupation, each of whom was asked to rate the requirements of his or her job. The incumbent sample was obtained through a stratified random sampling of 80 occupations within a stratified random sampling of establishments (i.e., employers). A total of 722 incumbents returned questionnaires that were at

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least partially completed. From these data, we eliminated occupations with fewer than four respondents. Following this process, 598 cases remained. Figure 5-2 lists the 34 occupations and the number of incumbents who completed the ratings. Note that incumbents whose responses were retained are employed at over 100 establishments. We used these data for most of our analyses.

Results

We conducted various analyses on the data to assist in evaluating the effectiveness of these descriptors. Our analyses included calculation of descriptive statistics for each descriptor, reliability analyses for each descriptor, application of Analysis of Variance (ANOVA) procedures meant to examine sources of variation in the ratings, reliability analyses for each major area of occupational preparation, intercorrelations of the descriptors, factor analyses, and discriminant function analyses.

Before presenting the results, a note on the descriptor Instructional Program (Descriptor #2) is necessary. The Instructional Program (Descriptor #2) was intended as a single descriptor (Anderson, 1995). The purpose of the descriptor was to indicate the instructional program required for an occupation. It was not intended to gather information on the relevance of 42 separate instructional programs. However, to facilitate presentation of the descriptive statistics on the descriptor, and to allow for an evaluation of the descriptor as 42 separate descriptors, we present statistics 42 separate descriptors in many of the tables that follow. For purposes of presenting these results, each of the 42 programs is defined as a dichotomous variable with 0 indicating "not checked", and 1 indicating "checked".

Descriptive Statistics

Table 5-1 presents the basic descriptive statistics obtained for each scale. This table presents the overall, cross-occupation mean and standard deviation of the ratings where occupations were treated as the unit of analysis. The associated interrater agreement coefficients and standard errors of measurement are also presented.

The descriptive statistics are consistent with the results we expected given the occupations included in our sample. The results on general level of education are typical--the mean indicates that the average amount of education is somewhere between "High School Diploma" and "Some College Courses." In fact, over 50 percent of our respondents indicated that the general level of education required for their occupation is High School or less. This is in line with the general level of education found in the U.S. (National Center for Education Statistics, 1993).

The descriptive statistics on Instructional Program Requirement (Descriptor #2) indicate that 43% of the sample endorsed No Specific Major (Descriptor #2pp). Also, 26% of the sample endorsed more than one instructional program. The responses also appear to be consistent with the occupations in the sample. Note that at least 10 percent of the sample indicated that their occupations required a major in computer sciences, education, or health professions. This is not surprising when one considers that the sample included Computer Programmers, Education Administrators, Elementary School Teachers, Registered Nurses, and Medical and Clinical Laboratory Technologists.

Descriptors pertaining to Training/Experience and Licensure/Certification also provided results in line with our expectations. In terms of the different types of experience, Related Work Experience (Descriptor #7a) was viewed as required more often than the other types of experience, with Apprenticeship Experience (Descriptor #7d) being reported as the least frequently required type of experience. Licensure/certification was reported as required nearly thirty percent of the time. The most frequently reported requirement for a license was examination. A license was most frequently required by the employer, the law, and a union/association, respectively.

Reliability

We examined the reliability of each descriptor score by calculating an intraclass correlation for each of the ratings across occupations (Shrout & Fleiss, 1979). With this type of intraclass statistic, reliability increases as the between occupations variance is greater and the within occupations variance is lower. These interrater agreement coefficients are based on a harmonic mean of 9.04 raters per occupation and are presented in Table 5-1, along with the associated standard errors of measurement.

The reliabilities for most of the descriptors were good. The descriptor General Education Level (Descriptor #1) had a reliability of .97. Most of the descriptors pertaining to Training/Experience and Licensure/Certification had acceptable reliabilities (i.e., greater than .75). The exceptions to this include Requirements to Obtain a License: Graduate Degree (Descriptor #5b), which has a low mean and low variance in this sample, and Experience: On-Site Training Experience (Descriptor #7b), a descriptor that likely varies with different organizational training expectations, and thus varies within occupation.

When analyzed as separate descriptors, Instructional Program (Descriptor #2) provided reliabilities that varied greatly. Some of these descriptors (e.g., Health Professions [Descriptor #2q], Mechanics/Repairers [Descriptor #2x], and Law/Legal Studies [Descriptor #2s]) had reliabilities above .90, while others had reliabilities below .10 (e.g., Social Sciences/History [Descriptor #2kk], Science Technologies [Descriptor #2jj], and Philosophy/Religion [Descriptor

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#2cc]). However, over half of these descriptors had reliabilities less than .60. It is of note that descriptors with particularly low reliabilities also had low mean scores and low standard deviations. It is likely that with some of these descriptors that have such an obvious tie to specific occupations (e.g., Architecture [Descriptor #2c]), reliabilities would increase if these occupations were part of the sample.

Overall, these initial analyses indicate that virtually all independent descriptors of occupational preparation yielded adequate, consistent descriptions of occupational requirements, while Instructional Program (Descriptor #2), when analyzed as separate descriptors, showed great variance in the size of the reliability coefficients. We obtained these results with relatively small samples of incumbents within each occupation. As the size of interrater agreement coefficients depends on the number of raters, it might be useful to examine how these reliabilities would be affected by changes in the number of raters. Table 5-2 contains the results of analyses where we have adjusted the reliability coefficients to both one and 30 raters.

The pattern of the results for different numbers of raters is naturally the same, while the general level of the reliability coefficients changes. Adjusting the reliability coefficient estimates for 30 raters increases the reliability coefficients among the various domains so that approximately half of the coefficients eclipse .90, however, there are still some coefficients below .60. Most of these low reliability numbers come from the Instructional Program (Descriptor #2) descriptors. The single rater reliability coefficients show that General Education Level (Descriptor #1), and descriptors pertaining to Licensure/Certification continue to have acceptable reliability (most of them are above .60), while the reliabilities for Instructional Program (Descriptor #2) are generally inadequate.

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Analyses of Variance

Another way one might examine interrater agreement, in addition to the simple one-way analyses described above, is by examining interrater agreement under conditions where descriptors within a domain or typology are treated as a repeated measures variable. The results obtained in this analysis are presented in Tables 5-4a, 5-4b, 5-4c, and 5-4d, which present the results of these analyses for the following areas: Instructional Program (Descriptor #2), Subject Area Education Level (Descriptor #3), Licensure/Certification, and Training/Experience.

Across all five analyses, significant differences were found for the "occupations" main effect, the "descriptor" main effect, and the "descriptor by occupation" interaction. These findings are in line with our expectations. They indicate that the mean ratings vary across occupations, across descriptors, and that the pattern of ratings across descriptors differs from occupation to occupation.

The interrater agreement coefficients resulting from these analyses are presented in Table 5-5, along with the single rater and thirty rater agreement coefficients implied by these analyses. These overall analyses indicate that the ratings evidenced good interrater agreement, yielding coefficients of .78, .74, .85, and .79 for the Instructional Program (Descriptor #2), Level of Education Required in Specific Subject Areas (Descriptor #3), Licensure/Certification, and Training/Experience descriptors respectively. Single rater agreement coefficients are below .40, and with 30 raters these agreement coefficients would lie in the .90's. These results indicate that approximately 10 ratings per occupation would provide statistics with adequate reliability, while a single rater would be inadequate, and 30 ratings may be unnecessary.

The reliabilities of these descriptors when examined in the one-way analyses (Table 5-1) are generally lower than those when they are examined in the repeated measures analysis (Table

5-5). The reason for this is that the one-way analyses examine differences across occupations within descriptor only, while the repeated measures analyses examine differences across occupations across all descriptors within an area. Thus, these findings are not in conflict.

The applicability of these different reliability estimates depends on the way the data are being used. If the difference of individual descriptor scores across occupations is the only difference that is relevant, then the reliability estimates associated with the one-way analyses apply. If the mean differences between the patterns of descriptor ratings across occupations are also relevant, then the repeated-measures estimate is more appropriate. Thus the one-way estimates apply when the data are examined on a descriptor by descriptor basis, and the repeated measures estimates apply when examining the results on a set of descriptors. For example, if the query were "Is the instructional program of Architecture (Descriptor #2c) required for this job?," then the one-way estimate (.52) would be relevant, and one might conclude that the data lacks sufficient reliability to respond to the query. However, if the query were "What instructional program is relevant?," then the repeated measures estimate (.78) would be relevant, and one might conclude that the reliability is more than adequate to respond to the query.

Descriptor Relationships

Table 5-9 presents the correlations among the descriptors at the occupation level, obtained by correlating the occupation means on each descriptor. Table 5-10 presents similar correlations but at the individual level using four individuals per occupation. Because the primary concern of the present study is occupation description, we will focus on the correlations obtained at the occupation level. It is of note in this regard, however, that the pattern of relationships observed at the individual level was similar to that obtained at the occupation level,

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bearing in mind the higher reliability of the aggregate ratings, and the fact the lack of variance on some variables at the individual level preclude the calculation of correlations.

In examining the occupational correlations among descriptors, it is clear that descriptors pertaining to a given type of occupational preparation correlated highly with one another. For example, virtually all 15 descriptors pertaining to education level, with the exception of Subject Area Education Level: Technical Vocational (Descriptor #3a) and Subject Area Education Level: Business Vocational (Descriptor #3b), had intercorrelations above .50. Most descriptors pertaining to licensure/certification also had high positive intercorrelations. Finally, all descriptors pertaining to training/experience had positive intercorrelations. Training/Experience descriptors that include a training element (e.g., On-Site Training Experience [Descriptor #7b], On-the-Job Training Experience [Descriptor #7c], and Apprenticeship Experience [Descriptor #7d]) had intercorrelations above .50).

Instructional Program (Descriptor #2), when examined as separate descriptors, had largely uninterpretable intercorrelations. The low correlations are likely due to the low reliability associated with these descriptors when viewed individually, which in turn is due to the understandably very low endorsement rates of the descriptors, owing to the fact that we had just 34 occupations. Also of note is the fact that more than 50 percent of the sample indicated that only one instructional program was required. As any correlation among these descriptors would be driven by the fraction of the sample where more than one instructional program is required, these correlations may not reveal the true relationship among the various instructional programs. The correlations between these descriptors and other descriptors pertaining to Education, Training/Experience, and Licensure/Certification were also uninterpretable.

Factor Structure

To further examine the pattern of relationships among the various descriptors, we conducted a principal components factor analysis. We applied this factor analysis to the occupation level correlations among all of the descriptors of occupational preparation, save for those pertaining to Instructional Program (Descriptor #2). We chose not to include Instructional Program (Descriptor #2) as separate descriptors because of the generally low reliability and low base rate associated with these descriptors. Table 5-11 summarizes the results obtained in this analysis following a varimax rotation.

Inspection of the eigenvalues and a scree test indicated that a three factor solution provided a clear structure for summarizing the relationships among the descriptors. These factors accounted for 75% of the total variance in the ratings.

The first factor extracted in this analysis, accounting for 39% of this variance, was labeled education. General Level of Education (Descriptor #1) had a high loading on this factor (r = .87). Also, most of the descriptors pertaining to Subject Area Education Level (Descriptor #3) yielded sizable loadings on this factor. For example, Oral Communications (Descriptor #3d) (r = .93), Advanced Math (Descriptor #3g) (r = .93), English/Language Arts (Descriptor #3c) (r = .92), and Social Sciences (Descriptor #3l) (r = .92) all produced sizable loadings. Two descriptors pertaining to Subject Area Education Level (Descriptor #3) failed to load highest on this factor: Technical Vocational (Descriptor #3a) (r = .34) and Business Vocational (Descriptor #3b) (r = .32). These loadings make sense however, given that these subject areas typically result in somewhat lower levels of education (in terms of years completed) and tend to occur for different types of occupations.

The second factor extracted in this analysis, accounting for 26% of the total variance, was labeled licensure. Virtually all variables pertaining to Licensure/Certification had high loadings (r

> .90) on this factor. Two descriptors pertaining to Licensure/Certification did not have a particularly high loading on this factor: Licenses: Commercial Vehicle License (Descriptor #4a) (r = .40), and Requirements to Obtain a License: Graduate Degree (Descriptor #5b) (r = .41). The first of these two descriptors likely had a low loading due to the different nature of commercial vehicle licenses relative to other licenses. The loading for Requirements to Obtain a License: Graduate Degree (Descriptor #5b) was likely attenuated by the low base rate and variance associated with this type of degree. Subject Area Education Level: Business Vocational (Descriptor #3b) had a moderately high, but negative loading on this factor. This loading likely occurred because that subject area is not typically associated with occupations that require licensure.

The third, and final, factor extracted in this analysis accounted for 9% of the variance in descriptor ratings. This factor, labeled training, was defined in terms of occupation specific training, including Apprenticeship Experience (Descriptor #7d) (r = .85), On-the-Job Training Experience (Descriptor #7c) (r = .82), On-Site Training Experience (Descriptor #7b) (r = .79), and Subject Area Education Level: Technical Vocational (Descriptor #3a) (r = .68).

Taken as a whole, the results obtained in this analysis provide some initial evidence for the meaningfulness of different types of occupational preparation. Each factor describes different types of occupational preparation, that receive different emphasis depending on the occupation at hand.

While the factor analysis provides information as to the relationships among the descriptors, it does not directly address the issue of how the various descriptors differentiate occupations. Thus, it should not be assumed that these factors necessarily provide an adequate summary system when our concern is describing the similarities and differences among occupations.

Occupation Differences

Some initial evidence bearing on the ability of these descriptors to capture the similarities and differences among occupations might be obtained by contrasting the mean profile of occupations on the various skill scales. Table 5-12 presents the means and standard deviations of the descriptors on six occupations selected to reflect distinct types of employment: (1) General Managers and Top Executives, (2) Computer Programmers, (3) Registered Nurses, (4) Police Patrol Officers, (5) Janitors and Cleaners, and (6) Maintenance Repairers, General Utility.

The mean scores of incumbents on these descriptors meet with our expectations of the education, training, experience, and licensure/certification requirements for these occupations. According to the mean General Level of Education (Descriptor #1), these six occupations rank in terms of our expectations, with General Managers and Top Executives indicating the highest, and Janitors and Cleaners indicating the lowest requirements. Subject Area Education Level (Descriptor #3) ratings were generally higher for Computer Programmers and Registered Nurses than they were for the other occupations included in the six. Ratings on individual subject areas also met with our expectations. Computer programmers provided the highest ratings of the six on Computer Science (Descriptor #3i), Advanced Math (Descriptor #3g), and English/Language Arts (Descriptor #3c). Registered Nurses received the highest ratings of the six occupations on Biological Sciences (Descriptor #3j), Applied Sciences (Descriptor #3k), and Physical Sciences (Descriptor #3h).

Instructional Program Requirements (Descriptor #2) were generally in line with our expectations. The most frequently endorsed Instructional Program Requirement (Descriptor #2)

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for General Managers and Top Executives was Management and Administration (Descriptor #2f) (53%), for Computer Programmers, it was Computer Information Sciences (Descriptor #2i) (83%), for Registered Nurses, it was Health Professions (Descriptor #2q) (97%), for Police Patrol Officers, it was Law and Legal Studies (Descriptor #2s) (82%), for Janitors and Cleaners it was No Specific Major (Descriptor #2pp) (68%), and for Maintenance Repairers, General Utility, it was Mechanics/Repairers (Descriptor #2x) (62%).

Licensure/certification descriptors were generally rated highly by Registered Nurses and Police Patrol Officers, with 100 percent of the incumbents in both occupations indicating that licensure/certification/registration is required by their employer. Licensure/certification ratings were moderately high for Maintenance Repairers, General Utility, with 51 percent of incumbents indicating that licensure/certification/registration is required by their employer. These ratings were lowest for Computer Programmers, where 100% of incumbents marked "no" in response to all descriptors pertaining to licensure requirements.

Finally, in terms of training and experience, General Managers and Top Executives indicated the most years of experience required in related occupations. Maintenance Repairers, General Utility provided the highest ratings on three descriptors pertinent to training (On-Site Training Experience [Descriptor #7b], On-the-Job Training Experience [Descriptor #7c], and Apprenticeship Experience [Descriptor #7d]).

The evidence presented above does lead to a noteworthy conclusion. Specifically, it appears that the various descriptors provide a meaningful description of the similarities and differences among occupations in terms of education, training, experience, and licensure/certification. This point is of some importance since ultimately a viable descriptive system must be capable of capturing and accurately reflecting meaningful differences in all types of occupational preparation.

Discriminant Analyses

While the foregoing analysis of mean differences provided information on how the descriptors differentiated six of the occupations, we also wanted to determine the degree to which the descriptors differentiate occupations in the larger sample of occupations. We conducted a discriminant analysis to address this issue. This analysis included all of the descriptors pertaining to occupational preparation, save for Instructional Program (Descriptor #2). The results obtained in this analysis are presented in Table 5-13, which displays both the loadings on the discriminant functions and the discriminating variance attributable to a given descriptor.

Discriminant analysis addresses the question, "Do the Education, Training, Experience, and Licensure descriptors differentiate among occupations?" Table 5-13 presents the results of a discriminant analysis of the incumbent respondents from the 34 occupations included in the analyses for this chapter. Table 10-13 shows (1) the correlation between each descriptor and the first six rotated discriminant functions, (2) the sum of the squared rotated correlations between the discriminating variables (i.e., descriptors) across six discriminant functions ($\Sigma \underline{F}^2$), (3) the proportion of variance in the ratings of each descriptor accounted for by occupations (η^2), (4) the canonical correlation for each function ($\underline{R}_c$), (5) the percent of variance accounted for by each function, and (6) the eigenvalue for each function.

Using all 15 classification functions, not just the six shown in Table 5-13, 44% of the incumbents were correctly reassigned into the occupations from which they were drawn. This correct assignment rate is substantially above chance, which would be about 3% for 34 occupations, if all the occupations were of equal size.

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The best discriminators of job assignments were General Education Level (Descriptor #1), Licenses (Descriptor #4): Commercial Vehicle License (Descriptor #4a), and Related Work Experience (Descriptor #7a). The descriptors pertaining to licensure/certification were generally moderately useful in discriminating between job assignments. The descriptors pertaining to Instructional Program (Descriptor #2) and Subject Area Education Level (Descriptor #3) demonstrated less usefulness individually for differentiating job assignments in this sample. However, collectively, the educational subject area description did show utility in differentiating occupations (the fifth function).

The findings obtained in this analysis provide some clues about how these descriptors discriminate occupations. Inspection of the descriptors loading on the six functions retained in this analysis indicated that the functions appeared to reflect, respectively, (1) <u>licenses</u>, (2) <u>education level</u>, (3) <u>degree required to obtain licensure</u>, (4) <u>commercial vehicle license</u>, (5) <u>coursework required</u>, and (6) <u>work experience</u>.

Four out of the six functions were dominated by a single descriptor. General Education Level (Descriptor #1), Post Secondary Degree (Descriptor #5a) (a requirement to obtain a license), Commercial Vehicle License (Descriptor #4a), and Related Work Experience (Descriptor #7a) each loaded singularly with one of the four functions. The first function had high correlations with several variables related to licensure, and the fifth function had high correlations with several variables related to math and science coursework.

Conclusions

In this section, we consider the findings for each type of descriptor, make conclusions as to the usefulness of these descriptors, and recommend improvements. Before we turn to the conclusions of the present study, certain limitations of the present study should be noted.

Some of these limitations are relevant to every domain discussed in this report, and thus have been discussed in detail elsewhere. We summarize them here in the form of two caveats. First, although occupations and incumbents were sampled in a scientifically sound and representative manner, the number of occupations and the number of incumbents within those occupations may not be sufficient to make firm conclusions about these descriptors. Second, these analyses are necessarily limited in scope, and our conclusions may change as additional analyses are done, or as the data on education, training, experience, and licensure/certification is compared with the data from other domains.

The first caveat is especially relevant with education, training, experience, and licensure/certification descriptors, because some of these descriptors are likely to be particularly relevant for only certain occupations (e.g., Subject Area Education Level: Languages [Descriptor #3e]). If these occupations are not in the sample, then the variance and the reliability of the given descriptor will be difficult to estimate accurately.

Even bearing these caveats in mind, we believe that the findings obtained in the present study have some important implications for the assessment of education, training, experience, and licensure/certification requirements. To begin, it appears that it is possible to formulate questions and rating scales that can be used to obtain reliable, meaningful data on these descriptors. The apparent feasibility of assessing these descriptors through an incumbent survey strategy is noteworthy because it represents a relatively low-cost procedure for establishing education, training, experience, and licensure/certification requirements.

General Education Level

This descriptor was meant to determine the education level required for the occupation at hand. The scale for this descriptor was derived from the CIP, which references the different education levels. Our findings on this descriptor include:

- descriptive statistics in line with expectations,
- high reliability ,
- logical correlations with other education, training, experience, and licensure/certification descriptors,
- prominence in defining the factor of Education (factor analytic results), and
- usefulness in differentiating occupations.

These findings provide generally positive evidence for retaining the item as written. Note, however, that this conclusion is based on the premise that the level of education required is the relevant level of analysis. If it is determined that users may be more interested in the relevance of each of the levels of education, then a change in the item might be warranted. This change would amount to splitting the item into eleven different descriptors, each of which evaluates the importance of obtaining education at the given level. This will naturally provide more information, and thus increase overall reliability and validity, but it would come at the cost of adding items to an already lengthy survey.

Educational Subject Area

These descriptors were meant to determine the amount of formal education required in each of 15 different subject areas. The scale for these items was also developed from the CIP. Our findings on this set of descriptors include:

- descriptive statistics in line with expectations,
- generally adequate reliability, with a few exceptions,

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- logical correlations with other education, training, experience, and licensure/certification descriptors,
- particularly high intercorrelations,
- some loadings on the factor of Education (Descriptor #21) (factor analytic results), and
- some usefulness collectively in differentiating occupations.

These findings provide mixed evidence for retaining the descriptors as measured in this study. The descriptors appear to have reasonable internal validity; however, they provide somewhat redundant information between themselves and with General Education Level (Descriptor #1).

To determine if the same information could be obtained with fewer items, we conducted a principal components factor analysis of these descriptors alone. We discovered five factors (technical vocational, business vocational, English/language arts, foreign language, and math/science). Thus, items could be constructed that tap these broader coursework areas. Use of these revised items would reduce the overall length of the survey, while still providing essentially the same information to users. However, as mentioned previously, these findings are somewhat limited by the occupations included in this sample. Thus, we suggest further study of these descriptors with other samples of occupations. If these findings persist, we recommend reducing the descriptors down to a smaller set based on factor analysis and the needs of users.

Instructional Program

As noted previously, Instructional Program (Descriptor #2) was intended as a single descriptor with the purpose of indicating the major field of study required to perform the job. However, as 26% of the respondents to the item indicated that more than one instructional

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program was required, we decided it may be useful to evaluate Instructional Program (Descriptor #2) as 42 separate descriptors, each corresponding to the different instructional programs.

Our findings on Instructional Program (Descriptor #2), examined as 42 separate descriptors, include:

- descriptive statistics in line with expectations, with many instructional programs being endorsed by fewer than 1% of the sample,
- great variance in reliability when viewed as 42 separate descriptors, with those programs receiving little endorsement having unacceptable reliabilities, and
- generally uninterpretable correlations with other descriptors.

Our findings on Instructional Program (Descriptor #2), examined as a single descriptor, include:

- a profile of endorsement for the sample as a whole consistent with expectations,
- acceptable reliability, and
- a logical profile of endorsement for six example occupations.

Given these findings, it seems clear that Instructional Program (Descriptor #2) provides more than adequate information for its intended purpose of identifying the required instructional program. However, given that many incumbents endorsed more than one instructional program, it may be prudent to reword the item to explicitly allow respondents to check more than one. Even with this refinement, however, the item will provide limited information in that it does not allow for the evaluation of the relevance of individual instructional programs.

Information on the relevance of individual instructional programs may be valued by certain users. For example, a job seeker with a degree in Computer Sciences (Descriptor #3i) might want to examine the data on occupations to see whether or not a degree in Computer

Sciences (Descriptor #3i) is relevant. To serve the purpose of providing information on the relevance of individual instructional programs, 42 separate items would have to be created, with a separate rating for each one. This treatment of Instructional Program (Descriptor #2) would require more effort on the part of the respondents, but it may be warranted, depending on the needs of the users. It is of note that the relevance of individual instructional programs could likely also be assessed by users through an examination of occupation scores within the knowledge domain.

Our recommendations on this descriptor are to (1) reword the item to make it clear that more than one instructional program can be endorsed, and (2) determine if the needs of the users to have information on the relevance of individual instructional programs warrants the costs of expanding the item to 42 separate items.

Licensure/Certification

These descriptors were meant to determine (1) whether or not licensure/certification/registration is required, (2) the type of license/certification/registration required, (3) the requirements for obtaining licensure/certification/registration, and (4) entities requiring the licensure/certification/registration. There are 12 items, 11 with a response scale of "yes/no," and one "fill in the blank." Our findings on this set of descriptors include:

- descriptive statistics in line with expectations,
- generally high reliability,
- logical correlations with other education, training, experience, and licensure/certification descriptors,
- some variables have particularly high intercorrelations,
- loadings on the factor of Licensure (factor analytic results), and

- some usefulness in differentiating occupations.

These findings provide evidence for retaining the descriptors as measured in this study. The descriptors appear to have reasonable internal validity, and they are useful for differentiating among occupations.

However, some of the descriptors provide statistically redundant information. With the occupations in our sample, some of the requirements to obtain and retain licensure certification/registration have intercorrelations of .90 or higher (i.e., On-the-Job Training Experience [Descriptor #5c], Examination [Descriptor #5d], Character References [Descriptor #5e], and Coursework [Descriptor #5f]). In addition, when a non-vehicle license was reported as required, it was also usually reported as required by both the employer and the law--thus, the three descriptors relevant to these issues had intercorrelations of .90 or higher.

Given these statistical redundancies, the items might be collapsed so that, at least in theory, the same amount of information could be gathered with fewer items. However, we advise caution before taking this step. The items are generally distinct in terms of content, and additional samples including other occupations may reveal less statistical redundancy.

Training/Experience

These descriptors were meant to determine the amount of training/experience required for the given occupation. There are four items with a response scale of "years of experience" based on an expanded version of the scale used to assign Specific Vocational Preparation in the current DOT (DOL, 1991). Our findings on this set of descriptors include:

- descriptive statistics in line with expectations,
- adequate reliability,

- logical correlations with other education, training, experience, and licensure/certification descriptors,
- loadings on the factor of Training (factor analytic results),
- some usefulness in differentiating occupations.

These findings provide evidence for retaining the descriptors as measured in this study. The descriptors appear to have reasonable internal validity, and they are useful for differentiating among occupations.

Summary

We found that the education, training, experience, and licensure/certification descriptors have acceptable reliability and validity. Thus, in general, we recommend that the descriptor measures be retained as used in the prototype. A refinement to one descriptor is strongly recommended (i.e., Instructional Program Requirements [Descriptor #2]). Other refinements to reduce redundancies in the measures should be considered if the data in additional samples indicate the stability of these findings.

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Figure 5-1

O*NET Descriptors for Education, Training, Licensure/Certification, and Experience, Listed by Item Type and Scale Type

Category	Descriptors	Item Type	Scale Type
General Education Level		Check level required	Twelve point degree level (1 = Less than a High School Diploma, 12 = Post-Doctoral Certificate)
Instructional Program Required (42 descriptors):	Agriculture Business/Production Agricultural Sciences Architecture Area/Ethnic/Cultural Studies Biological/Life Sciences Business Management/Administrative Services Communications Communications Technologies Computer Information Sciences Conservation Construction Trades Education Engineering Engineering Technologies English Languages/Literatures Foreign Languages/Literature Health Professions Home Economics Law/legal Studies Liberal Arts/Sciences Library Science Marketing/Distribution Mathematics Mechanics/Repairers Military Technologies Interdisciplinary Studies Parks/Recreation/Leisure/Fitness Personal/Miscellaneous Services Philosophy/Religion Physical Sciences Precision Production Trades Protective Services Psychology	Check the instructional program required	42 options are presented, (e.g., Biological/Life Science; Management & Admin; Law/legal Studies;Transportation/Moving; No Specific Major)

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Figure 5-1 (continued)
O*NET Descriptors for Education, Training, Licensure/Certification, and Experience, Listed by Item Type and Scale Type

Category	Descriptors	Item Type	Scale Type
	Public Administration/Services ROTC Science Technologies Social Sciences/History Theological Studies Transportation/Moving Visual/Performng Arts Vocational Home Economics No Specific Major		
Subject Area Education Level (15 descriptors):	Technical Vocational Business Vocational English/Lang Arts Oral Communications Languages Basic Math Advanced Math Physical Sciences Computer Sciences Biological Sciences Applied Sciences Social Science s Arts Humanities Physical Education	Check highest level of educational coursework required	Five point level scale (0 = not required, 4 = graduate school or other post undergraduate)
Licenses Required (2 descriptors)	Commercial Vehicle Lic Non-Vehicle License	Check "yes" if required, "no" if not required	(0 = no, 1 = yes)
Licenses Named	Licenses Named	List licenses required	Analyzed two ways: Qualitative, and Quantitative (0 = no license listed; 1 = one or more licenses listed)
Requirement to Obtain a License License (6 descriptors)	Post Secondary Degree Graduate Degree On-the-Job Training Examination Character References Coursework	Check "yes" if required, "no" if not required	(0 = no, 1 = yes)
Who Requires License (3 descriptors)	Law Employer Union/Association	Check "yes" if required by this entity, "no" if not	(0 = no, 1 = yes)

Figure 5-1 (continued)
O*NET Descriptors for Education, Training, Licensure/Certification, and Experience, Listed by Item Type and Scale Type

Category	Descriptors	Item Type	Scale Type
		required	
Related Work Experience (4 descriptors)	On-Site Training Experience On-the-Job Training Experience Apprenticeship Experience	Check level of experience required	Eleven point scale (0 = not applicable or none, 10 = over 10 years)

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Figure 5-2

Thirty-Four Occupations With Four or More Incumbents Completing the Skills Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	11
19005	General Managers & Top Executives	38
22135	Mechanical Engineers	6
25105	Computer Programmers	6
27311	Recreation Workers	7
31303	Teachers, Preschool	4
31305	Teachers, Elementary School	7
31502	Librarians, Professional	4
32502	Registered Nurses	29
32902	Medical & Clinical Laboratory Technologists	8
49008	Salespersons, Except Scientific & Retail	7
49011	Salespersons, Retail	22
49017	Counter & Rental Clerks	5
49021	Stock Clerks, Sales Floor	8
49023	Cashiers	27
	Tellers	4
51002	First Line Supervisors, Clerical/Administrative	57
53121	Loan & Credit Clerks	4
53311	Insurance Claims Clerks	11
53905	Teachers' Aides & Assistants, Clerical	8
55108	Secretaries, Except Legal & Medical	66
55305	Receptionists & Information Clerks	6
55338	Bookkeeping, Accounting, & Auditing Clerks	23
55347	General Office Clerks	68
61005	Police & Detective Supervisors	11
63014	Police Patrol Officers	17
65008	Waiters & Waitresses	15
	Cooks,Restaurant	4
65038	Food Preparation Workers	14
66008	Nursing Aides, Orderlies, & Attendants	14
67005	Janitors & Cleaners	29
	Other Machinery	4
85132	Maintenance Repairers, General Utility	36
87902	Earth Drillers, Except Oil & Gas	8
89108	Machinists	4
92974	Packaging & Filling Machine Operators	10
97102	Truck Drivers, Heavy or Tractor Trailer	9
97111	Bus Drivers, Schools	10

Table 5-1

Descriptive Statistics Across Occupations and Reliability Estimates for Rated Differences Between Occupations: Education, Training, Licensure, and Experience

Descriptor	Variable M	SD	SEM[a]	r_k[b]
1. General Education Level	3.43	2.01	.37	.97
2. Instructional Program				
2a. Agriculture Business/Production	.01	.05	.03	.59
2b. Agricultural Sciences	.01	.05	.04	.43
2c. Architecture	.00	.02	.01	.52
2d. Area/Ethnic/Cultural Studies	.02	.05	.03	.57
2e. Biological/Life Sciences	.03	.07	.04	.75
2f. Business Management/ Administrative Services	.12	.15	.08	.74
2g. Communications	.10	.11	.09	.30
2h. Communications Technologies	.01	.03	.03	.00
2i. Computer Information Sciences	.12	.18	.11	.66
2j. Conservation	.00	.02	.02	.22
2k. Construction Trades	.03	.10	.04	.81
2l. Education	.10	.15	.09	.64
2m. Engineering	.03	.08	.05	.63
2n. Engineering Technologies	.03	.10	.05	.76
2o. English Languages/Literatures	.07	.09	.08	.25
2p. Foreign Languages/Literature	.03	.09	.06	.59
2q. Health Professions	.11	.23	.05	.96
2r. Home Economics	.01	.02	.02	.43
2s. Law/legal Studies	.05	.17	.03	.96
2t. Liberal Arts/Sciences	.01	.02	.02	.08
2u. Library Science	.03	.17	.03	.97
2v. Marketing/Distribution	.04	.08	.06	.47
2w. Mathematics	.11	.13	.09	.51
2x. Mechanics/Repairers	.08	.17	.05	.91
2y. Military Technologies	.01	.02	.02	.46
2z. Interdisciplinary Studies	.02	.04	.03	.41
2aa. Parks/Recreation/Leisure/Fitness	.00	.02	.02	.22
2bb. Personal/Miscellaneous Services	.02	.05	.03	.51
2cc. Philosophy/Religion	.01	.03	.03	.08
2dd. Physical Sciences	.01	.03	.03	.30
2ee. Precision Production Trades	.01	.05	.02	.73
2ff. Protective Services	.02	.04	.03	.51
2gg. Psychology	.04	.06	.05	.38
2hh. Public Administration/Services	.03	.06	.05	.32

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Table 5-1 (continued)

Descriptive Statistics Across Occupations and Reliability Estimates for Rated Differences Between Occupations: Education, Training, Licensure, and Experience

Descriptor		Variable			
		M	SD	SEM	r_k
2ii.	ROTC	.00	.02	.02	.34
2jj.	Science Technologies	.01	.02	.02	.00
2kk.	Social Sciences/History	.01	.02	.03	.00
2ll.	Theological Studies	.01	.05	.02	.73
2mm.	Transportation/Moving	.04	.11	.05	.77
2nn.	Visual/Performing Arts	.01	.03	.02	.44
2oo.	Vocational Home Economics	.03	.07	.04	.75
2pp.	No Specific Major	.43	.26	.12	.81
3. Subject Area Education Level					
3a.	Technical Vocational	.69	.44	.24	.71
3b.	Business Vocational	1.08	.41	.23	.67
3c.	English/Language Arts	1.55	.68	.31	.79
3d.	Oral Communications	1.61	.67	.30	.80
3e.	Languages	.99	.46	.41	.20
3f.	Basic Math	1.40	.56	.24	.81
3g.	Advanced Math	1.28	.78	.36	.78
3h.	Physical Sciences	1.19	.77	.38	.76
3i.	Computer Sciences	1.36	.67	.35	.73
3j.	Biological Sciences	1.15	.75	.35	.78
3k.	Applied Sciences	1.31	.71	.37	.73
3l.	Social Sciences	1.29	.77	.34	.80
3m.	Arts	.81	.52	.37	.49
3n.	Humanities	1.06	.70	.39	.68
3o.	Physical Education	.71	.47	.32	.53
4. Licenses					
4a.	Commercial Vehicle License	.15	.28	.07	.93
4b.	Non-Vehicle License	.29	.33	.08	.94
4c.	Licenses Named	.27	.33	.07	.95
5. Requirements to Obtain a License					
5a.	Post Secondary Degree	.13	.26	.05	.96
5b.	Graduate Degree	.04	.06	.05	.50
5c.	On-the-Job Training	.24	.30	.08	.93
5d.	Examination	.25	.31	.07	.95
5e.	Character References	.17	.24	.08	.89
5f.	Coursework	.20	.28	.07	.93

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Table 5-1 (continued)
Descriptive Statistics Across Occupations and Reliability Estimates for Rated Differences Between Occupations: Education, Training, Licensure, and Experience

Descriptor		Variable			
		M	SD	SEM	r_k
6. Who Requires License					
6a.	Law	.28	.33	.08	.94
6b.	Employer	.34	.36	.09	.94
6c.	Union/Association	.17	.22	.07	.90
7. Experience					
7a.	Related Work Experience	3.80	1.69	.64	.86
7b.	On-Site Training Experience	1.76	.85	.54	.59
7c.	On-the-Job Training Experience	2.49	.97	.58	.65
7d.	Apprenticeship Experience	.81	.79	.39	.75

Note. Statistics are based on 34 occupations with Education, Training, Licensure, and Experience questionnaire responses from at least 4 incumbents (mean number of incumbents = 17.50, median = 11, harmonic mean = 9.04).

[a]This estimate of the standard error of measurement was calculated as $SEM = SD * \sqrt{(1 - r_k)}$.

[b]This estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: $ICC(1,k) = [BMS-WMS]/BMS$ (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

Table 5-2

Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Education, Training, Licensure and Experience

Descriptor	Variable r_1[a]	Variable r_{30}[b]
1. General Education Level	76	99
2. Instructional Program		
2a. Agriculture Business/Production	14	83
2b. Agricultural Sciences	08	71
2c. Architecture	11	79
2d. Area/Ethnic/Cultural Studies	13	82
2e. Biological/Life Sciences	25	91
2f. Business Management/ Administrative Services	24	90
2g. Communications	05	59
2h. Communications Technologies	00	00
2i. Computer Information Sciences	18	87
2j. Conservation	03	48
2k. Construction Trades	32	94
2l. Education	16	85
2m. Engineering	16	85
2n. Engineering Technologies	26	91
2o. English Languages/Literatures	03	52
2p. Foreign Languages/Literatures	14	83
2q. Health Professions	73	99
2r. Home Economics	08	72
2s. Law/legal Studies	74	99
2t. Liberal Arts/Sciences	01	22
2u. Library Science	80	99
2v. Marketing/Distribution	09	75
2w. Mathematics	10	77
2x. Mechanics/Repairers	52	97
2y. Military Technologies	09	74
2z. Interdisciplinary Studies	07	70
2aa. Parks/Recreation/Leisure/Fitness	03	48
2bb. Personal/Miscellaneous Services	10	77
2cc. Philosophy/Religion	01	21
2dd. Physical Sciences	04	58
2ee. Precision Production Trades	23	90
2ff. Protective Services	10	78
2gg. Psychology	06	67
2hh. Public Administration/Services	05	61
2ii. ROTC	05	64
2jj. Science Technologies	00	00
2kk. Social Sciences/History	00	00

Table 5-2 (continued)
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Education, Training, Licensure and Experience

Descriptor		Variable r_1	r_{30}
2ll.	Theological Studies	23	90
2mm.	Transportation/Moving	27	92
2nn.	Visual/Performing Arts	08	73
2oo.	Vocational Home Economics	25	91
2pp.	No Specific Major	31	93
3. Educational Subject Area			
3a.	Technical Vocational	22	89
3b.	Business Vocational	18	87
3c.	English/Language Arts	29	93
3d.	Oral Communications	31	93
3e.	Languages	03	45
3f.	Basic Math	33	94
3g.	Advanced Math	28	92
3h.	Physical Sciences	26	91
3i.	Computer Sciences	23	90
3j.	Biological Sciences	28	92
3k.	Applied Sciences	23	90
3l.	Social Sciences	31	93
3m.	Arts	09	76
3n.	Humanities	19	88
3o.	Physical Education	11	79
4. Licenses			
4a.	Commercial Vehicle License	60	98
4b.	Non-Vehicle License	65	98
4c.	Licenses Named	67	98
5. Requirements to Obtain a License			
5a.	Post Secondary Degree	71	99
5b.	Graduate Degree	10	77
5c.	On-the-Job Training	61	98
5d.	Examination	66	98
5e.	Character References	48	96
5f.	Coursework	61	98
6. Who Requires License			
6a.	Law	62	98
6b.	Employer	64	98
6c.	Union/Association	51	97

Table 5-2 (continued)

Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Education, Training, Licensure and Experience

	Descriptor	Variable r_1	r_{30}
7. Experience			
7a.	Related Work Experience	40	95
7b.	On-site Training Experience	14	83
7c.	On-the-Job Training Experience	17	86
7d.	Apprenticeship Experience	25	91

Note. Reliability estimates are based on 34 occupations with Education, Training, Licensure, and Experience questionnaire responses from at least 4 incumbents (mean number of incumbents = 17.50, median = 11, harmonic mean = 9.04). Decimals are omitted.

[a]Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judge ratings across occupations: ICC(1,1) = [BMS-WMS]/[BMS+(k-1)WMS] (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

[b]Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

Table 5-4a

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation: Instructional Program Required

Source of Variation	SS	df	MS	F
Occupations	8.21	33	0.25	2.02*
S(Occupations)	70.14	564	0.12	
Descriptor	62.04	41	1.51	54.26*
Descriptor x Occupations	171.62	1353	0.13	4.55*
Descriptor x S(Occupations)	644.96	23124	0.03	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

Table 5-4b

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation: Educational Subject Area

Source of Variation	SS	df	MS	F
Occupations	1407.89	33	42.66	3.65*
S(Occupations)	6591.91	564	11.69	
Descriptor	334.66	14	23.90	43.63*
Descriptor x Occupations	968.52	462	2.10	3.83*
Descriptor x S(Occupations)	4326.42	7896	0.55	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 5-4c
Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation: Licensure

Source of Variation	SS	df	MS	F
Occupations	355.08	33	10.76	27.83*
S(Occupations)	218.09	564	0.39	
Descriptor	23.85	11	2.17	44.35*
Descriptor x Occupations	116.64	363	0.32	6.57*
Descriptor x S(Occupations)	303.31	6204	0.05	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.
*$p < .05$

Table 5-4d

Analysis of Variance for Descriptor Occupation and Relevant Interactions as Sources of Variation: Experience

Source of Variation	SS	df	MS	F
Occupations	1277.29	33	38.71	3.97*
S(Occupations)	5503.88	564	9.76	
Descriptor	1465.47	3	488.49	172.33*
Descriptor*Occupations	1357.96	99	13.72	4.84*
Descriptor*S(Occupations)	4796.17	1692	2.83	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 5-5

Interater Agreement Coefficients for Each Scale Type: Education, Training, Licensure, and Experience.

	Number of Raters on Each Variable		
Scale Type	r_k	r_1	r_{30}
Instructional Program	78	28	92
Educational Subject Area	74	24	90
Licensure	85	38	95
Experience	79	30	93

Note. Interrater agreement coefficient estimates are based on 34 occupations with Education, Training, Licensure, and Experience questionnaire responses from at least 4 incumbents (mean number of incumbents = 17.50, median = 11, harmonic mean = 9.04). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Descriptor x Occupations" term from Tables 5-4a, 5-4b, 5-4c, and 5-4d as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

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Table 5-9

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

Desctiptor	1	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
1. General Education Level	--																	
2. Instructional Program Required																		
2a. Agriculture Business Production	13	--																
2b. Agricultural Sciences	18	94	--															
2c. Architecture	14	38	35	--														
2d. Area/Ethnic/Cultural Studies	04	07	05	32	--													
2e. Biological/Life Sciences	09	54	48	18	11	--												
2f. Business Management/ Administrative Services	05	18	17	01	18	04	--											
2g. Communications	31	00	05	39	33	23	14	--										
2h. Communications Tech	18	16	12	53	12	20	17	59	--									
2i. Computer Information Sciences	09	33	28	01	14	17	14	01	17	--								
2j. Conservation	08	35	32	95	36	37	06	43	55	03	--							
2k. Construction Trades	21	01	03	14	05	08	25	03	00	08	12	--						
2l. Education	15	21	24	14	03	09	15	03	03	11	14	01	--					
2m. Engineering	10	55	50	18	04	23	00	21	00	06	16	09	03	--				
2n. Engineering Tech	02	01	01	15	03	06	16	11	02	14	13	17	10	79	--			
2o. English Lang/Lit	27	02	01	31	28	14	05	77	44	02	32	16	02	19	12	--		
2p. Foreign Lang/Lit	22	92	92	16	01	47	18	05	16	36	14	07	23	47	05	03	--	
2q. Health Professions	35	11	07	00	04	77	13	08	12	03	20	15	06	01	12	01	05	--
2r. Home Economics	18	29	26	82	23	21	10	31	40	08	77	08	10	11	10	27	10	09
2s. Law/legal Studies	03	02	04	07	64	10	08	23	05	06	05	08	03	08	06	55	03	12
2t. Liberal Arts &Sciences	03	30	27	84	37	50	08	44	51	02	96	08	13	12	10	31	11	35
2u. Library Science	39	00	01	08	03	06	14	12	01	12	07	05	10	05	04	11	04	08
2v. Marketing/Distrib	14	20	23	65	10	17	21	35	47	02	60	01	13	04	05	34	11	07

Table 5-9 (continued)
Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

Descriptor	1	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
2w. Mathematics	36	28	26	29	02	26	08	59	27	12	29	37	04	07	02	31	20	01
2x. Mechanics/Repairers	27	47	45	15	07	21	16	04	02	06	13	81	10	41	21	17	43	08
2y. Military Technologies	05	27	24	77	81	09	11	40	37	09	73	07	11	10	09	27	09	05
2z. Interdisciplinary Studies	08	09	07	38	72	05	19	19	15	16	38	04	02	45	58	08	02	03
2aa. Parks/Recreation/ Leisure/Fitness	08	35	32	95	36	37	06	43	55	03	01	12	14	16	13	32	14	20
2bb. Personal/Misc Services	22	91	85	34	08	46	07	02	09	24	31	04	17	46	02	04	83	04
2cc. Philosophy/Religion	30	20	17	64	31	33	09	31	34	09	73	01	17	14	03	37	07	32
2dd. Physical Sciences	00	15	12	51	14	14	19	08	23	13	52	14	03	74	90	04	01	02
2ee. Precision Prod Trades	17	12	09	38	08	00	14	01	15	11	36	43	05	01	01	00	01	08
2ff. Protective Services	07	08	05	38	53	04	18	36	12	13	38	44	10	01	02	47	04	05
2gg. Psychology	29	00	04	22	37	15	10	39	18	12	29	21	07	00	06	43	05	22
2hh. Public Administration/ Services	02	03	01	25	81	06	04	51	17	01	22	09	02	08	05	55	00	12
2ii. ROTC	12	32	29	88	35	13	02	41	44	01	84	10	14	13	11	55	17	04
2jj. Science Technologies	17	31	29	87	25	15	06	31	42	01	82	31	12	29	31	25	12	05
2kk. Social Sciences/History	08	28	25	83	37	27	03	46	46	01	87	06	12	09	09	56	14	12
2ll. Theological Studies	15	01	93	38	08	55	13	01	15	33	36	00	22	54	01	00	92	10
2mm. Transportation/Moving	22	21	23	65	26	01	13	30	29	18	61	61	13	09	09	12	05	11
2nn. Visual and Perf Arts	07	19	16	58	13	03	16	15	25	12	54	02	77	04	04	09	04	08
2oo. Vocational Home Econ	20	02	00	21	00	01	11	16	14	20	21	07	02	03	05	07	02	03
2pp. No Specific major	69	07	03	16	02	32	06	23	13	13	07	07	11	35	29	21	00	42
3. Subject Area Education Level																		
3a. Technical Vocational	02	05	04	08	06	02	29	16	11	18	07	79	09	44	50	32	02	00
3b. Business Vocational	27	06	06	13	10	19	37	18	12	32	16	03	24	17	14	28	14	11
3c. English/Language Arts	86	21	24	09	06	01	15	29	19	01	01	05	13	02	04	25	29	21
3d. Oral Communications	90	17	19	10	05	00	10	28	11	03	04	02	14	08	06	25	23	22
3e. Languages	38	10	13	05	12	01	27	23	08	03	05	16	26	20	16	26	09	10

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

	Descriptor	1	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
3f.	Basic Math	82	13	13	09	10	10	14	36	11	01	03	01	18	18	20	36	20	35
3g.	Advanced Math	79	11	11	04	07	11	17	39	17	00	01	02	17	25	28	41	21	29
3h.	Physical Sciences	71	12	14	07	04	18	39	29	16	11	01	18	24	18	22	36	19	40
3i.	Computer Sciences	72	21	24	18	24	16	03	46	25	23	20	04	06	11	16	44	29	06
3j.	Biological Sciences	75	12	14	06	01	32	30	22	12	22	05	01	25	02	03	30	19	59
3k.	Applied Sciences	72	09	12	08	01	31	28	24	11	14	03	09	05	25	25	32	19	58
3l.	Social Sciences	85	15	17	12	14	17	17	23	14	26	02	09	32	02	01	22	21	38
3m.	Arts	62	04	04	05	14	01	11	35	22	32	02	13	38	10	03	42	11	05
3n.	Humanities	70	10	11	07	05	04	16	22	14	27	01	07	38	04	12	21	14	14
3o.	Physical Education	52	03	01	10	01	04	29	15	23	23	05	22	42	01	07	07	02	03
4. Licenses																			
4a.	Commercial Vehicle Lic.	29	13	15	54	08	02	21	24	21	20	50	50	11	09	13	15	02	13
4b.	Non-Vehicle License	24	04	01	14	41	39	34	13	04	35	25	17	33	02	06	13	04	53
4c.	Licenses Named	25	03	01	12	41	40	33	13	05	34	23	16	34	09	14	13	04	55
5. Requirements to Obtain a License																			
5a.	Post Secondary Degree	55	12	15	09	28	46	30	05	06	28	07	11	25	03	04	14	17	80
5b.	Graduate Degree	20	02	06	20	00	23	34	15	12	25	28	10	45	24	29	03	14	27
5c.	On-the-Job Training	18	05	01	12	39	32	35	07	08	34	21	18	35	01	03	10	01	47
5d.	Examination	21	07	01	17	46	39	30	14	03	32	28	16	24	01	04	16	01	53
5e.	Character References	21	10	15	06	50	16	33	06	10	38	14	00	39	07	01	10	16	32
5f.	Coursework	27	12	16	01	48	27	29	13	08	36	12	05	35	18	15	19	17	44
6. Who Requires License																			
6a.	Law	03	21	16	26	45	40	35	23	04	26	35	23	33	00	09	24	14	39
6b.	Employer	20	08	03	32	45	31	41	20	06	36	40	12	44	01	01	22	01	37
6c.	Union/Association	14	11	13	05	33	33	35	20	12	30	21	10	49	17	10	22	09	40
7. Experience																			
7a.	Related Work Experience	42	08	03	18	02	04	12	04	06	10	16	14	31	40	34	07	09	07
7b.	Onsite Training Exp	08	18	16	10	32	01	15	12	06	10	05	19	01	30	29	24	12	30

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

Descriptor		1	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
7c.	On-the-Job Training Exp	18	02	07	15	30	00	05	28	04	15	18	37	07	09	18	18	02	17
7d.	Apprenticeship Exp	23	14	18	11	04	11	14	09	05	05	12	52	06	13	05	07	19	05

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

	Descriptor	2r	2s	2t	2u	2v	2w	2x	2y	2z	2aa	2bb	2cc	2dd	2ee	2ff	2gg	2hh	2ii
2r.	Home Economics	--																	
2s.	Law/legal Studies	03	--																
2t.	Liberal Arts	67	03	--															
2u.	Library Science	05	-04	05	--														
2v.	Marketing/Distrib	49	-05	50	-01	--													
2w.	Mathematics	16	-10	28	-12	28	--												
2x.	Mechanics/ Repairers	08	-11	10	-07	05	46	--											
2y.	Military Technologies	61	39	63	04	45	14	07	--										
2z.	Interdisciplinary Studies	28	35	36	-02	15	-06	-06	72	--									
2aa.	Parks/Recreation Leisure/Fitness	77	05	96	07	60	29	13	73	38	--								
2bb.	Personal/Misc Serv	25	-05	26	-02	18	34	41	23	05	31	--							
2cc.	Philosophy/Religion	50	30	75	01	32	11	00	46	23	73	15	--						
2dd.	Physical Sciences	39	-02	49	00	26	08	16	36	69	52	11	34	--					
2ee.	Precision Prod Trades	30	-02	30	00	19	-02	23	27	10	36	09	20	16	--				
2ff.	Protective Services	27	74	35	-03	13	28	33	49	32	38	04	47	17	09	--			
2gg.	Psychology	12	59	34	-08	-02	22	10	27	17	29	-01	71	08	-01	75	--		
2hh.	Public Administration	16	82	19	-05	12	12	-12	67	57	22	00	27	04	03	61	50	--	
2ii.	ROTC	71	45	73	06	54	23	10	67	31	84	28	72	43	32	64	46	44	--
2jj.	Science Technologies	70	04	74	05	55	34	37	65	31	82	26	55	54	31	34	18	22	75
2kk.	Social Sciences/ Hist	66	41	84	03	50	23	05	62	31	87	23	79	43	29	61	51	43	94
2ll.	Theological Studies	30	-02	30	00	19	29	48	27	10	36	92	20	16	12	09	-01	03	32
2mm.	Transportation/ Moving	50	05	51	00	39	46	53	56	27	61	14	34	30	20	61	33	18	55
2nn.	Visual and Perf Arts	45	-01	47	01	41	12	03	42	17	54	19	32	25	19	16	03	11	49
2oo.	Vocational Home Econ	25	-07	19	-04	07	-01	07	12	00	21	22	09	09	03	00	10	-07	16
2pp.	No Specific major	21	-18	00	-27	17	15	-09	10	-18	07	08	-14	-23	11	-19	-31	-06	05
3.	Subject Area Education Level																		
3a.	Technical Vocational	00	-07	05	-07	01	22	69	02	18	07	06	05	42	42	29	19	-11	05

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

	Descriptor	2r	2s	2t	2u	2v	2w	2x	2y	2z	2aa	2bb	2cc	2dd	2ee	2ff	2gg	2hh	2ii
3b.	Business Vocational	-25	-13	-16	-15	-08	02	-07	-07	10	-16	-14	-04	04	01	-15	06	02	-21
3c.	English/Language Arts	-13	14	05	44	-15	-32	-15	-04	10	-01	-28	32	06	01	18	40	03	-01
3d.	Oral Communications	-19	10	00	36	-09	-33	-18	-03	13	-04	-27	29	06	-01	09	36	03	-05
3e.	Languages	-04	-06	04	58	-05	-08	09	-05	08	05	11	10	20	20	08	11	-15	05
3f.	Basic Math	-21	-12	02	34	-04	-27	-10	-12	09	-03	-23	13	19	-01	-07	09	-17	-12
3g.	Advanced Math	-10	-10	04	33	-03	-29	-10	-06	19	01	-20	16	28	08	-06	10	-15	-07
3h.	Physical Sciences	-12	-05	07	35	-18	-21	02	-08	15	01	-16	18	24	09	10	23	-15	-06
3i.	Computer Sciences	-23	-14	-21	35	-16	-42	-22	-20	01	-20	-27	-03	07	14	-22	-03	-19	-20
3j.	Biological Sciences	-07	-06	14	37	-16	-25	-11	-06	03	05	-13	28	04	11	00	26	-12	-07
3k.	Applied Sciences	-08	-03	11	16	-17	-21	-02	-07	20	03	-12	28	27	07	07	33	-09	-07
3l.	Social Sciences	-12	15	06	38	-13	-35	-21	00	13	-02	-18	31	02	05	08	37	06	-06
3m.	Arts	-03	-18	-01	48	-06	-20	05	-10	-05	-02	-05	21	04	12	-07	15	-23	-11
3n.	Humanities	-08	10	04	48	-12	-24	-07	-04	-03	-01	-10	32	-08	19	10	37	00	-01
3o.	Physical Education	-14	24	-01	47	-04	-05	14	-10	-06	-05	-04	24	-06	06	35	42	03	07
4. Licenses																			
4a.	Commercial Vehicle Lic	42	-01	42	-03	36	41	46	36	15	50	12	31	31	14	48	26	02	47
4b.	Non-Vehicle License	23	41	31	-14	-08	02	16	29	25	25	-02	40	08	-08	58	55	31	26
4c.	Licenses Named	21	41	30	-13	-09	02	14	28	20	23	-02	39	00	-09	57	55	31	24
5. Requirements to Obtain a License																			
5a.	Post Secondary Degree	-02	08	20	-10	-22	-22	-16	09	21	07	-16	27	04	-12	08	29	09	-11
5b.	Graduate Degree	44	-13	32	-09	-02	10	00	09	26	28	-01	31	41	-02	13	28	-08	13
5c.	On-the-Job Training	16	42	25	-13	-14	00	18	28	25	21	-01	30	08	-08	57	46	31	25
5d.	Examination	21	46	33	-12	-07	00	15	34	30	28	00	39	11	-06	61	53	36	31
5e.	Character References	07	47	18	-12	-16	-16	-02	33	35	14	-13	21	08	-10	43	35	41	17
5f.	Coursework	12	51	20	-13	-16	-11	-01	26	23	12	-17	31	-05	-12	54	53	40	18
6. Who Requires License																			
6a.	Law	30	45	38	-12	05	17	31	39	24	35	15	39	08	-03	65	50	36	38
6b.	Employer	34	45	43	-01	08	04	16	43	30	40	05	46	18	-02	58	49	38	44

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

Descriptor	2r	2s	2t	2u	2v	2w	2x	2y	2z	2aa	2bb	2cc	2dd	2ee	2ff	2gg	2hh	2ii
6c. Union/Association	14	37	32	-13	-12	-02	05	14	11	21	-09	35	02	-10	48	53	23	20
7. Experience																		
7a. Related Work Experience	07	-13	13	21	14	08	11	17	25	16	02	23	32	05	-03	21	04	06
7b. On-site Training Exp	07	40	00	-10	12	-04	27	31	38	05	14	-02	24	34	25	11	42	19
7c. On-the-Job Training Exp	-19	32	-20	-33	02	22	33	18	29	-18	-03	-30	03	11	29	13	44	-09
7d. Apprenticeship Exp	-15	19	-14	-19	02	35	62	00	-09	-12	18	-07	-07	20	28	26	17	-02

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

Descriptor	2jj	2kk	2ll	2mm	2nn	2oo	2pp	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k
2jj. Science Technologies	--																	
2kk. Social Sciences/Hist	73	--																
2ll. Theological Studies	31	29	--															
2mm. Transportation/Moving	59	49	20	--														
2nn. Visual and Perf Arts	48	45	19	32	--													
2oo. Vocational Home Econ	21	14	03	10	06	--												
2pp. No Specific Major	10	-01	-04	12	-02	21	--											
3. Subject Area Education Level																		
3a. Technical Vocational	24	01	05	35	12	12	-35	--										
3b. Business Vocational	-10	-16	-09	-14	-21	-23	-16	14	--									
3c. English/Language Arts	-14	06	-23	-06	11	-17	-72	22	32	--								
3d. Oral Communications	-16	-01	-19	-12	09	-20	-70	20	42	96	--							
3e. Languages	-05	01	11	01	23	03	-39	38	16	60	58	--						
3f. Basic Math	-11	-08	-15	-14	19	-28	-77	30	30	83	88	54	--					
3g. Advanced Math	-08	-07	-13	-10	20	-18	-74	38	30	83	87	63	93	--				
3h. Physical Sciences	-11	-04	-12	-01	22	-06	-76	50	10	81	79	67	87	91	--			
3i. Computer Sciences	-21	-21	-22	-30	01	-19	-58	22	55	78	83	58	80	85	70	--		
3j. Biological Sciences	-12	-01	-11	-15	21	00	-66	32	-01	73	71	54	77	79	90	59	--	
3k. Applied Sciences	-11	-02	-10	-09	05	-03	-72	48	21	74	77	49	81	87	91	66	88	--
3l. Social Sciences	-19	00	-16	-20	22	-04	-69	24	11	86	85	57	78	80	83	63	89	81
3m. Arts	-07	-12	-04	-07	30	00	-41	38	10	64	60	72	56	66	67	53	73	58
3n. Humanities	-13	01	-10	-12	28	-01	-49	29	04	77	72	70	59	66	71	53	80	63
3o. Physical Education	-14	07	-03	05	26	-05	-49	38	02	72	66	77	54	57	68	43	63	52
4. Licenses																		
4a. Commercial Vehicle Lic.	49	41	14	91	25	10	21	26	-26	-17	-23	-03	-26	-19	-09	-35	-22	-16
4b. Non-Vehicle License	09	31	04	39	25	00	-40	21	-39	24	17	-10	16	17	39	-17	44	42
4c. Licenses Named	06	29	04	36	25	00	-38	18	-39	24	17	-10	16	16	38	-17	45	41

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

Descriptor		2jj	2kk	2ll	2mm	2nn	2oo	2pp	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k
5. Requirements to Obtain a License																			
5a.	Post Secondary Degree	-13	01	-12	-09	16	-06	-53	12	-12	43	43	-02	53	47	61	18	73	70
5b.	Graduate Degre	12	17	-02	20	47	15	-25	30	-09	29	22	30	22	34	44	09	39	45
5c.	On-the-Job Training	08	28	06	38	27	-04	-39	20	-44	18	10	-11	15	14	37	-18	39	36
5d.	Examination	11	35	07	40	19	-02	-40	17	-41	20	13	-14	13	14	34	-19	39	38
5e.	Character References	04	20	-10	24	33	-03	-32	07	-45	14	08	-18	11	12	28	-17	33	26
5f.	Coursework	-04	23	-12	24	24	-02	-37	07	-41	26	18	-14	13	14	32	-15	40	34
6. Who Requires License																			
6a.	Law	21	41	21	53	28	02	-24	16	-49	06	-01	-16	-03	-04	17	-36	19	18
6b.	Employer	28	46	09	43	45	10	-32	15	-50	19	12	-06	12	11	30	-22	34	28
6c.	Union/Association	03	30	-10	19	35	19	-30	12	-47	23	15	02	12	09	32	-22	38	30
7. Experience																			
7a.	Related Work Experience	27	09	05	11	-17	05	-24	18	59	39	44	14	31	28	13	42	03	21
7b.	On-site Training Exp	20	13	18	00	06	03	-08	28	14	-01	05	09	-03	03	-06	09	-16	
7c.	On-the-Job Training Exp	00	-12	-02	05	-10	02	-15	37	22	-12	-05	-15	-06	-07	-06	-02	-17	00
7d.	Apprenticeship Exp	12	-08	15	10	-17	13	-04	56	16	-16	-10	10	-12	-10	-04	-09	-04	06

Table 5-9 (continued)

Intercorrelations of Descriptors (Occupation-Level Data): Education, Training, Licensure, and Experience

Descriptor	3l	3m	3n	3o	4a	4b	4c	5a	5b	5c	5d	5e	5f	6a	6b	6c	7a	7b	7c
3l. Social Sciences	--																		
3m. Arts	76	--																	
3n. Humanities	90	90	--																
3o. Physical Education	75	75	84	--															
4. Licenses																			
4a. Commercial Vehicle Lic.	-30	-13	-20	01	--														
4b. Non-Vehicle License	39	11	24	28	37	--													
4c. Licenses Named	40	12	26	29	33	100	--												
5. Requirements to Obtain a License																			
5a. Post Secondary Degree	64	25	38	22	-16	74	75	--											
5b. Graduate Degree	40	41	37	29	20	46	44	44	--										
5c. On-the-Job Training	32	04	17	24	37	98	97	70	37	--									
5d. Examination	32	01	16	21	38	98	97	70	34	98	--								
5e. Character References	33	03	18	16	26	88	86	66	31	92	89	--							
5f. Coursework	43	10	29	29	22	95	95	71	40	93	93	93	--						
6. Who Requires License																			
6a. Law	16	-08	07	22	54	93	92	52	31	92	93	83	86	--					
6b. Employer	34	08	23	31	44	91	90	60	41	91	90	89	88	94	--				
6c. Union/Association	42	12	33	37	20	80	81	63	53	78	76	77	85	76	82	--			
7. Experience																			
7a. Related Work Experience	18	14	12	05	-03	-28	-30	-12	01	-37	-28	-38	-35	-31	-25	-37	--		
7b. On-site Training Exp	02	-04	01	10	-08	-05	-07	-19	-05	-05	-03	04	00	03	05	-01	28	--	
7c. On-the-Job Training Exp	-09	-25	-18	-06	-09	06	06	-03	-08	07	08	10	10	09	02	06	16	71	--
7d. Apprenticeship Exp	-07	03	03	20	07	04	05	-12	-14	03	01	-06	-01	10	03	06	06	54	61

Table 5-10

Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor	1	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
1. General Education Level	--																	
2. Instructional Program Required																		
2a. Agriculture Business	-09	--																
2b. Agricultural Sciences	02	-01	--															
2c. Architecture	-	-	-	-														
2d. Area/Ethnic/Cultural	-02	-01	-01	-	--													
2e. Biological/Life Sciences	10	-01	57	-	-02	--												
2f. Business Management/ Administrative Services	02	-03	-03	-	19	-04	--											
2g. Communications	-09	-03	-03	-	35	11	15	--										
2h. Communications Tech	-	-	-	-	-	-	-	-	-									
2i. Computer Information Sciences	06	-03	22		-05	09	12	00	-	--								
2j. Conservation	-	-	-	-	-	-	-	-	-	-	-							
2k. Construction Trades	-08	-02	-02	-	-02	-03	-06	-06	-	05	-	--						
2l. Education	08	-03	21	-	13	08	04	33	-	09	-	-07	--					
2m. Engineering	-03	-01	49		-02	27	-05	-06	-	06	-	22	05	--				
2n. Engineering Tech	03	-02	-02	-	-02	-03	-06	-07	-	-08	-	19	-08	43	--			
2o. English Lang/Lit	06	-02	-02	-	-03	-04	04	31	-	18	-	-05	26	-04	-05	--		
2p. Foreign Lang/Lit	-03	-01	57	-	-02	32	32	-05	-	24	-	-03	23	27	-03	-04	--	
2q. Health Professions	22	-03	24	-	-04	26	-02	02	-	-08	-	-07	-02	07	-07	01	10	--
2r. Home Economics	-05	-01	-01	-	-01	-01	-03	24	-	-03	-	-02	21	-01	-02	34	-01	24
2s. Law/Legal Studies	08	-01	-01	-	34	-03	11	22	-	06	-	-03	18	-03	-03	14	-03	-06
2t. Liberal Arts	06	-01	-01	-	-01	57	-03	24	-	-03	-	-02	-03	-01	-02	-02	-01	24
2u. Library Science	36	-02	-02		-02	-03	-06	-07	-	-08	-	-04	-08	-03	-04	-05	-03	-07
2v. Marketing/Distrib	-03	-01	-01	-	-02	-02	14	27	-	09	-	-03	23	-03	-03	18	32	-05
2w. Mathematics	-05	-03	23	-	14	24	05	50	-	18	-	08	23	33	16	28	09	00
2x. Mechanics/Repairers	-13	-03	29	-	-04	14	01	15	-	12	-	44	11	42	22	-08	32	-03
2y. Military Technologies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-10 (continued)

Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor	1	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
2z. Interdisciplinary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2aa. Parks/Recreation/ Leisure/Fitness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2bb. Personal/Misc Services	02	-01	01	-	-01	57	-03	-03	-	22	-	-02	21	49	-02	-02	57	24
2cc. Philosophy/Religion	06	-01	-01	-	-01	57	-03	24	-	-03	-	-02	-03	-01	-02	-02	-01	24
2dd. Physical Sciences	02	-01	-01	-	-01	-01	-03	-03	-	-03	-	-02	-03	-01	44	-02	-01	-03
2ee. Precision Prod trades	-02	-01	-01	-	-01	-01	-03	-03	-	-03	-	-02	-03	-01	-02	-02	-01	-03
2ff. Protective Services	-05	-01	-01	-	-01	-01	-03	01	-	-03	-	20	00	-01	-02	-02	-01	-03
2gg. Psychology	01	-01	-01	-	-02	-02	-05	11	-	-06	-	-01	-06	-03	-03	39	-02	-06
2hh. Public Administration/ Services	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2ii. ROTC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2jj. Science Technologies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2kk. Social Sciences/Hist	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2ll. Theological Studies	02	-01	01	-	-01	57	-03	-03	-	22	-	-02	21	49	-02	-02	57	24
2mm. Transportation/Moving	-13	-02	-02	-	-02	-03	-06	08	-	-07	-	26	-07	-03	-04	-05	-03	-07
2nn. Visual and Perf Arts	10	-01	-01	-	-01	-01	-03	-03	-	-03	-	-02	21	-01	-02	-02	-01	-03
2oo. Vocational Home Econ	02	-01	-01	-	-01	-01	29	24	-	-03	-	-02	-03	-01	-02	-02	-01	-03
2pp. No Specific Major	-38	-08	-08	-	02	-13	-21	-17	-	-26	-	-16	-31	-15	-17	-16	-13	-32
3. Subject Area Education Level																		
3a. Technical Vocational	08	-06	21	-	-08	11	08	03	-	-06	-	29	04	38	23	-01	16	04
3b. Business Vocational	20	-09	19	-	-06	06	27	-02	-	15	-	19	-02	19	05	00	16	01
3c. English/Language Arts	52	-11	11	-	-10	07	04	-01	-	06	-	03	15	04	-05	06	07	16
3d. Oral Communications	49	-11	11	-	-06	14	13	09	-	07	-	04	17	10	04	-01	10	08
3e. Languages	11	00	14	-	-10	12	06	01	-	08	-	08	15	10	-04	-01	20	-03
3f. Basic Math	46	-12	14	-	-05	04	13	-01	-	09	-	03	26	20	20	-13	15	09
3g. Advanced Math	43	-09	11	-	-12	15	05	-05	-	10	-	06	16	15	19	-04	08	20
3h. Physical Sciences	35	-07	10	-	-11	18	02	01	-	04	-	08	10	15	13	-04	08	30
3i. Computer Sciences	38	-09	12	-	-13	13	12	-04	-	24	-	-03	07	14	08	-04	09	06

Table 5-10 (continued)

Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor	1	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q
3j. Biological Sciences	35	-07	11	-	-10	16	08	-01	-	-01	-	03	12	11	-08	-05	09	32
3k. Applied Sciences	32	-07	10	-	-11	14	17	01	-	02	-	08	02	18	11	-07	14	29
3l. Social Sciences	45	-08	11	-	-11	15	04	-04	-	03	-	01	16	06	-04	00	12	23
3m. Arts	21	-06	15	-	-08	18	14	01	-	-04	-	11	14	13	-10	-07	14	-03
3n. Humanities	32	-07	12	-	-09	14	10	00	-	08	-	08	15	09	-12	-03	10	03
3o. Physical Education	26	-05	18	-	-08	22	11	00	-	03	-	07	16	13	-09	13	18	06
4. Licenses																		
4a. Commercial Vehicle Lic.	-22	-04	-04	-	-05	-06	02	25	-	07	-	21	07	-07	02	-02	07	-16
4b. Non-Vehicle License	22	-06	-06	-	05	01	-02	08	-	-16	-	10	16	-11	-04	04	01	41
4c. Licenses Named	21	-06	-06	-	06	01	-01	09	-	-16	-	10	17	-11	-13	05	01	42
5. Requirements to Obtain a License																		
5a. Post Secondary Degree	41	-04	-04	-	11	07	-06	10	-	-18	-	-08	22	-08	02	01	-07	58
5b. Graduate Degree	15	-02	-02	-	-03	17	-08	20	-	-11	-	-05	10	-05	11	06	-04	33
5c. On-the-Job Training	14	-05	-05	-	06	02	00	06	-	-19	-	12	14	-11	-03	-01	02	32
5d. Examination	08	-05	-05	-	07	03	-05	09	-	-13	-	03	06	-10	-03	03	03	33
5e. Character References	12	-04	-04	-	10	05	-01	01	-	-20	-	12	13	-09	00	-05	-08	17
5f. Coursework	14	-05	-05	-	08	04	-03	05	-	-16	-	05	20	-09	-10	09	-08	25
6. Who Requires License																		
6a. Law	-06	12	-06	-	18	00	02	26	-	-13	-	09	13	-12	-14	03	11	18
6b. Employer	15	-06	-06	-	04	00	02	20	-	-10	-	-14	20	-13	-06	15	10	31
6c. Union/Association	09	-04	-04	-	28	07	09	22	-	-17	-	-08	05	-08	-09	-03	-07	40
7. Experience																		
7a. Related Work Experience	21	00	00	-	09	-05	18	13	-	13	-	12	04	14	20	06	05	-10
7b. On-site Training Exp	-07	09	17	-	18	08	22	22	-	11	-	21	08	32	22	04	13	-02
7c. On-the-Job Training Exp	-14	05	05	-	22	03	30	32	-	01	-	28	09	21	15	06	07	-06
7d. Apprenticeship Exp	-08	-04	23	-	-06	09	25	21	-	16	-	31	20	36	18	07	25	13

Table 5-10 (continued)
Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

	Descriptor	2r	2s	2t	2u	2v	2w	2x	2y	2z	2aa	2bb	2cc	2dd	2ee	2ff	2gg	2hh	2ii
2r.	Home Economics	--																	
2s.	Law/Legal Studies	-01	--																
2t.	Liberal Arts	-01	-01	--															
2u.	Library Science	-02	-03	-02	--														
2v.	Marketing/Distrib	-01	-03	-01	-03	--													
2w.	Mathematics	-03	06	23	-08	24	--												
2x.	Mechanics/Repairers	-03	-05	-03	-06	14	38	--											
2y.	Military Technologies	-	-	-	-	-	-	-	-										
2z.	Interdisciplinary	-	-	-	-	-	-	-	-	-									
2aa.	Parks/Recreation/	-	-	-	-	-	-	-	-	-	-								
2bb.	Personal/Misc Services	-01	-01	-01	-02	-01	23	29	-	-	-	--							
	Leisure/Fitness																		
2cc.	Philosophy/Religion	-01	-01	01	-02	-01	23	-03	-	-	-	-01	--						
2dd.	Physical Sciences	-01	-01	-01	-02	-01	-03	-03	-	-	-	-01	-01	--					
2ee.	Precision Prod trades	-01	-01	-01	-02	-01	-03	-03	-	-	-	-01	-01	-01	--				
2ff.	Protective Services	-01	-01	-01	-02	-01	08	15	-	-	-	-01	-01	-01	-01	--			
2gg.	Psychology	-01	-03	-01	-03	-02	10	-03	-	-	-	-01	-01	-01	-01	07	--		
2hh.	Public Administration/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Services																		
2ii.	ROTC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2jj.	Science Technologies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2kk.	Social Sciences/Hist	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2ll.	Theological Studies	-01	-01	-01	-02	-01	23	29	-	-		01	-01	-01	-01	-01	-01	-	-
2mm.	Transportation/Moving	-02	-03	-02	-04	26	08	29	-	-		-02	-02	-02	-02	20	-01	-	-
2nn.	Visual and Perf Arts	-01	-01	-01	-02	-01	-03	-03	-	-		-01	-01	-01	-01	-01	-01	-	-
2oo.	Vocational Home Econ	-01	-01	-01	-02	-01	-03	-03	-	-		-01	-01	-01	-01	-01	-01	-	-
2pp.	No Specific Major	-08	-15	-08	-17	-13	-16	-26	-	-		-08	-08	-08	-08	-03	-13	-	-
3. Subject Area Education Level																			
3a.	Technical Vocational	-06	-03	-06	-05	11	21	36	-	-		21	-06	-06	12	03	-05	-	-

Table 5-10 (continued)
Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor		2r	2s	2t	2u	2v	2w	2x	2y	2z	2aa	2bb	2cc	2dd	2ee	2ff	2gg	2hh	2ii
3b.	Business Vocational	-09	-09	-09	-04	16	13	18	-	-		19	-09	00	-09	00	06	-	-
3c.	English/Language Arts	-04	00	04	25	11	-03	03	-	-		11	04	04	-11	-04	06	-	-
3d.	Oral Communications	-04	03	03	24	10	03	14	-	-	-	11	03	03	-11	03	06	-	-
3e.	Languages	-07	-04	-07	18	24	09	18	-	-	-	14	-07	-07	-07	07	-08	-	-
3f.	Basic Math	-03	-02	-03	16	04	09	01	-	-	-	14	-03	-03	05	05	-15	-	-
3g.	Advanced Math	-02	-04	04	19	11	03	05	-	-	-	11	04	11	-09	04	-11	-	-
3h.	Physical Sciences	-01	-03	10	13	11	07	13	-	-	-	10	10	10	-07	10	-09	-	-
3i.	Computer Sciences	-02	-04	-02	21	13	02	07	-	-	-	12	-02	-09	05	-09	-13	-	-
3j.	Biological Sciences	-01	-02	05	17	09	00	07	-	-	-	11	05	-07	-07	-07	-09	-	-
3k.	Applied Sciences	-02	-03	04	10	18	03	15	-	-	-	10	04	10	-07	10	-09	-	-
3l.	Social Sciences	-02	-03	05	22	15	-05	-01	-	-	-	11	05	-08	-08	-08	00	-	-
3m.	Arts	01	-01	01	18	14	00	14	-	-	-	15	01	-06	-06	08	-06	-	-
3n.	Humanities	00	02	00	24	14	01	12	-	-	-	12	00	-07	-07	00	-08	-	-
3o.	Physical Education	02	09	02	16	04	04	-02	-	-	-	18	02	-05	-05	10	10	-	-
4. Licenses																			
4a.	Commercial Vehicle Lic	-04	-07	-04	-08	35	11	13	-	-	-	-04	-04	-04	-04	20	-05	-	-
4b.	Non-Vehicle License	13	08	13	-13	01	-04	00	-	-	-	-06	13	-06	-06	13	02	-	-
4c.	Licenses Named	14	08	14	-13	01	-03	01	-	-	-	-06	14	-06	-06	11	02	-	-
5. Requirements to Obtain a License																			
5a.	Post Secondary Degree	19	04	19	-09	-07	-05	-07	-	-	-	-04	19	-04	-04	-04	00	-	-
5b.	Graduate Degree	34	-05	34	-05	-04	08	03	-	-	-	-02	34	-02	-02	-02	-04	-	-
5c.	On-the-Job Training	14	09	14	-12	-09	-06	03	-	-	-	-05	14	-05	-05	14	03	-	-
5d.	Examination	04	10	15	-12	03	00	04	-	-	-	-05	15	-05	-05	15	04	-	-
5e.	Character References	01	14	18	-10	-08	-08	-09	-	-	-	-04	18	-04	-04	-04	02	-	-
5f.	Coursework	16	12	16	-10	04	-08	-13	-	-	-	-05	16	-05	-05	16	05	-	-
6. Who Requires License																			
6a.	Law	12	06	12	-14	22	04	05	-	-	-	-06	12	-06	-06	12	01	-	-
6b.	Employer	12	24	12	-06	21	00	-06	-	-	-	-06	12	-06	-06	-06	10	-	-
6c.	Union/Association	20	16	20	-09	-07	01	-06	-	-	-	-04	20	-04	-04	-04	-07	-	-

Table 5-10 (continued)

Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor		2r	2s	2t	2u	2v	2w	2x	2y	2z	2aa	2bb	2cc	2dd	2ee	2ff	2gg	2hh	2ii
7. Experience																			
7a.	Related Work Experience	-03	09	-11	10	09	16	16	-	-	-	00	-11	12	-11	-08	00	-	-
7b.	On-site Training Exp	05	26	-03	00	06	31	10	-	-	-	17	-03	13	01	-03	04	-	-
7c.	On-the-Job Training Exp	02	19	-05	-09	05	31	14	-	-	-	05	-05	-09	-02	-05	09	-	-
7d.	Apprenticeship Exp	08	10	-04	-09	09	37	21	-	-	-	23	-04	-04	-04	00	07	-	-

Table 5-10 (continued)

Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor	2jj	2kk	2ll	2mm	2nn	2oo	2pp	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k
2jj. Science Technologies	-	-																
2kk. Social Science/Hist.	-	-																
2ll. Theological Studies	-	-	--															
2mm. Transportation/Moving	-	-	-02	--	-													
2nn. Visual and Perf Arts	-	-	-01	-02	--													
2oo. Vocational Home Econ	-	-	-01	-02	-01	--												
2pp. No Specific Major	-	-	-08	-16	-08	-08	--											
3. Subject Area Education Level																		
3a. Technical Vocational	-	-	21	07	12	21	-19	--										
3b. Business Vocational	-	-	19	00	09	19	-16	51	--									
3c. English/Language Arts	-	-	11	-04	11	11	-32	40	46	--								
3d. Oral Communications	-	-	11	-04	11	11	-41	34	45	80	--							
3e. Languages	-	-	14	01	14	14	-25	61	44	60	50	--						
3f. Basic Math	-	-	14	-10	05	14	-34	33	30	48	59	29	--					
3g. Advanced Math	-	-	11	-03	11	11	-40	52	36	70	64	68	61	--				
3h. Physical Sciences	-	-	10	02	10	16	-36	57	37	70	62	71	42	83	--			
3i. Computer Sciences	-	-	12	-10	12	-03	-31	44	49	64	65	57	51	70	64	--		
3j. Biological Sciences	-	-	11	-06	11	18	-32	54	36	70	63	73	42	77	88	64	--	
3k. Applied Sciences	-	-	10	02	10	16	-37	59	47	61	59	67	38	77	83	62	85	--
3l. Social Sciences	-	-	11	-05	11	17	-35	48	33	74	62	71	46	76	78	63	85	76
3m. Arts	-	-	15	00	15	15	-16	58	38	59	54	74	38	66	66	57	74	68
3n. Humanities	-	-	12	-01	18	12	-26	51	36	65	62	76	36	68	72	66	83	70
3o. Physical Education	-	-	18	-05	02	18	-17	45	29	57	53	56	35	54	63	47	66	57
4. Licenses																		
4a. Commercial Vehicle Lic	-	-	-04	44	-04	20	-11	07	-02	-08	02	12	-02	-05	-01	-13	-05	03
4b. Non-Vehicle License	-	-	-06	19	13	-06	-28	-08	-21	07	07	-10	04	07	11	-15	13	09
4c. Licenses Named	-	-	-06	16	14	-06	-26	-08	-21	08	09	-09	02	05	12	-17	15	08

Table 5-10 (continued)

Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor	2jj	2kk	2ll	2mm	2nn	2oo	2pp	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k
5. Requirements to Obtain a License																		
5a. Post Secondary Degree	-	-	-04	-08	19	-04	-31	-01	-14	24	19	-02	22	24	29	05	32	21
5b. Graduate Degree	-	-	-02	-05	05	-02	-18	07	-10	14	14	-01	04	11	18	11	18	13
5c. On-the-Job Training	-	-	-05	22	14	-05	-26	-04	-21	05	05	-06	08	09	12	-13	12	07
5d. Examination	-	-	-05	23	15	-05	-20	-05	-23	00	01	-10	-05	02	06	-17	06	05
5e. Character References	-	-	-04	12	18	-04	-14	-10	-19	06	04	-08	01	04	07	-10	08	-02
5f. Coursework	-	-	-05	15	16	-05	-17	-07	-20	03	-04	-03	-06	05	09	-15	07	00
6. Who Requires License																		
6a. Law	-	-	-06	27	12	12	-12	-02	-20	-02	03	02	00	-04	03	-23	05	08
6b. Employer	-	-	-06	13	12	-03	-22	-07	-23	10	11	-04	03	07	12	-10	15	11
6c. Union/Association	-	-	-04	-08	20	20	-10	00	-19	14	11	00	-02	08	16	-07	15	06
7. Experience																		
7a. Related Work Experience	-	-	00	00	-11	06	-20	21	26	30	36	18	26	27	23	36	17	25
7b. On-site Training Exp	-	-	17	-05	-07	05	-16	19	15	03	15	07	19	11	08	07	05	14
7c. On-the-Job Training Exp	-	-	05	02	-09	16	-12	16	20	-03	18	01	22	05	03	06	02	04
7d. Apprenticeship Exp	-	-	23	-08	-04	20	-27	39	30	06	23	19	35	20	21	15	21	26

Table 5-10 (continued)

Intercorrelations of Descriptors (Individual-Level Data): Education, Training, Licensure, and Experience

Descriptor	3l	3m	3n	3o	4a	4b	4c	5a	5b	5c	5d	5e	5f	6a	6b	6c	7a	7b	7c
3l. Social Sciences	--																		
3m. Arts	70	--																	
3n. Humanities	81	83	--																
3o. Physical Education	63	69	70	--															
4. Licenses																			
4a. Commercial Vehicle Lic	-01	00	01	-01	--														
4b. Non-Vehicle License	17	-01	02	-01	25	--													
4c. Other Licenses Named	17	00	03	00	24	98	--												
5. Requirements to Obtain a License																			
5a. Post Secondary Degree	34	05	12	03	-14	68	66	--											
5b. Graduate Degree	20	08	14	08	-03	42	36	62	--										
5c. On-the-Job Training	18	02	02	-02	25	93	90	68	38	--									
5d. Examination	08	-07	-07	-12	26	90	88	54	35	85	--								
5e. Character References	16	00	03	-03	20	78	75	46	19	78	71	--							
5f. Coursework	14	08	08	04	16	81	82	51	27	76	71	67	--						
6. Who Requires License																			
6a. Law	10	09	06	07	44	64	65	33	17	59	62	43	50	--					
6b. Employer	23	00	09	08	30	71	69	54	38	64	68	57	55	67	--				
6c. Union/Association	16	08	07	01	03	54	56	56	44	48	54	46	44	51	49	--			
7. Experience																			
7a. Related Work Experience	21	27	25	16	-02	-09	-09	-09	03	-13	-11	-11	-15	-09	-04	-03	--		
7b. On-site Training Exp	05	11	09	09	03	-07	-05	-14	-09	-07	-05	03	-04	06	04	03	41	--	
7c. On-the-Job Training Exp	02	07	03	08	11	05	06	-07	-09	03	00	13	04	14	06	10	35	63	--
7d. Apprenticeship Exp	17	21	19	21	12	-03	-02	-03	-02	-01	-04	00	-07	07	02	-01	27	66	53

Note. N - 136 (4 incumbents selected at random from each of 34 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

A "-" indicates that one of the variables used to calculate the correlation has a standard deviation equal to 0.

Table 5-11

Principal Components Analysis Pattern Matrix for Education Training, Licensure/Certification, and Experience

Descriptor	Factor F1	F2	F3	Communality
1. General Level of Education	.87	.08	-.19	.79
3. Subject Area Education Level				
3a. Technical Vocational	.34	.13	.68	.59
3b. Business Vocational	.32	-.55	.27	.48
3c. English/Language Arts	.92	.07	-.03	.86
3d. Oral Communications	.93	-.01	.02	.87
3e. Languages	.71	-.18	.15	.56
3f. Basic Math	.90	.02	-.02	.81
3g. Advanced Math	.93	.01	.03	.87
3h. Physical Sciences	.91	.25	.05	.88
3i. Computer Sciences	.84	-.33	.04	.81
3j. Biological Sciences	.86	.32	-.10	.86
3k. Applied Sciences	.86	.25	.10	.81
3l. Social Sciences	.92	.26	-.04	.91
3m. Arts	.79	.00	.00	.63
3n. Humanities	.84	.14	-.01	.72
3o. Physical Education	.72	.19	.19	.60
4. Licenses				
4a. Commercial Vehicle License	-.28	.40	.16	.26
4b. Non-Vehicle License	.17	.97	.04	.97
4c. Licenses Named	.17	.96	.02	.96
5. Requirements to Obtain a License				
5a. Post Secondary Degree	.48	.67	-.17	.71
5b. Graduate Degree	.35	.41	.00	.29
5c. On-the-Job Training	.11	.97	.04	.95
5d. Examination	.11	.96	.04	.93
5e. Character References	.08	.92	-.02	.84
5f. Coursework	.16	.95	-.01	.92
6. Who Requires License				
6a. Law	-.06	.95	.11	.92
6b. Employer	.11	.94	.05	.90
6c. Union/Association	.15	.86	.02	.75
7. Experience				
7a. Related Work Experience	.34	-.42	.29	.38
7b. On-Site Training Experience	-.01	-.06	.79	.63
7c. On-the-Job Training Experience	-.13	.05	.82	.69
7d. Apprenticeship Experience	-.07	.02	.85	.72
Percent of Variance	40	26	9	
Eigenvalues	11.28	9.76	2.82	

Table 5-11 (continued)

Principal Components Analysis Pattern Matrix Education Training, Licensure/Certification, and Experience

Note. N = 34. The correlation matrix was based on means calculated at the occupation level. F1 = Education, F2 = Licensure, F3 = Training. These loadings are based on a varimax orthogonal rotation.

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Table 5-12

Descriptor Means and Standard Deviations on Six Example Occupations: Education, Training, Licensure, and Experience

Descriptor	General Managers & Top Executives (n=45) M	SD	Computer Programmers (n=5) M	SD	Registered Nurses (n=32) M	SD	Police Patrol Officers (n=21) M	SD	Janitors & Cleaners[a] (n=23) M	SD	Maintenance Repairers, General Utility (n=27) M	SD
1. General Educ Level	6.08	1.50	5.00	1.55	5.45	1.24	3.41	1.23	1.86	0.88	2.69	0.92
2. Instructional Program Required												
2a. Agriculture Business	0.03	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2b. Agricultural Sciences	0.03	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2c. Architecture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2d. Area/Ethnic/Cultural	0.00	0.00	0.00	0.00	0.07	0.26	0.06	0.24	0.00	0.00	0.00	0.00
2e. Biological/Life Sciences	0.00	0.00	0.00	0.00	0.31	0.47	0.00	0.00	0.00	0.00	0.03	0.17
2f. Business Management/ Administrative Services	0.53	0.51	0.00	0.00	0.00	0.00	0.12	0.33	0.11	0.31	0.00	0.00
2g. Communications	0.00	0.00	0.00	0.00	0.21	0.41	0.18	0.39	0.18	0.38	0.03	0.17
2h. Communications Tech	0.03	0.16	0.00	0.00	0.03	0.19	0.00	0.00	0.04	0.19	0.00	0.00
2i. Computer Information Sciences	0.08	0.27	0.83	0.41	0.07	0.26	0.12	0.33	0.00	0.00	0.06	0.23
2j. Conservation	0.00	0.00	0.00	0.00	0.03	0.19	0.00	0.00	0.00	0.00	0.00	0.00
2k. Construction Trades	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.26	0.28	0.45
2l. Education	0.00	0.00	0.00	0.00	0.10	0.31	0.12	0.33	0.11	0.31	0.06	0.23
2m. Engineering	0.08	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.38
2n. Engineering Technologies	0.03	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.19	0.25	0.44
2o. English Lang/Lit	0.00	0.00	0.00	0.00	0.10	0.31	0.35	0.49	0.04	0.19	0.03	0.17
2p. Foreign Lang/Lit	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.24	0.04	0.19	0.00	0.00
2q. Health Professions	0.18	0.39	0.00	0.00	0.97	0.19	0.00	0.00	0.04	0.19	0.00	0.00
2r. Home Economics	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5-12 (continued)

Descriptor Means and Standard Deviations on Six Example Occupations: Education, Training, Licensure, and Experience

	Descriptor	General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
2t.	Law/legal Studies	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.39	0.00	0.00	0.00	0.00
2u.	Liberal Arts/Sciences	0.00	0.00	0.00	0.00	0.07	0.26	0.00	0.00	0.00	0.00	0.00	0.00
2v.	Library Science	0.03	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2w.	Marketing/Distribution	0.08	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.19	0.03	0.17
2x.	Mathematics	0.03	0.16	0.00	0.00	0.14	0.35	0.06	0.24	0.04	0.19	0.22	0.42
2y.	Mechanics/Repairers	0.03	0.16	0.00	0.00	0.03	0.19	0.00	0.00	0.14	0.35	0.61	0.49
2z.	Military Technologies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Interdisciplinary Studies	0.00	0.00	0.00	0.00	0.03	0.19	0.00	0.00	0.00	0.00	0.00	0.00
2aa.	Parks/Recreation/ Leisure/Fitness	0.00	0.00	0.00	0.00	0.03	0.19	0.00	0.00	0.00	0.00	0.00	0.00
2bb.	Personal/Misc Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2cc.	Philosophy/Religion	0.00	0.00	0.00	0.00	0.07	0.26	0.06	0.24	0.00	0.00	0.00	0.00
2dd.	Physical Sciences	0.00	0.00	0.00	0.00	0.03	0.19	0.00	0.00	0.00	0.00	0.06	0.23
2ee.	Precision Prod Trades	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2ff.	Protective Services	0.00	0.00	0.00	0.00	0.03	0.19	0.18	0.39	0.00	0.00	0.03	0.17
2gg.	Psychology	0.05	0.23	0.00	0.00	0.14	0.35	0.24	0.44	0.00	0.00	0.03	0.17
2hh.	Public Administration/	0.03	0.16	0.00	0.00	0.00	0.00	0.18	0.39	0.00	0.00	0.00	0.00
2ii.	Services												
2jj.	ROTC	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.24	0.00	0.00	0.00	0.00
2kk.	Science Technologies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.23
2ll.	Social Sciences/History	0.00	0.00	0.00	0.00	0.03	0.19	0.06	0.24	0.00	0.00	0.00	0.00
2mm.	Theological Studies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5-12 (continued)

Descriptor Means and Standard Deviations on Six Example Occupations: Education, Training, Licensure, and Experience

		Occupations											
		General Managers & Top Executives (n=45)		Computer Programmers (n=5)		Registered Nurses (n=32)		Police Patrol Officers (n=21)		Janitors & Cleaners[a] (n=23)		Maintenance Repairers, General Utility (n=27)	
Descriptor		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
2t.	Transportation/Moving	0.08	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.19	0.08	0.28
2u.	Visual and Perf Arts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2v.	Vocational Home Econ	0.00	0.00	0.00	0.00	0.03	0.19	0.00	0.00	0.25	0.43	0.06	0.23
2w.	No Specific major	0.08	0.27	0.17	0.41	0.00	0.00	0.12	0.33	0.68	0.47	0.22	0.42
3. Subject Area Education Level													
3a.	Technical Vocational	0.63	0.88	0.33	0.52	0.66	1.11	0.59	0.80	0.86	1.13	1.81	0.92
3b.	Business Vocational	1.63	1.00	1.33	0.52	0.79	0.90	0.65	0.70	0.72	1.13	0.97	1.13
3c.	English/Language Arts	2.37	0.94	2.50	0.84	2.48	1.18	2.13	0.99	1.07	1.10	1.08	1.11
3d.	Oral Communications	2.51	0.98	2.50	0.84	2.28	1.16	1.94	1.03	1.24	1.15	1.14	1.17
3e.	Languages	0.68	1.09	1.17	1.47	1.03	1.40	1.06	1.39	0.90	1.26	0.61	0.96
3f.	Basic Math	2.18	1.06	2.17	0.98	2.07	1.07	1.18	1.01	0.93	0.96	1.44	1.00
3g.	Advanced Math	2.00	1.27	2.50	0.84	1.97	1.43	0.94	1.39	0.86	1.19	1.08	1.08
3h.	Physical Sciences	1.24	1.42	1.83	1.33	2.34	1.32	1.18	1.47	1.00	1.46	0.97	1.21
3i.	Computer.Sciences	1.97	1.15	2.83	0.41	1.00	1.22	1.06	1.34	0.86	1.22	1.00	1.10
3j.	Biological Sciences	1.00	1.27	1.00	1.10	2.76	0.79	1.00	1.37	0.97	1.55	0.75	1.16
3k.	Applied Sciences	1.68	1.54	1.67	1.51	2.76	0.79	1.29	1.65	1.03	1.52	1.19	1.31
3l.	Social Sciences	2.05	1.29	1.00	1.10	2.72	0.92	1.76	1.44	1.00	1.54	0.69	1.04
3m.	Arts	0.71	1.04	0.33	0.82	1.07	1.44	0.44	0.79	0.69	1.20	0.80	1.12
3n.	Humanities	1.30	1.29	0.50	0.84	1.86	1.53	1.53	1.46	0.83	1.39	0.67	1.07
3o.	Physical Education	0.61	0.97	0.33	0.82	1.14	1.38	1.59	1.23	0.69	1.26	0.56	0.94

Table 5-12 (continued)

Descriptor Means and Standard Deviations on Six Example Occupations: Education, Training, Licensure, and Experience

Descriptor	General Managers & Top Executives (n=45) M	SD	Computer Programmers (n=5) M	SD	Registered Nurses (n=32) M	SD	Police Patrol Officers (n=21) M	SD	Janitors & Cleaners[a] (n=23) M	SD	Maintenance Repairers, General Utility (n=27) M	SD
4. Licenses												
4a. Commercial Vehicle Lic	0.03	0.16	0.00	0.00	0.03	0.19	0.12	0.33	0.03	0.19	0.25	0.44
4b. Non-Vehicle License	0.21	0.41	0.00	0.00	1.00	0.00	0.82	0.39	0.07	0.26	0.25	0.44
4c. Licenses Named	0.19	0.39	0.00	0.00	1.00	0.00	0.80	0.39	0.07	0.26	0.21	0.40
5. Requirements to Obtain a License												
5a. Post Secondary Degree	0.21	0.41	0.00	0.00	0.93	0.26	0.06	0.24	0.00	0.00	0.03	0.17
5b. Graduate Degree	0.03	0.16	0.00	0.00	0.14	0.30	0.00	0.00	0.00	0.00	0.00	0.00
5c. On-the-Job Training	0.13	0.34	0.00	0.00	0.75	0.40	0.76	0.44	0.03	0.19	0.25	0.44
5d. Examination	0.18	0.39	0.00	0.00	0.90	0.31	0.82	0.39	0.07	0.26	0.19	0.40
5e. Character References	0.13	0.34	0.00	0.00	0.55	0.44	0.53	0.51	0.03	0.19	0.23	0.42
5f. Coursework	0.21	0.41	0.00	0.00	0.79	0.41	0.76	0.44	0.07	0.26	0.14	0.35
6. Who Requires License												
6a. Law	0.16	0.37	0.00	0.00	0.90	0.31	0.88	0.33	0.14	0.35	0.34	0.47
6b. Employer	0.24	0.43	0.00	0.00	1.00	0.00	1.00	0.00	0.19	0.38	0.51	0.50
6c. Union/Association	0.11	0.31	0.00	0.00	0.86	0.35	0.59	0.51	0.11	0.31	0.23	0.42
7. Experience												
7a. Related Work Exp.	6.89	2.33	4.67	2.42	3.14	2.60	1.71	3.00	3.03	2.57	5.81	2.65
7b. On-site Training Exp.	1.63	1.92	2.00	1.55	1.14	1.43	2.82	2.35	1.17	1.63	3.31	2.66
7c. On-the-Job Training Exp.	2.35	2.12	2.67	2.58	1.76	1.62	3.00	2.29	2.45	2.23	4.22	2.51
7d. Apprenticeship Exp.	0.24	1.02	0.00	0.00	0.52	1.50	1.53	2.58	0.48	1.33	3.25	2.95

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 5-13
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions: Education, Training, Experience, and Licensure

Descriptor	Functions F1	F2	F3	F4	F5	F6	ΓF^2	η^2
1. General Education Level	.11	.82	.06	.08	.26	.19	.79	.64
3. Subject Area Education Level								
3a. Technical Vocational	.01	-.21	.04	.01	.18	.20	.12	.17
3b. Business Vocational	-.08	.09	.00	.04	.09	.11	.04	.15
3c. English/Language Arts	.07	.09	-.05	-.04	.23	.18	.10	.22
3d. Oral Communications	.00	.21	-.03	.02	.30	.09	.14	.23
3e. Languages	-.08	-.03	.05	.07	.11	-.05	.03	.07
3f. Basic Math	-.06	.06	.04	.01	.61	.00	.39	.24
3g. Advanced Math	.02	.07	.05	.00	.44	-.03	.20	.21
3h. Physical Sciences	.04	-.06	.20	.05	.25	.01	.11	.20
3i. Computer Sciences	-.02	.09	.01	-.03	.13	.05	.03	.18
3j. Biological Sciences	.09	.05	.29	.01	.02	.01	.10	.21
3k. Applied Sciences	.09	.07	.13	-.02	.18	.05	.07	.18
3l. Social Sciences	.10	.14	.04	-.08	.17	.05	.07	.23
3m. Arts	.02	.04	.05	.02	.02	-.04	.01	.10
3n. Humanities	.04	.11	-.01	-.03	-.01	.02	.01	.15
3o. Physical Education	.04	-.04	-.09	-.04	.13	-.03	.03	.11
4. Licenses								
4a. Commercial Vehicle Lic	.14	.05	-.03	.90	.01	.04	.84	.46
4b. Non-Vehicle License	.73	.03	.07	.03	-.01	.00	.54	.51
4c. Licenses Named	.76	.04	.10	.01	-.05	-.05	.60	.53
5. Requirements to Obtain a License								
5a. Post Secondary Degree	.45	.06	.55	-.12	.20	.03	.57	.57
5b. Graduate Degree	.16	-.05	.08	.04	.03	.00	.04	.10
5c. On the Job Training	.64	-.04	.06	.05	.05	-.09	.43	.47
5d. Examination	.73	.03	.07	.01	-.03	.09	.54	.52
5e. Character References	.44	.05	.01	.03	-.04	-.10	.20	.35
5f. Coursework	.61	.12	-.03	-.03	-.11	-.09	.41	.47
6. Who Requires License								
6a. Law	.66	-.03	-.05	.08	.08	.03	.45	.48
6b. Employer	.65	.00	-.05	.02	.11	.11	.45	.50
6c. Union/Assoc	.23	.00	.07	.05	.05	.04	.07	.38

Table 5-13 (continued)
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions: Education, Training, Experience, and Licensure

	Functions							
Descriptor	F1	F2	F3	F4	F5	F6	$\Gamma\underline{F}^2$	η^2
7. Experience								
7a. Related Work Exp	-.09	.15	.02	.04	.00	.81	.69	.29
7b. On-site Training	.10	.04	-.10	-.06	.06	.14	.05	.13
7c. On the Job Training	.04	-.02	.09	.05	.01	.07	.02	.14
7d. Apprenticeship	-.02	.07	-.03	.04	.01	.01	.01	.19
$\underline{R}_c$	.87	.83	.70	.63	.57	.53		
Percent of Variance	40	23	10	7	5	4		
Eigenvalue	2.98	2.18	.95	.66	.49	.39		

Note. Statistics are based on 34 occupations with responses from at least 4 incumbents (mean number of incumbents = 17.50, median = 11, harmonic mean = 9.04). F1 = License required, F2 = Education Level, F3 = Degree Required to Obtain Licensure, F4 = Commercial Vehicle License, F5 = Coursework Required, and F6 = Work Experience.
$\Gamma\underline{F}^2$ = Sum of squared rotated standardized discriminant function coefficients across 6 functions.
η^2 = Variance in ratings accounted for by occupations.
The statisitcs "$\underline{R}_c$," "Percent of Variance," and "Eigenvalue," were calculated based on the unrotated discriminant functions.

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Chapter 6

Generalized Work Activities:

Evidence for the Reliability and Validity of the Measures

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Historically, the focus of job analysis has been on the development of rather specific information that documents either job content (e.g., tasks) or job requirements (e.g., skills). While a high degree of specificity can be extremely useful for many practical applications (e.g., design of skill training), for many other important purposes (e.g., determining the similarities in jobs from different occupational settings), it may not be as helpful. Thus, the degree of generality in a job analytic process should be determined by both organizational needs (i.e., what use will be made of the job analysis information obtained by the process), as well as the nature of

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predictive hypotheses that will be derived (i.e., documenting the job-relatedness of a construct measured by a selection procedure).

There is one other variable that has considerable influence, namely the type of descriptor used in the job analytic process. McCormick (1979) discussed at length the nature of job descriptors, and classified them into two broad categories: job-oriented and worker-oriented. Job-oriented descriptors are best characterized by task statements which are specific to a particular job; worker-oriented descriptors on the other hand describe or imply the human behaviors that are involved in accomplishing work. There has been little research on the efficacy of the two types of descriptors, although the research that has been conducted indicates that one may well reach different conclusions depending on the type of descriptor used. What is clear however is that when examining relationships across occupations the most reasonable bridges can be established with generalizable work behaviors. (See for example, Ballentine, Cunningham, & Wimpee, 1992; Colbert & Taylor, 1978; Cornelius, Carron, & Collins, 1979; DeNisi & McCormick, 1974; Dowell & Wexley, 1978; Hamer & Cunningham, 1981; McCormick, DeNisi, & Shaw, 1977; McCormick & Jeanneret, 1988; Pearlman, 1980; Sackett, Cornelius, & Carron, 1981; Taylor, 1978; and Taylor & Colbert, 1978.) Consequently, as the development of work teams continues to emerge, as work is designed into larger blocks of activity, as placement and career pathing decisions become more prominent, and as determining the requirements for work becomes more critical to preparing tomorrow's workforce, the measurement of work using Generalized Work Activities (GWAs) will be an important component of the O*NET content model. Whether used in a standalone manner or in combination with other job analysis measures, it is intended that GWAs will be an important information source when matching people to work.

The criteria that were used to determine what constructs would qualify as GWAs were as follows:

- Constructs must be broad in scope with applicability to a wide range of occupations.
- Constructs must be based on job analytic research.
- Constructs must be characteristics of the underlying structure of work.

Based on these criteria, a simple definition of a GWA emerged:

> A Generalized Work Activity is an aggregation of similar job activities/behaviors that underlies the accomplishment of major work functions.

Further information on the evolution of GWAs and particularly their importance to understanding the structure of work is provided in the following section of this chapter.

Background

The origin of the GWA concept can be traced to research in the 1960s by Ernest McCormick and his students (Cunningham & McCormick, 1964; Gordon & McCormick, 1963; Jeanneret & McCormick, 1969; Mecham & McCormick, 1969; and McCormick, Mecham, & Jeanneret 1972). Conceptually, McCormick and his associates hypothesized and subsequently substantiated that GWAs (or what McCormick labeled as job dimensions) could serve as the linking pins for generalizing the results from empirical selection test validation studies to situations where sample sizes were small or other validation strategies were not feasible.

What emanated from the initial research was a methodology that integrated the strengths and capabilities of both job-oriented (task-based) and worker-oriented (requirements-based) job analytic techniques. The original job analysis data collection instrument designed to measure worker-oriented variables was known as the Work Activity Profile (WAP; McCormick, 1964). Two instruments subsequently emerged that have been used in numerous job analysis studies--

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the Position Analysis Questionnaire (PAQ) by McCormick, Jeanneret, and Mecham (1969, 1972) and the Generalized Work Inventory (GWI) by Cunningham and Ballentine (1982). Initial studies conducted with these two job analysis questionnaires were designed to obtain information on large, diverse samples of jobs encompassing numerous occupational domains. Importantly, this information was also used to conduct factor analyses in an attempt to identify the underlying structure of work. Results of the factor analyses were reasonably consistent beginning with the pioneering efforts of Jeanneret (1969) using data based on the PAQ, through replications by Harvey (1987) and then to subsequent follow-on studies with very large databases by McCormick, Jeanneret, and Mecham (1989) and Jeanneret (1990). The same set of job dimensions (factors) repeatedly appeared. Further, the same, or very similar factors were being identified by others using related instruments: the GWI and its longer version--the Occupational Analysis Inventory (OAI) of Cunningham (1988), both derivatives of the original WAP, or the simplified version of the PAQ known as the Job Element Inventory (JEI) by Cornelius and Hakel (1978). The conclusion of these various studies was that these job dimensions (factors) represented the fundamental taxonomic structure of work (Boese & Cunningham, 1975; Cunningham & Scott, 1988; Cunningham, Wimpee, & Ballentine, 1990; Harvey, 1987; Harvey, Friedman, Hakel, & Cornelius, 1988; Jeanneret, 1969, 1987, 1990; Marquardt & McCormick, 1973; and McCormick, Jeanneret, & Mecham, 1972). It is further reasoned that the stability of the factor structure found with quite diverse databases is satisfying evidence that the methodology (i.e., analyzing jobs with worker-oriented or generalized work behaviors) can provide consistent results even as the tasks of jobs evolve with changing technology and work redesign.

While the factor analytic research using nomothetic questionnaires had significant influence on our development of the GWAs, we also relied heavily on job analytic studies of managerial and professional work. In particular, Flanagan's (1951) critical incident dimensions; William's (1956) taxonomy of executive performance; the factor analytic studies of Hemphill (1960), Tornow and Pinto (1976), and Mitchell (1978); and the integrating studies of Yukl (1987) and Borman and Brush (1993) were used to define many of the GWA constructs. Additionally, we reviewed and drew upon other specialized job analysis taxonomies of performance. These sources included the Dowell and Wexley (1978) taxonomy of first-line supervisor attributes; Outerbridge's (1981) summary of clusters of activities related to professional level government employees; O'Leary, Rheinstein, and McCauley's (1989) updated version of Outerbridge's effort; the Campbell, McCloy, Oppler, and Sager (1993) categories from their comprehensive model of job performance; the summary of general performance requirements for all non-managerial jobs in the U.S. labor force assembled by Borman, Ackerman, Kubisiak, and Quigley (1994); the competency dimension systems developed by the U.S. Office of Personnel Management (1991); activities from the National Job Analysis Survey (American College Testing, 1993); and the summary categories used for job activity descriptions in SCANS (Peterson, 1994).

Taxonomy

The taxonomic structure that underlies the formulation of the GWA constructs is rooted in the primary foundation of modern psychology--namely that behavior is a function of Stimuli (S) which are "processed" by Organization (O) which then lead to Responses (R). Miller (1953) was the first to apply the S-O-R model to the study of work and subsequently McCormick, Jeanneret, and Mecham (1969) used the paradigm in an information theory context to organize the PAQ and the factor analytic studies of the job analysis data obtained with the PAQ. The model is representative of the three primary components of work behavior.

S - the information received by the worker

O - the mediation processes performed by the worker on the information received

R - the activities performed by the worker in response to the "processed stimuli"

The model is limited when describing behavior in a work setting, however, because work typically involves interactions and relationships with others and occurs within a physical and social context. Accordingly, interactions with others were included in our development of the GWA constructs, while the environmental influences were determined to be best measured within the work context component of the O*NET content model (see McPhail, Blakley, Strong, Collings, Jeanneret, & Galarza, 1995). Thus, our highest-order GWA taxonomy is comprised of four broad components (see Figure 6-1):

- Information Input
- Mental Processes
- Work Output
- Interaction With Others

A second-order taxonomy was also identified and it included nine factors:

- Looking For and Receiving Job-Related Information
- Identifying/Evaluating Job-Relevant Information
- Information/Data Processing
- Reasoning/Decision Making
- Performing Physical and Manual Work Activities
- Performing Complex/Technical Activities

- Communicating/Interacting
- Coordinating/Developing/Managing/Advising Others
- Administering

Using the above structures as a framework, we began to identify the GWA constructs that provided coverage of the domains of interest from the previously described factor analytic research. Figure 6-2 presents both the nine dimension taxonomy and the 42 dimension lower-order system.

Information Input - Within this domain we identified two second-order factors: Looking for and Receiving Job-Related Information and Identifying/Evaluating Job Relevant Information. Research that used data obtained from the PAQ, JEI, and GWI was the dominant source for defining the GWA constructs that are necessary to describe the scope of the Information Input domain. Getting Information Needed to do the Job (Descriptor #1) and Monitoring Processes, Materials and Surroundings (Descriptor #2), were the two GWAs that describe activities of a worker when looking for and receiving job-related information. Once information is received, it must then be identified or evaluated. Three GWAs consistently emerged in the research literature that describe identifying/evaluating job-relevant information: Identifying Objects, Actions, and Events (Descriptor #3); Inspecting Equipment, Structures, or Materials (Descriptor #4); and Estimating the Characteristics of Materials, Products, Events, or Information (Descriptor #5).

Mental Processes - Once job relevant input has been received, the worker's mental capabilities are involved and can be categorized as two second-order factors: Processing Information or Data, and Reasoning/Making Decisions. Four GWAs were identified from the research literature that were descriptive of Information/Data Processing activities: Judging the Qualities of Objects, Services, or Persons (Descriptor #6); Processing Information (Descriptor

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#7); Evaluating Information for Compliance Standards (Descriptor #8); and Analyzing Data or Information (Descriptor #9). These GWAs emerged from the analysis of all levels of work. On the other hand, when examining the Reasoning/Making Decisions second-order factor, the research literature indicated that many of the relevant constructs were derived from studies of supervisory, managerial, or professional work. More specifically, two GWAs--Making Decisions and Solving Problems (Descriptor #10); and Updating and Using Job-Relevant Knowledge (Descriptor #12)--emerged from studies of all types and levels of jobs. Alternatively, three other GWAs are more specific to managerial/professional work. These GWAs include: Thinking Creatively (Descriptor #11); Developing Objectives and Strategies (Descriptor #13); and Scheduling Work Activities (Descriptor #14). Because of the distinction that is made in the literature between organizing one's own work versus the activities of others, Descriptor-15 Organizing, Planning, and Prioritizing Work is intended to include personal time management, and therefore, is likely to be relevant at some level to virtually all jobs.

Work Output - Given that job-relevant information has been received and processed, and decisions have been made, the worker responds with some type of output. Two second-order factors were identified which segment the work output into either physical or technical activities. The first second-order factor, Performing Physical and Manual Work Activities includes four GWAs: Performing General Physical Activities (Descriptor #16); Handling and Moving Objects (Descriptor #17); Controlling Machines and Processes (Descriptor #18); and Operating Vehicles and Mechanized Devices or Equipment (Descriptor #19). The other second-order factor was labeled Performing Complex/Technical Activities. While certain physical movements are necessarily involved in the accomplishment of the specific GWAs subsumed under this factor, they are characterized more by the skill demands required for successful performance. These six

GWAs are: Interacting with Computers (Descriptor #20); Drafting, Laying Out and Specifying Technical Devices, Parts, or Equipment (Descriptor #21); Implementing Ideas, Programs, Systems, or Products (Descriptor #22); Repairing and Maintaining Mechanical Equipment (Descriptor #23); Repairing and Maintaining Electronic Equipment (Descriptor #24); and Documenting and Recording Information (Descriptor #25).

Interacting With Others - Communication is, of course, a critical activity in organizational life and we found Communicating/Interacting to be a useful second-order factor that is descriptive of a critical component of interpersonal relationships. One important element of any communication is making sure that the intended audience understands the content of the communication. Descriptor #26, Interpreting the Meaning of Information for Others, addresses this understanding aspect of communication.

The GWA taxonomy draws a distinction between communicating inside an organization and communicating to customers and others outside the organization, including the public. Communicating With Supervisors, Peers, or Subordinates (Descriptor #27) is concerned with the internal communication activity; Communicating With Persons Outside the Organization (Descriptor #28) relates to external communication activities. A related activity is establishing good working relations with others, especially relevant in a team setting, but more generally important for contributing to a smooth running organization. The dimension covering this activity is labeled Establishing and Maintaining Interpersonal Relationships (Descriptor #29). An activity that is especially relevant to the health care industry and to elder-care operations is Descriptor #30, Assisting and Caring for Others.

Still another interpersonal activity, but of a very different type is Selling or Influencing Others (Descriptor #31). This GWA includes persuading others to buy products or otherwise

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influencing others to change their behavior. Similar in some ways is Descriptor #32, Resolving Conflicts and Negotiating With Others. However, this GWA involves handling complaints and arbitrating disputes. A GWA that at first appears related to the external communication dimension is Performing or Working Directly With the Public (Descriptor #33). Actually, this activity is intended to represent important dimensions of certain high population occupations such as patrol officers, restaurant servers, and government employees dealing directly with the public. Another second-order factor underlying interaction with others was found to involve coordinating, developing, managing, or advising others. There are six GWAs that we believe describe these types of interrelationships. Descriptor #36 is similar to Descriptor #33 in that it is targeted toward a particular large population set of occupations. Teaching Others (Descriptor #36) involves both the development of training programs and the delivery of training or instruction to others. Presumably, this dimension is at the core of school teaching jobs, as well as trainer positions in corporate or other types of organizations.

GWAs 34 and 35, as well as 37-39 are supervisory or management dimensions. They are intended to cover, in a comprehensive yet parsimonious fashion, work activities required in a supervisory/managerial setting. Descriptor #34, Coordinating the Work of Others involves overseeing the coordination of a team's or a larger group's work activities. A similar GWA, but with a more direct team focus, is Developing and Building Teams (Descriptor #35). The increasing emphasis in U.S. organizations on team-based structures motivated this dimension.

A broader GWA, Guiding, Directing, and Motivating Subordinates (Descriptor #37), is concerned with setting standards for performance and monitoring employee performance against those standards. Descriptor #38, Coaching and Developing Others has overlap with the teaching dimension but is more focused on providing developmental opportunities for subordinates as a supervisor working directly with them on a full-time basis. Providing Advice and Consultation to Others (Descriptor #39) is not necessarily a management dimension. It may involve external consulting on technical or management matters.

The third second-order factor involving relationships with others we labeled administering, and the last three GWAs relate more to administrative than hands-on management or supervision dimensions. Accomplishing Administrative Activities (Descriptor #40) describes the paperwork, recordkeeping, and similar activities in management jobs. Staffing Organizational Units (Descriptor #41) refers to the recruiting, selecting, and hiring functions in an organization. Finally, Monitoring and Controlling Resources (Descriptor #42) involves overseeing non-personnel related resources such as budgets, materiel, and other assets.

Figure 6-2 describes the 42 lower level generalized work activities (GWAs) contained in the O*NET content model. Jeanneret and Borman (1995) provided the theoretical and research-based rationale for this taxonomy. The taxonomy has ties to several other models or taxonomies of work activities. In fact, a cross-walk between our model's constructs and the constructs contained in the models reviewed (Jeanneret & Borman, 1995) shows that our model is quite comprehensive and subsumes the vast majority of these models' constructs.

Thus, Jeanneret and Borman (1995) provided compelling evidence for the internal, substantive validity of the 42 dimension system. However, that work did not speak to the empirical reliability and validity of <u>measures</u> of these dimensions. Accordingly, the purpose of the research to be reported here was to address issues of reliability and, to an extent, validity of the descriptor measures.

Sample and Measures

Previous chapters have described the target sample of occupations for job analysis and the subset of these occupations that have actually been sufficiently analyzed to date. Figure 6-3 lists these occupations and the N for each. Briefly, the data analyses to be reported involve 35 occupations with a minimum of four incumbents per occupation. The number of incumbents varies from four to 88, with an harmonic mean of 9.68 per occupation. Occupational Analysis Field Center (OAFCs) job analysts also provided ratings on the GWAs. At least six analyst ratings were generated for each GWA on each of the 80 occupations in the entire sample.

Level, importance, and frequency scales were developed for the GWA questionnaire. As in several other domains, the level scales can be characterized as measuring complexity. The level scales are 7-point scales (1-7) with an additional not relevant option. Three behavioral statements were also developed for each GWA level scale to anchor the high, mid-range, and low levels. Where possible, we identified statements from research on the Position Analysis Questionnaire (PAQ) or Occupational Analysis Inventory (OAI) that had been previously scaled according to level or complexity. The remaining anchors were prepared by the authors specifically for this study. The importance scales have five points (1-5) with the verbal anchors: Not Important, Somewhat Unimportant, Important, Very Important, and Extremely Important.

The analyst rating scales were identical to those used by incumbents except for those having to do with frequency. For incumbents, the frequency scales are 7-point scales with verbal anchors. Those anchors are: Once per year or less; More than once per year; More than once per month; More than once per week; Daily; Several times per day; and Hourly or more often. For analysts, the frequency scales are 5-point scales with verbal anchors. Those anchors are: Never; Almost never; Sometimes: Often; and Always.

For each descriptor, the respondent to the survey was asked to read the descriptor label and definition, and then to answer the level scale question, the importance scale question next, and then the frequency question. Figure 6-4 provides examples of the level, importance, and frequency scales.

Results

Descriptive Statistics

Table 6-1 contains the GWA overall means across all 35 occupations and the standard deviations associated with those means. Also appearing in Table 6-1 are the interrater agreement coefficients for each descriptor along with the standard error of measurement.

Focusing first on the level scales, there is considerable variation in the means across the 42 descriptors. The repair dimensions and some of the managerial dimensions have quite low means, reflecting the fact that most jobs in the economy (and in our sample of 35 occupations) do not involve any repairing or managing. The highest means are for descriptors such as Establishing Relationships (Descriptor #29) and Communicating, Internal (Descriptor #27), activities that apply to most occupations. Even with the latter dimensions, however, the means are only slightly above the scale mid-point, with considerable variation across occupations. This suggests that range restriction is not a problem with these GWA level scales. A similar pattern of means and standard deviations is evident for the importance scales. The frequency scale means are almost uniformly higher than the level scale means, where this comparison is appropriate (i.e., they both have 7-point scales). The standard deviations are in general lower, indicating a relative restriction-in-range for the frequency ratings.

Reliability

The k-rater interrater agreement coefficients are for the most part quite impressive, especially for the level scales. Most of the coefficients are in the .70s and .80s for the level scales, with the range from .51 to .92 and a median of .82; for the importance scales these coefficients are usually slightly lower (Mdn = .78). Finally, interrater agreement is lower still for the frequency scales (Mdn = .68). Nonetheless, overall reliability for the GWA descriptor scales is acceptable. Of course, if we can achieve the target of 30 incumbents per occupation, interrater agreement should be outstanding.

Along these lines, Table 6-2 displays the 30-rater reliabilities to be expected, along with the 1-rater interrater agreement coefficients. For the level scales, 35 of the 42 descriptors have coefficients of .90 or higher at the 30-rater level. As expected, the importance scales provide somewhat lower reliabilities, but 33 of the 42 dimensions have 30-rater interrater agreement coefficients at .90 or higher. Again, the frequency scale interrater agreement coefficients are somewhat lower, but at the 30-rater level, these scales are also quite reliable, as well. In summary, Tables 6-1 and 6-2 demonstrate that the generalized work activity requirements of occupations can be reliably evaluated by incumbents in those occupations. As a benchmark, the reader is referred to the work of Geyer, Hice, Hawk, Boese, & Brannon (1989) who the reliabilities of four experienced occupational analysts across 20 diverse occupations using the standard United States Employment Services job analysis procedures. For work functions (data, people, things), the reported reliabilities ranged from .77 (one rater) to .95 (four raters) using coefficient alpha and a variance ratio procedure to measure analyst consistency.

Scoring

As discussed in previous chapters, it might be argued that including not relevant (i.e., zero) scores when computing interrater agreement provides estimates of reliability higher than if these were not included. This argument could be extended to the importance and frequency scales in that when not relevant was indicated on the level scale, a 1 (not important or once per year or less) rating was employed in computing the interrater agreement for the importance and frequency scales. To address the possibility of different reliability estimates for these different scoring procedures, we recalculated the reliabilities with not relevant responses removed. Finally

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for the level scales only, reliabilities were computed using a simple relevant/not relevant coding scheme.

Interrater agreement coefficients calculated using these alternative coding systems appear in Table 6-3. For the level and frequency scales the interrater agreement coefficients are not affected when the not relevant option is not considered. They are virtually the same as when not relevant is scored as zero. For importance, the changes in reliabilities are very small; in several cases, interrater agreement actually improves slightly when the not relevant response on the level scale is ignored. When the level scales are scored dichotomously, as relevant or not relevant, some of the descriptors suffer a substantial loss of reliability, but others lose very little, and in four cases, reliabilities actually improve.

From both a reliability and a conceptual perspective, the full scale scoring method employing the not relevant response seems preferable. Interrater agreement is somewhat better for the importance ratings when the not relevant (zero) scale point is included. In addition, the case can certainly be made that a not relevant rating for a GWA is conceptually quite different from a low level requirement for that GWA.

Analyses of Variance

An alternative view of interrater agreement can be derived from analysis of variance (ANOVA). ANOVA provides summary, across descriptor indices of interrater agreement. Results of these analyses are in Tables 6-4a, 6-4b, and 6-4c, for the level, importance, and frequency scales respectively. Results are quite similar for the three types of scales. First, the significant occupations effect indicates that occupations are in fact differentiated by these descriptors. The significant descriptor effect confirms what we reported in Table 6-1. Means for the descriptors across the 35 occupations vary considerably. Finally, the significant descriptor by occupations interaction provides evidence that different patterns of GWA requirements are evident for different occupations.

The intraclass interrater agreement coefficients summarizing the ANOVA results appear in Table 6-5. The k-rater coefficients for the three types of scales are .80, .78, and .74. The 30-rater interrater agreement coefficients are .90 or above. These findings indicate, again, that interrater agreement for the GWAs is quite high, and very consistent with occupational analyst reliability found by other researchers (Geyer, et al., 1989; McCormick & Jeanneret, 1988).

Tables 6-6a, 6-6b, and 6-6c present ANOVA results at the aggregate construct level--that is, for the mean scores computed across the GWA descriptors found within the nine-dimension higher-order taxonomy. The findings for the occupations, descriptor, and descriptor x occupations effect are highly similar to what was found for the lower level, 42-construct system. All three of the effects are highly significant for each of the scale types. Further, Table 6-7 shows the intraclass interrater agreement coefficients at this aggregated level. The k-rater coefficients are higher by 4-6 correlation points than the coefficients computed for the lower level 42-dimension system. The 1-rater and 30-rater coefficients are similarly larger for the aggregated 9-dimension system than for to the 42-descriptor system. Accordingly, the GWA descriptors appear to have very good reliability, either at the individual scale or the aggregated scale level.

Descriptor and Scale Relationships

As with other domains in the content model, we investigated redundancies among the level, importance, and frequency scales. Although there are clear conceptual distinctions between the scales, empirical redundancies are certainly possible. Table 6-8 summarizes correlations between the three types of scales computed in two different ways. First, a mean correlation between each pair of scale types was computed for each dimension (at the 42 dimension level) across the 35 occupations and then averaged over the 42 dimensions. A second mean correlation was derived by computing a between-scale correlation for each occupation across the 42 dimensions and averaging over the 35 occupations. Correlations are high between the level and importance scales, .92 and .93 for the two approaches to data averaging. The standard deviations for these mean correlations are quite a bit higher when the correlations are computed across the 42 descriptors within occupation and averaged across the 35 occupations. Apparently, for some occupations, the level-importance relationship is lower. The corresponding importance-frequency mean correlations are somewhat lower than the level-importance ratings (.89 and .91), but still very high. The level-frequency mean correlations are definitely lower (.82 and .88). Overall, Table 6-8 suggests considerable redundancy for the level and importance scales. The frequency scale demonstrated less redundancy, particularly with the level scale.

Tables 6-9a, 6-9b, and 6-9c present correlations between dimensions for the level, importance, and frequency scales. These correlations are at the occupation level, with the N for each correlation equal to 35. Tables 6-10a, 6-10b, and 6-10c contain between-dimension correlations at the individual level. Because the focus of the present research is to study occupations and differences between them, we will focus on the Table 6-9 relationships. In addition, as the patterns of relationships are similar for level, importance, and frequency, so our attention will be primarily on the level results.

Correlations in Table 6-9a for the most part make good intuitive sense. Perhaps most impressive, as with several other domains, the mean correlations between-descriptors, within higher-order constructs (e.g., Looking For and Retrieving Job-Related Information in Figure 6-2) is .61, whereas the mean between-descriptor, across higher-order construct correlation is .43. As an example, for the Administering higher level composite, the three GWAs in this composite

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(Performing Administrative Tasks [Descriptor #40], Staffing Organizational Units [Descriptor #41] and Monitoring Resources [Descriptor #42]) intercorrelate .55, .55, and .77. The negative correlations between descriptors are also intuitively appealing. For example, Controlling Machines (Descriptor #18) and Performing Administrative Tasks (Descriptor #40) correlate -.50; Performing Physical Work Tasks (Descriptor 16) and Processing Information (Descriptor #8) correlate -.60. The sense of these negative relationships is that for several of these pairs of dimensions, occupations require either one of the dimensions <u>or</u> the other, but seldom both. Overall, the GWA scales provide a coherent and meaningful pattern of correlations.

Factor Structure

Examining the patterns of correlations in Table 6-9 is useful for evaluating the rationality of these relationships. However, a more comprehensive and efficient approach is to conduct an exploratory factor analysis of the correlation matrix. Accordingly, we accomplished this with a principal components analysis and an orthogonal rotation of the correlations between the level scales in Table 6-9a. In particular, the two through five rotated factor solutions were examined, and the three-factor solution proved to be the most interpretable. This solution is presented in Table 6-11. The three factors accounted for 71% of the total variance for ratings on the level scale. Also, the communalities suggested that for the most part the GWA dimensions are well-represented in this solution. The first factor we called <u>working with information</u>. It accounts for 48% of the total variance.

The second factor has many of the supervisory and working with others GWAs loading on it; the factor is labeled <u>working with and directing the activities of others</u> and accounts for 14% of the variance. The third factor was named <u>manual and physical activities: performing repair and other physical work</u>, and it accounts for 8% of the variance.

The three-factor solution lines up fairly well with the highest order 4-dimension system in the Jeanneret and Borman (1995) hierarchical taxonomy (see Figure 6-1). The working with others factor overlaps considerably with the interacting with others dimension, and the manual and physical activities factor contains many of the work output GWAs. Factor 1, working with information, overlaps with much of the information input and mental processes part of the GWA model. Overall, this 3-factor system summarizes well the GWA domain. The factors are highly interpretable and almost all of the GWAs are represented in the solution.

As mentioned in previous chapters, we must remember that the factor analysis is based on a small N (N = 34 in this domain). This may create less than a stable solution. However, the interpretability of these results argues against this conclusion.

A more direct test of the viability of the 3-dimension highest order or the 9-dimension systems is to conduct confirmatory factor analyses. We attempted these analyses, but the solutions did not converge. This is not surprising, given the small number of occupations in comparison to the number of variables.

Occupation Differences

An important application of the O*NET data will be to provide profiles of occupational requirements on the O*NET descriptors. Accordingly, we present the GWA profiles for six different occupations selected to be representative of very different types of employment. This should provide an initial view as to what the profiles might look like in the GWA domain. Tables 6-12a, 6-12b, and 6-12c display the means and standard deviations for, respectively, the level, importance, and frequency scales relative to these six occupations. A summary observation is that the GWAs appear to describe these occupations quite accurately. The similarities and, especially, the differences between occupations seem appropriate, given the nature of these occupations. For example, for the Performing Physical Work Tasks (Descriptor 16) GWA, means for the General Managers and Computer Programmers are very low; substantially higher means are evident for Patrol Officers, Janitors, and Repairers. For Operating Vehicles (Descriptor #20), as would be expected, the highest mean value is for Patrol Officers, whereas the Computer Programmer mean is literally zero (not relevant). Also, as expected, General Managers have the highest mean on Directing Subordinates (Descriptor #37), and Managers and Patrol Officers are highest on the Resolving Conflict (Descriptor #32) GWA. The profiles, for both occupations (across GWAs) and GWAs (across these occupations) seem to offer an appropriate and useful picture of the GWA requirements for occupations.

Some of the standard deviations are instructive as well. For example, one of the highest standard deviations is for Providing Consultation (Descriptor #39) relative to Computer Programmers. It is quite possible this reflects actual differences in the respondents' jobs, such that some Programmers work alone and others consult. Thus, in some cases, the standard deviations may be interpretable and provide useful occupational information.

A quite different way to explore occupation differences in GWAs is to compare patterns of GWA ratings within occupation to the patterns across occupations. A very simple way to address occupation differences in this regard, at least initially, is to identify a small number of occupations for which we have a relatively large incumbent sample size, split the samples in two within each of the occupations, and then correlate the mean incumbent ratings within and across occupations. This was accomplished for three occupations: First-Line Supervisors; Secretaries (Except Legal and Medical); and General Office Clerks.

The six by six correlation matrix (3 occupations x 2 samples for each) appears in Table 6-17. As can be seen, the within-occupation, split-half correlations are .96, .96., and .98, and these are all higher than any of the across-occupation correlations. The Secretary-Clerk correlations are almost as high as the correlations within each of these occupations, however. This is not surprising, as these occupations would be expected to require very similar work.

Discriminant Analysis

A central objective for the GWA descriptors is to discriminate between occupations. A preliminary look at how well they accomplish this was provided by the results in Table 6-13 and our discussion of the six occupations' standing on various GWAs. Also, the Table 6-17 results showed that the patterns of mean ratings within occupation are more similar than these patterns across occupations. A more systematic way to assess the GWA's ability to differentiate occupations is to conduct a discriminant function analysis on all 35 occupations. The discriminant analysis also indicates the GWAs that contribute most (and least) to this differentiation. The 1-5 function solutions were examined and the 4-function solution was selected as most interpretable. Table 6-13 presents the rotated correlations between the discriminating variables and the four canonical discriminant functions. These vectors of correlations should be interpreted as the loadings on the GWA level scales that maximally differentiate between the 35 occupations. The data in Table 6-13 also show for each GWA, η^2 coefficients that summarize how much discriminating variance each GWA level scale is providing.

The first function is clearly a supervisory or management variable. Apparently, a clear-cut and important distinction between occupations in our sample is whether or not they are management or non-management jobs. The second function involves working with data; the third function is primarily concerned with operating vehicles; and the fourth function has some similarity to the manual and physical activities factor in the factor analysis, with repair and

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inspecting activities loading on it. Thus, for the most part, the discriminant analysis yielded interpretable functions describing the GWA-related features of occupations that provide maximum differentiation between the occupations.

The discriminant analysis functions were able to correctly classify 62% of the incumbents into their occupations, when all 35 functions are used, and 38% when only the four retained functions are used. Both of these classification rates are well above chance, which would be 3% correct classification for 35 occupations, if the occupations were of equal size. The η^2 importantly show that with a few exceptions the GWAs each provide a fair amount of differentiation. These η^2 vary from .10 to .40. The GWAs that have the smallest η^2 are Handling Objects (Descriptor #17) (.10), Estimating Characteristics (Descriptor #5) (.13), Interpreting Information (Descriptor #26) (.14), and Documenting Information (Descriptor #25) (.14). Interestingly, these are the four least reliable level scales. These findings, along with the occupation differences data in Table 6-12a, suggest that GWAs will be an important domain for providing information about job requirements that differentiate between occupations.

Convergence with Analysts' Ratings

As mentioned previously, OAFC occupational analysts provided ratings on GWAs and several other content model domains for all 80 occupations in the target sample. In this section, we compare their GWA ratings with the incumbent ratings on the 35 occupations evaluated by both the incumbents and the analysts. Tables 6-14a and 6-14b present these comparisons for the level and importance scales, respectively. These comparisons were not appropriate for frequency scales because incumbents and analysts used different frequency scales. Tables 6-14a and 6-14b provide means, standard deviations, and k-level reliabilities for both data sources. Also provided

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are t and F tests comparing the means and standard deviations of incumbent and analyst data, as well as the correlation between the two sets of ratings for each GWA, and a d statistic indicating the average squared difference between analyst and incumbent mean ratings.

Regarding results, the interrater agreement within-source findings indicate that analyst ratings are about .10 points higher than those for the incumbents (Mdn r_s = .93 and .82). The analyst GWA level ratings are highly reliable, with no need to have additional analysts provide these ratings. Reliability results for the PAQ job dimensions provide benchmark data for analyst ratings that are relevant to many of our GWAs. McCormick, Mecham, & Jeanneret (1989) report the reliability of job dimension scores calculated from 43 studies that involved 19,961 analyst pairs. The median of the median reliability coefficients across all 45 PAQ dimensions was .91. If we examine just the reliabilities for those PAQ dimensions that are "matched" to the GWAs, there are 20 such dimensions with median reliabilities that range from .84 to .97 and an overall median of .915. Correlations between the two sources (i.e., incumbents and analysts) are reasonably high. The median correlation between the mean level ratings is .70. Looking at agreement in a correlational sense, the lowest agreement between analysts and incumbents is on the Handling Objects (Descriptor #17) and Establishing Relationships (Descriptor #29) GWAs. The latter case is curious because the reliabilities within source are reasonably high; incumbents and analysts are in good agreement among themselves on how to order occupations on this dimension, but these views are fairly idiosyncratic to their own source. More broadly, however, the correlational results for the level scales suggest substantial agreement across the two sources in the rated patterns of occupational GWA requirements for this sample of occupations.

Another view of the similarities and differences between the two sets of ratings can be obtained by comparing the factor structures of the incumbents' and analysts' data. Table 6-16 depicts the 3-factor varimax rotated solution for the analyst ratings. This solution is very similar to the 3-factor solution emerging from the incumbent data (see Table 6-11). The labels for the incumbent factors are very appropriate for these factors as well. Thus, from the standpoint of relationships between the descriptors, i.e., what dimensions are perceived as similar to and different from each other, there is also good agreement between incumbents and analysts.

Although correlational agreement and structural similarity are high, many significant level differences were found between incumbents' and analysts' ratings. The t-tests indicate that a little more than half of the GWAs (23) show significant differences between the two sources' ratings. In seven cases, the analysts' means are significantly higher than the incumbents' means. However, for 16 of the GWAs the incumbent means are higher, with some substantial differences. For example, the Using Job Knowledge (Descriptor #12) means for the incumbent and analyst groups are 3.80 and 2.96. For Organizing and Planning (Descriptor #15), the corresponding means are 3.80 and 2.73. Thus, on several GWAs, the incumbents believe that the GWA requirements are at a higher level than do the analysts. Essentially, incumbents are reporting that their job is more complex than is seen by the analysts.

For the importance ratings (Table 6-14b), the across-source correlations are not quite as high as for the level ratings. However, the real differences between incumbents and analysts is seen by looking at the means. The level trend is substantially reversed, with many of the GWAs having significantly higher means for the analysts. Analysts see dimensions of these occupations as less complex but more important than do the incumbents. Overall, the correlational results show reasonable convergent validity for the incumbent and analyst ratings, especially for the level scales. However, significant, and in some cases substantial, differences in means are evident between the two sources.

Another way to examine incumbent-analyst differences in the ratings is to treat the level scale as dichotomous (i.e., is the dimension seen as relevant or not relevant for an occupation?), and evaluate the differences between means on this zero (not relevant) to one (relevant) scale. Table 6-15 contains means, standard deviations, within source reliabilities, and t statistics indexing the significance of the differences between means. Surprisingly, the means for the analysts are almost all greater than those for the incumbents. Recall that the incumbent means tend to be higher than the analyst means when the entire level scale is considered. Apparently, analysts are considerably less likely than incumbents to use the not relevant option. For example, the means are .98 or higher for GWAs 1, 2, 3, 7, 8, 9, 10, 12, 15, 17, 27, and 29. The highest mean for the incumbents is .90 (for Communicating, Internal [Descriptor 27]).

Because of this relative restriction-in-range for analyst ratings on several of the dimensions, interrater agreement between analysts was lower on average than the agreement between incumbents. The median k-rater reliability was .70 for incumbents and .62 for the analysts. Thus, if a dichotomous relevant-not relevant scale were to be employed in O*NET, for GWAs the incumbents' data would be considerably more useful than analyst data from the standpoint of both reliability of responses and the balanced use of the relevant and not relevant response options.

Conclusions

Research reported in this chapter indicated that job incumbents using the GWA descriptors could reliably describe their jobs. Interrater agreement was quite high, even for the k-level reliabilities, where k fell considerably short of the target 30 incumbents per occupation. For GWAs, at least, this target might be reduced somewhat based on these results. Of the three types of scales, the behaviorally anchored level scales showed the highest reliabilities, slightly higher than for the importance scales, and substantially higher than those obtained with the frequency scales.

Relationships between the level and importance scales were high (above .90). The level scales did not correlate as highly with the frequency scales. The high level-importance scale correlations argue for possibly dropping one of these scales for future research and implementation. If a scale is to be dropped, we recommend eliminating the importance scale. The level scales are somewhat more reliable and the behavioral statements anchoring the level scales appear to clarify the definitions of these scales.

The present research tends to support the Jeanneret and Borman (1995) taxonomy. Regarding the hierarchical structure proposed in that taxonomy, data from the level scale ratings indicate that the mean correlation between-descriptor, within higher-order construct (e.g., Looking for and Retrieving Job-Related Information) is substantially higher than the mean between-descriptor, across higher-order construct correlation (r = .61 versus .43). This provides support for the particular hierarchical system proposed for the GWAs. Also, a factor analysis of the between-descriptor correlations yielded a readily interpretable 3-factor solution, further evidence for the coherence of this GWA taxonomy.

Especially important for evaluating the usefulness of O*NET with respect to the GWAs, a discriminant function analysis showed that the vast majority of GWA dimensions contributed substantially to the differentiation between the 35 occupations in this research. Accordingly, the GWA descriptors accomplished what was intended by describing activity requirements that differentiate occupations. Further, the GWA profiles for the six example occupations demonstrated in a concrete way how useful these profiles can be for documenting differences between occupations.

As argued in previous chapters, we are reluctant to drop descriptors from the taxonomy. The 42-dimension system has a strong theoretical and conceptual rationale. The dimensions were carefully developed to provide a comprehensive yet parsimonious depiction of GWA requirements in occupations. Nonetheless, the Handling Objects (Descriptor #17), Estimating Characteristics (Descriptor #5), and Documenting Information (Descriptor #25) GWAs might be candidates for either dropping or revising based on our results to date. These dimensions were the least reliable and also played a minimal role in differentiating between occupations. It should be recognized, however, that these results are based on only 35 occupations at this point.

In sum, the proposed GWA taxonomy received considerable support in this research. The scales measuring dimensions of the taxonomy provided reliable, coherent, and useful occupational information. The GWA taxonomy and measures of its dimensions appear to provide a viable system for describing similarities and differences between occupations.

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Figure 6-1
Highest Order GWA Taxonomy

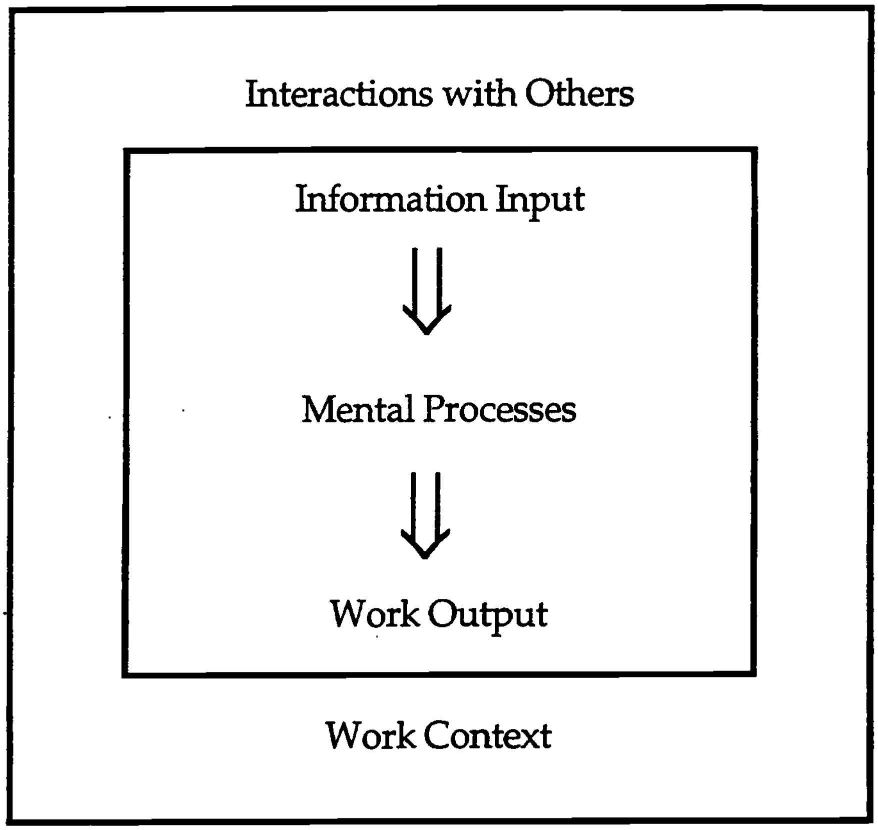

Figure 6-2
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
Looking For and Receiving Job Related Information[a]		
1. Getting information needed to do the job	Observing, receiving, and otherwise obtaining information from all relevant sources	High - Getting new information from many sources, often by actively interacting with the sources. Low - Making regular use of the same types of information from a single source.
3. Monitoring processes, materials, or surroundings	Monitoring and reviewing information from materials, events, or the environment, often to detect problems or to find out when things are finished.	High - Monitoring very complex processes, events, or circumstances. Low - Monitoring processes, events, or circumstances that are not complex.
Identifying and Evaluating Job Related Information		
2. Identifying objects, actions, and events	Identifying information received by making estimates or categorizations, recognizing differences or similarities, or sensing changes in circumstances or events.	High - Making extremely difficult identifications based on very complex information. Low - Making easy identification based on information that is not complex.

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Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
4. Inspecting equipment, structures, or materials.	Inspecting or diagnosing equipment, structures, or materials to identify the causes of errors or other problems or defects.	High - Making inspections or diagnoses of a complex system that may have many interrelated parts, and determining whether conditions exist within a range of acceptable limits. Low - Making inspections of very simple components, machines, or structures, where indications of problems or defects are easily found.
5. Estimating the characteristics of materials, products, events, or information.	Estimating sizes, distances, and quantities, or determining time, costs, resources, or materials needed to perform a work activity.	High - Making very difficult estimates of characteristics, time, or resources where there is limited guidance or supporting information. Low - Making straightforward estimates of characteristics, time, or resources where there is considerable guidance and supporting information.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
Information/Data Processing		
6. Judging the qualities of objects, services, or persons.	Making judgments about or assessing the value, importance, or quality of things or people.	High - Making very difficult judgments about the quality or importance of things or people for which there is limited guidance or supporting information. Low - Evaluating information against a simple criterion.
7. Evaluating information for compliance to standards.	Evaluating information against a set of standards and verifying that it is correct.	High - Evaluating complex information for compliance with regulations, laws, or technical criteria, where compliance decisions require significant interpretation or judgment. Low - Evaluating information against a simple criterion.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
8. Processing information.	Compiling, coding, categorizing, calculating, tabulating, auditing, verifying, or processing information or data.	High - Processing very different and complicated data or information, where there are several ways in which the information can be processed. Low - Processing data or information that is standardized and easy to understand, where there is only one way to process the information.
9. Analyzing data or information.	Identifying underlying principles, reasons, or facts by breaking down information or data into separate parts.	High - Analyzing very different and complicated data or information that can be used for making critical decisions. Low - Analyzing data or information that is easy to understand.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
Reasoning/Decision Making		
10. Making decisions and solving problems.	Combining, evaluating, and reasoning with information and data to make decisions and solve problems. These processes involve making decisions about the relative importance of information and choosing the best solution.	High - Reaching conclusions after considering a large number of choices that are often ambiguous or abstract, where there are competing viewpoints and alternatives that must be considered before reaching final decisions and the solutions decided upon will have very significant impact. Low - Reaching conclusions after considering a few choices that are usually well defined, where there are a limited number of possible actions, and the decisions or solutions will have minor impact.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
11. Thinking creatively.	Originating, inventing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions.	High - Creating or inventing new and yet-to-be-proven practices, technologies, materials, products, or strategies, where the creative effort will have widespread impact and will result in substantial improvements for both an organization and its customers. Low - Offering suggestions for some change or improvement to immediate work functions or products.
12. Updating and using job-relevant knowledge.	Keeping up-to-date technically and knowing one's own jobs' and related jobs' functions.	High - Learning, retaining, and staying current with complex, often highly technical information. Low - Learning, retaining, and staying current with relatively easy-to-master information.
13. Developing objectives and strategies.	Establishing long-range objectives and specifying the strategies and actions to achieve these objectives.	High - Doing complex, future oriented strategic planning. Low - Doing strategic or long-term planning that is not complex.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
14. Scheduling work and activities.	Scheduling events, programs, activities, as well as the work of others.	High - Engage in complex and difficult scheduling activities. Low - Engaging in simple or straightforward scheduling activities.
15. Organizing, planning, and prioritizing work.	Developing plans to accomplish work, and prioritizing and organizing one's own work.	High - Doing a high degree of complex planning, organizing, and prioritizing of one's own work. Low - Doing uncomplicated planning, organizing, or prioritizing of one's own work.
Performing Physical and Manual Work Activities		
16. Performing general physical activities.	Performing physical activities that require moving one's whole body, such as in climbing, lifting, balancing, walking, stooping, where the activities often also require considerable use of the arms and legs, such as in the physical handling of materials.	High - Making repetitive and often fatiguing extensive use of the whole body in completing work activities that are done with or without the use of tools. Low - Making non-fatiguing use of the whole body in completing work activities that are done with or without the use of tools.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
17. Handling and moving objects.	Using one's own hands and arms in handling, installing, forming, positioning, and moving materials, or in manipulating things, including the use of keyboards.	High - Using one's hands and arms to do the same functions almost continually. Low - Making little use of one's hands and arms.
18. Controlling machines and processes.	Using either control mechanisms or direct physical activity to operate machines or processes (not including computers of vehicles).	High - Controlling machines or processes that are very difficult to operate. Low - Controlling machines or processes that are easy to operate.
20. Operating vehicles, mechanized devices, or equipment.	Running, maneuvering, navigating, or driving vehicles or mechanized equipment, such as forklifts, passenger vehicles, aircraft, or water craft.	High - Operating equipment or vehicles that are very difficult to run. Low - Operating equipment or vehicles that are easy to run.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
Performing Complex/Technical Activities		
19. Interacting with computers.	Controlling computer functions by using programs, setting up functions, writing software, or otherwise communicating with computer systems.	High - Using computers to develop very complex, high speed data linkages and operating systems. Low - Using computers to produce standard correspondence, graphic materials, and business related information.
21. Drafting, laying-out, and specifying technical devices, parts, and equipment.	Providing documentation, detailed instructions, drawings, or specifications to inform others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used.	High - Drafting and specifying the components or technical relationships for complicated devices, parts, or equipment. Low - Drafting or specifying the components or technical relationships for devices, parts, or equipment that are easily understood.

Figure 6-2 (continued)
<u>Descriptions and Definitions of Generalized Work Activities</u>

Construct Label	Operational Definition	Level Scale
22. Implementing ideas, programs, systems, or products.	Conducting or carrying out work procedures and activities in accord with one's own ideas or information provided through directions/ instructions for purposes of installing, modifying, preparing, delivering, constructing, integrating, finishing, or completing programs, systems, structures, or products.	High - Performing highly complex and very difficult work activities with very limited guidelines to follow. Low - Performing activities that have clear cut directions and are easy to carry out.
23. Repairing and maintaining mechanical equipment.	Fixing, servicing, aligning, setting up, adjusting, and testing machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles.	High - Performing complex or non-routine repair, maintenance, or adjustment of mechanical equipment, often involving overhauls or rebuilding. Low - Performing straightforward repair, maintenance, or adjustment mechanical equipment using established, easy to understand procedures.

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Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
24. Repairing and maintaining electronic equipment.	Fixing, servicing, adjusting, regulating, calibrating, fine-tuning, or testing machines, devices, and equipment that operate primarily on the basis of electrical or electronic (not mechanical) principles.	High - Performing complex or non-routine repair, maintenance, of adjustment of electronic equipment, where repairs are often made to complex internal components or circuitry. Low - Performing straightforward repair, maintenance, or adjustment of electronic devices or equipment using established, easy to understand procedures.
25. Documenting and recording information.	Entering, transcribing, recording, storing, or maintaining information in either written form or by electronic/magnetic recording.	High - Documenting or recording very complex information using new, unstandardized procedures. Low - Documenting or recording straightforward information using predetermined forms and procedures.

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Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
Communicating/Interacting		
26. Interpreting the meaning of information for others.	Translating or explaining what information means and how it can be understood or used to support responses or feedback to others.	High - Making very difficult interpretations of information with limited, if any, guidance to follow. Low - Making easy interpretations of information with a high degree of guidance to follow.
27. Communicating with supervisors, peers, or subordinates.	Providing information to supervisors, fellow workers, and subordinates. This information can be exchanged face-to-face, in writing, or via telephone/electronic transfer.	High - Providing complex oral and written communications to others in the organization. Low - Providing straightforward oral or written communications to others in the organization.
28. Communicating with persons outside the organization.	Communicating with persons outside the organization, representing the organization to customers, the public, government, and other external sources. This information can be exchanged face-to-face, in writing, or via telephone/electronic transfer.	High - Presenting complex oral and written communications to persons outside the organization. Low - Presenting routine and simple oral and written communications to persons outside the organization.

Figure 6-2 (continued)
Descriptio[illegible] Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
29. Establishing and maintaining interpersonal relationships.	Developing constructive and cooperative working relationships with others.	High - Developing very good interpersonal relationships with highly diverse individuals or stakeholders in difficult situations. Low - Developing very few working relationships with others.
30. Assisting and caring for others.	Providing assistance or personal care to others.	High - Providing care or assistance to others in highly stressful or difficult situations. Low - Needing to provide minimal help or assistance to others.
31. Selling or influencing others.	Convincing others to buy merchandise/goods, or otherwise changing their minds or actions.	High - Doing a lot of high-level persuading to accomplish work objectives, involving persuading a very difficult to convince audience. Low - Doing little persuading to accomplish work objectives, because there is little need to convince others in any area.

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Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
32. Resolving conflicts and negotiating with others.	Handling complaints, arbitrating disputes, and resolving grievances, or otherwise negotiating with others.	High - Handling complaints and negotiations in very challenging situations, involving complex matters and significant conflict and pressure. Low - Handling negotiations that involve very simple matters that are easily resolved, or need to do a little complaint-handling or negotiation.
33. Performing for or working directly with the public.	Performing for people or dealing directly with the public, including serving persons in restaurants and stores, and receiving clients or guests.	High - Handling interactions with the public, where the audience is hard to please or other conflict is involved. Low - Having little interaction with the public, or needing to have only brief interactions.
Coordinating/Developing/Managing/Advising Others		
34. Coordinating the work and activities of others.	Coordinating members of a work group to accomplish tasks.	High - Coordinating the work of many employees, where a complex sequencing of others' tasks is required. Low - Needing to do little coordinating of others.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
35. Developing and building teams.	Encouraging and building mutual trust, respect, and cooperation among team members.	High - Managing large teams and building cooperation among diverse team members toward accomplishment of highly complex or poorly defined activities/projects. Low - Doing little team building.
36. Teaching others.	Identifying educational needs, developing formal training programs or classes, and teaching or instructing others.	High - Teaching and explaining difficult tasks, concepts, or material, and conducting complex training. Low - Doing little training or educating of others.
37. Guiding, directing, and motivating subordinates	Providing guidance and direction to subordinates, including setting performance standards and monitoring subordinates.	High - Directing and motivating several organization members, and building and maintaining morale in difficult or unpleasant work settings. Low - Doing little directing or motivating of subordinates.

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Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
38. Coaching and developing others.	Identifying developmental needs of others and coaching or otherwise helping others to improve their knowledge or skills.	High - Identifying effective ways of developing others to perform highly complex or difficult tasks, and coaching them under these difficult conditions. Low - Doing little coaching or developing of others.
39. Providing consultation and advice to others.	Providing consultation and expert advice to management or other groups on technical, systems-related, or process-related topics.	High - Providing expert guidance on complex matters regarding the design, development, or implementation of major programs. Low - Providing little advice or consultation to others.
Administering		
40. Performing administrative activities.	Approving requests, handling paperwork, and performing day-to-day administrative tasks.	High - Overseeing administrative activities for a large workforce, with a complex set of administrative procedures. Low - Doing very straightforward administrative activities.

Figure 6-2 (continued)
Descriptions and Definitions of Generalized Work Activities

Construct Label	Operational Definition	Level Scale
41. Staffing organizational units.	Recruiting, interviewing, selecting, hiring, and promoting persons for an organization.	High - Overseeing the staff of a large and diverse workforce, with complex staffing needs. Low - Doing very straightforward staffing activities.
42. Monitoring and controlling resources.	Monitoring and controlling resources and overseeing the spending of money.	High - Monitoring and controlling a large number of resources, including managing a large budget. Low - Needing to do little monitoring or controlling of resources or money.

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Figure 6-3

Thirty-five Occupations With Four or More Incumbents Completing the Generalized Work Activities Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	11
19005	General Managers & Top Executives	43
21108	Loan Officers & Counselors	6
22135	Mechanical Engineers	11
25105	Computer Programmers	7
31302	Teachers, Preschool	6
31305	Teachers, Elementary School	13
32502	Registered Nurses	25
32902	Medical & Clinical Laboratory Technologists	8
49008	Salespersons, Except Scientific & Retail	13
49011	Salespersons, Retail	18
49021	Stock Clerks, Sales Floor	13
49023	Cashiers	22
51002	1st Line Supervisors, Clerical & Administrative	59
53102	Tellers	4
53311	Insurance Claims Clerks	7
53905	Teachers' Aides & Assistants, Clerical	8
55108	Secretaries, Except Legal & Medical	65
55305	Receptionists & Information Clerks	5
55338	Bookkeeping, Accounting & Auditing Clerks	25
55347	General Office Clerks	88
61005	Police & Detective Supervisors	13
63014	Police Patrol Officers	24
65008	Waiters & Waitresses	10
65026	Cooks, Restaurant	4
65038	Food Preparation Workers	27
66008	Nursing Aides, Orderlies & Attendants	22
67005	Janitors & Cleaners	30
85119	Other Machinery Maintenance Mechanics	4
85132	Maintenance Repairers, General Utility	27
87902	Earth Drillers, Except Oil & Gas	4
89108	Machinists	4
92974	Packaging & Filling Machine Operators	16
97102	Truck Drivers, Heavy or Tractor Trailer	9
97111	Bus Drivers, Schools	11

Figure 6-4
Example Page From the Generalized Work Activities Questionnaire

23. Repairing and Maintaining Mechanical Equipment

Fixing, servicing, aligning, setting up, adjusting, and testing machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles.

Level

What level of this activity is needed to perform this job?

Performing complex or non-routine repair, maintenance, or adjustment of mechanical equipment, often involving overhauls or rebuilding.

Performing straightforward repair, maintenance, or adjustment of mechanical equipment using established, easy to understand procedures.

7
6 ← *Rebuilding a high-performance engine.* *Overhauling a power plant turbine.*
5
4 ← *Removing and replacing broken parts in an automobile transmission.* *Adjusting a grandfather clock.*
3
2
1 ← *Making routine preventive maintenance to a door lock.* *Making simple, external adjustments to a door hinge with ordinary hand tools.*

NR Not relevant at all for performance on this job

Importance

How important is this activity to performance on this job?

1	2	3	4	5
Not Important	Somewhat Important	Important	Very Important	Extremely Important

Frequency

How often is this activity performed on this job?

1	2	3	4	5	6	7
Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often

Table 6-1
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Generalized Work Activities

	Variable											
	Level				Importance				Frequency			
Descriptor	M	SD	SEM[a]	r_k[b]	M	SD	SEM	r_k	M	SD	SEM	r_k
1. Getting Information	3.47	1.35	.55	.83	3.15	0.70	.35	0.75	4.06	0.88	.53	.64
2. Identifying Objects	2.92	1.28	.57	.80	2.75	0.73	.37	0.75	3.79	0.87	.58	.56
3. Monitoring Processes	2.77	1.23	.56	.79	2.65	0.71	.36	0.75	3.79	1.04	.60	.67
4. Inspecting Equipment	1.91	1.10	.52	.77	2.31	0.69	.32	0.78	2.99	0.82	.47	.67
5. Estimating Characteristics	1.76	0.83	.50	.64	2.09	0.50	.33	0.57	2.73	0.72	.50	.53
6. Judging the Qualities	2.58	1.30	.55	.82	2.47	0.72	.34	0.78	3.26	0.96	.54	.68
7. Evaluating Information	2.72	1.27	.52	.83	2.82	0.72	.35	0.77	3.63	0.98	.50	.74
8. Processing Information	2.54	1.27	.62	.76	2.54	0.74	.36	0.77	3.36	1.07	.58	.71
9. Analyzing Data	2.37	1.54	.58	.86	2.41	0.77	.33	0.82	2.98	0.90	.44	.76
10. Making Decisions	3.12	1.34	.54	.84	2.90	0.73	.32	0.80	3.79	0.88	.48	.70
11. Thinking Creatively	2.78	1.33	.61	.79	2.51	0.72	.33	0.78	3.17	0.92	.48	.73
12. Using Job Knowledge	3.80	1.22	.61	.75	3.19	0.68	.36	0.72	3.59	0.70	.51	.47
13. Developing Objectives	2.19	1.28	.48	.86	2.26	0.75	.27	0.87	2.37	0.62	.36	.65
14. Scheduling Work	2.44	1.18	.52	.81	2.46	0.67	.31	0.79	3.06	1.00	.46	.79
15. Organizing and Planning	3.80	1.18	.52	.80	3.26	0.73	.32	0.80	4.30	0.86	.46	.72
16. Perform. Phys. Work Tasks	2.70	1.35	.54	.84	2.51	0.76	.32	0.82	4.26	1.11	.68	.62
17. Handling Objects	3.40	0.91	.64	.51	2.86	0.54	.36	0.56	4.50	0.84	.62	.46
18. Controlling Machines	1.70	1.54	.62	.84	2.17	0.83	.37	0.80	3.07	1.39	.66	.77
19. Interacting with Computers	2.01	1.39	.54	.85	2.50	0.86	.31	0.87	3.48	1.47	.50	.89
20. Operating Vehicles	1.53	1.54	.44	.92	1.96	0.95	.26	0.92	2.54	1.51	.41	.92
21. Specifying Equipment	0.87	0.92	.40	.81	1.48	0.55	.24	0.81	1.59	0.65	.30	.78
22. Implementing Ideas	2.02	1.00	.54	.71	2.25	0.62	.33	0.71	2.82	0.78	.49	.61
23. Repairing, Mechanical	1.11	1.25	.47	.86	1.63	0.74	.27	0.86	1.85	0.93	.39	.82
24. Repairing, Electronic	1.04	1.25	.55	.80	1.62	0.69	.32	0.78	1.91	0.82	.46	.68
25. Documenting Information	2.45	1.05	.61	.67	2.67	0.65	.38	0.65	3.63	0.93	.57	.63
26. Interpreting Information	2.32	0.93	.54	.66	2.48	0.57	.35	0.63	3.40	0.92	.56	.64
27. Communicating, Internal	4.14	1.14	.51	.80	3.54	0.57	.30	0.73	4.78	0.66	.51	.41
28. Communicating, External	3.09	1.35	.56	.83	2.88	0.83	.34	0.84	3.62	1.13	.54	.77
29. Establishing Relationships	4.48	0.93	.48	.73	3.76	0.63	.33	0.73	5.18	0.78	.44	.68
30. Assisting Others	3.08	1.05	.56	.72	3.11	0.58	.37	0.59	4.16	0.86	.53	.63
31. Selling or Influencing	2.07	1.18	.52	.81	2.31	0.69	.32	0.79	2.94	0.92	.49	.71
32. Resolving Conflicts	2.82	1.25	.48	.85	2.77	0.75	.33	0.81	3.19	0.86	.42	.77
33. Working with the Public	2.58	1.49	.65	.81	2.65	0.90	.43	0.77	3.41	1.35	.65	.77
34. Coordinating Others' Work	2.43	1.24	.47	.86	2.57	0.65	.30	0.78	3.31	0.77	.47	.63
35. Developing Teams	2.46	1.09	.49	.80	2.56	0.60	.29	0.76	3.18	0.67	.43	.60
36. Teaching Others	2.48	0.97	.48	.76	2.70	0.55	.33	0.64	3.11	0.83	.45	.70

Table 6-1 (continued)
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Generalized Work Activities

	Variable											
	Level				Importance				Frequency			
Descriptor	M	SD	SEM[a]	r_k[b]	M	SD	SEM	r_k	M	SD	SEM	r_k
37. Directing Subordinates	2.01	1.34	.41	.91	2.30	0.73	.26	0.87	2.69	0.89	.36	.84
38. Developing Others	2.58	1.07	.45	.82	2.66	0.61	.31	.74	3.15	0.73	.39	.71
39. Providing Consultation	2.17	1.15	.49	.82	2.28	0.61	.29	.78	2.71	0.69	.40	.65
40. Performing Admin. Tasks	2.38	1.18	.53	.80	2.59	0.64	.31	.77	3.52	1.00	.49	.76
41. Staffing Org. Units	1.19	1.12	.39	.88	1.73	0.66	.22	.89	1.57	0.46	.29	.61
42. Monitoring Resources	1.41	1.17	.47	.84	1.85	0.72	.29	.84	2.13	0.71	.41	.67

Note. Statistics are based on 35 occupations with Generalized Work Activities questionnaire responses from at least four incumbents (mean number of incumbents = 18.91, median = 13, harmonic mean = 9.68).

[a] This estimate of the standard error of measurement was calculated as $SEM = SD * \sqrt{(1 - r_k)}$.

[b] This estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

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Table 6-2
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Generalized Work Activities

	Variable					
	Level		Importance		Frequency	
Descriptor	r_1[a]	r_{30}[b]	r_1	r_{30}	r_1	r_{30}
1. Getting Information	34	94	24	90	16	85
2. Identifying Objects	30	93	24	90	12	80
3. Monitoring Processes	28	92	24	90	17	86
4. Inspecting Equipment	26	91	27	92	18	87
5. Estimating Characteristics	15	85	12	80	10	78
6. Judging the Qualities	33	94	26	91	18	87
7. Evaluating Information	33	94	25	91	23	90
8. Processing Information	25	91	25	91	20	88
9. Analyzing Data	39	95	31	93	25	91
10. Making Decisions	35	94	29	93	19	88
11. Thinking Creatively	28	92	27	92	22	89
12. Using Job Knowledge	23	90	21	89	08	73
13. Developing Objectives	39	95	40	95	16	85
14. Scheduling Work	30	93	29	92	28	92
15. Organizing and Planning	29	93	30	93	21	89
16. Performing Physical Work Tasks	35	94	32	93	15	84
17. Handling Objects	10	76	12	80	08	72
18. Controlling Machines	35	94	29	92	26	91
19. Interacting with Computers	36	94	42	96	45	96
20. Operating Vehicles	54	97	55	97	56	97
21. Specifying Equipment	30	93	31	93	27	92
22. Implementing Ideas	20	88	20	88	14	83
23. Repairing, Mechanical	39	95	39	95	32	93
24. Repairing, Electronic	30	93	27	92	18	87
25. Documenting Information	17	86	16	85	15	84
26. Interpreting Information	17	86	15	84	15	85
27. Communicating, Internal	29	92	22	90	07	69
28. Communicating, External	33	94	34	94	26	91
29. Establishing Relationships	22	89	22	89	18	87
30. Assisting Others	21	89	13	82	15	84
31. Selling or Influencing	30	93	27	92	20	89
32. Resolving Conflicts	37	95	31	93	25	91
33. Working with the Public	30	93	26	91	26	91
34. Coordinating Others' Work	38	95	27	92	15	84
35. Developing Teams	29	93	25	91	13	82
36. Teaching Others	25	91	16	85	20	88
37. Directing Subordinates	50	97	42	96	35	94

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Table 6-2 (continued)
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Generalized Work Activities

	Variable					
	Level		Importance		Frequency	
Descriptor	r_1 [a]	r_{30} [b]	r_1	r_{30}	r_1	r_{30}
38. Developing Others	32	93	23	90	20	88
39. Providing Consultation	32	93	27	92	16	85
40. Performing Admin. Tasks	29	93	25	91	24	91
41. Staffing Org. Units	43	96	44	96	14	83
42. Monitoring Resources	35	94	34	94	17	86

Note. Reliability estimates are based on 35 occupations with Generalized Work Activities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.9, median = 13, harmonic mean = 9.68). Decimals are omitted.
[a] Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judge ratings across occupations: ICC(1,1) = [BMS-WMS]/BMS + (k-1)WMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
[b] Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

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Table 6-3
Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Generalized Work Activities

	Type of Scale and Recoding Scheme Applied						
	Level			Importance		Frequency	
Descriptor	r_a	r_b	r_c	r_a	r_b	r_a	r_b
1. Getting Information	83	83	67	75	75	64	64
2. Identifying Objects	80	80	68	75	74	56	56
3. Monitoring Processes	79	79	70	75	75	67	67
4. Inspecting Equipment	77	77	69	78	77	67	67
5. Estimating Characteristics	64	64	48	57	55	53	53
6. Judging the Qualities	82	82	67	78	77	68	68
7. Evaluating Information	83	83	79	77	79	74	74
8. Processing Information	76	76	76	77	77	71	71
9. Analyzing Data	86	86	81	82	83	76	76
10. Making Decisions	84	84	70	80	79	70	70
11. Thinking Creatively	79	79	77	78	80	73	73
12. Using Job Knowledge	75	75	70	72	74	47	47
13. Developing Objectives	86	86	81	87	86	65	65
14. Scheduling Work	81	81	82	79	81	79	79
15. Organizing and Planning	80	80	78	80	82	72	72
16. Perform. Phys. Work Tasks	84	84	61	82	80	62	62
17. Handling Objects	51	51	46	56	54	46	46
18. Controlling Machines	84	84	72	80	79	77	77
19. Interacting with Computers	85	85	87	87	88	89	89
20. Operating Vehicles	92	92	88	92	92	92	92
21. Specifying Equipment	81	81	76	81	81	78	78
22. Implementing Ideas	71	71	68	71	71	61	61
23. Repairing, Mechanical	86	86	78	86	85	82	82
24. Repairing, Electronic	80	80	61	78	75	68	68
25. Documenting Information	67	67	64	65	66	63	63
26. Interpreting Information	66	66	58	63	63	64	64
27. Communicating, Internal	80	80	64	73	74	41	41
28. Communicating, External	83	83	81	84	84	77	77
29. Establishing Relationships	73	73	75	73	75	68	68
30. Assisting Others	72	72	33	59	56	63	63
31. Selling or Influencing	81	81	60	79	76	71	71
32. Resolving Conflicts	85	85	77	81	81	77	77
33. Working with the Public	81	81	70	77	77	77	77
34. Coordinating Others' Work	86	86	73	78	78	63	63
35. Developing Teams	80	80	70	76	77	60	60
36. Teaching Others	76	76	54	64	62	70	70
37. Directing Subordinates	91	91	81	87	87	84	84

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Table 6-3 (continued)
Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Generalized Work Activities

Descriptor	Level r_a	Level r_b	Level r_c	Importance r_a	Importance r_b	Frequency r_a	Frequency r_b
38. Developing Others	82	82	55	74	73	71	71
39. Providing Consultation	82	82	64	78	77	65	65
40. Performing Admin. Tasks	80	80	75	77	77	76	76
41. Staffing Org. Units	88	88	85	89	89	61	61
42. Monitoring Resources	84	84	79	84	83	67	67

Note. Reliability estimates are based on 35 occupations with Generalized Work Activities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.9, median = 13, harmonic mean = 9.68). Reliability estimates stipulated as r_a were calculated using the full eight point scale for level, and retaining all of the data for the importance and frequency scales. Reliability estimates stipulated as r_b were calculated using a reduced seven point scale for level, and excluding the data for the importance and frequency scales where the rater marked "NR" on the level scale. Reliability estimates stipulated as r_c were calculated using a binary coded scale for level (relevant/not relevant). Decimals are omitted.

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Table 6-4a

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Generalized Work Activities

Source of Variation	SS	df	MS	F
Occupations	11915.96	34	350.47	6.06*
S(Occupations)	36274.33	627	57.85	
Descriptor	9025.69	41	220.14	85.55*
Descriptor x Occupations	17833.73	1394	12.79	4.97*
Descriptor x S(Occupations)	66151.48	25707	2.57	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p<.05$

Table 6-4b

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Generalized Work Activities

Source of Variation	SS	df	MS	F
Occupations	3087.70	34	90.81	5.1*
S(Occupations)	11154.37	627	17.79	
Descriptor	3309.13	41	80.71	76.48*
Descriptor x Occupations	6781.85	1394	4.87	4.61*
Descriptor x S(Occupations)	27127.57	25707	1.06	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 6-4c

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Frequency Scale: Generalized Work Activities

Source of Variation	SS	df	MS	F
Occupations	3803.95	34	111.88	2.98*
S(Occupations)	23560.76	627	37.58	
Descriptor	8849.46	41	215.84	94.08*
Descriptor x Occupations	12494.13	1394	8.96	3.91*
Descriptor x S(Occupations)	58974.69	25707	2.29	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*p<.05

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Table 6-5
Interrater Agreement Coefficients for Each Scale Type: Generalized Work Activities

Scale Type	Number of Raters on Each Variable		
	r_k	r_1	r_{30}
Level	80	29	92
Importance	78	27	92
Frequency	74	23	90

Note. Interrater agreement coefficient estimates are based on 35 occupations with Generalized Work Activities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.91, median = 13, harmonic mean = 9.68). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Descriptor x Occupations" terms from Tables 6-4a, 6-4b, and 6-4c as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

Table 6-6a

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Generalized Work Activities

Source of Variation	SS	df	MS	F
Occupations	2647.17	34	77.86	6.23*
S(Occupations)	7842.03	627	12.51	
Aggregate	894.05	8	111.76	106.12*
Aggregate x Occupations	2030.55	272	7.47	7.09*
Aggregate x S(Occupations)	5282.65	5016	1.05	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.

*$p<.05$

Table 6-6b

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Generalized Work Activities

Source of Variation	SS	df	MS	F
Occupations	668.82	34	19.67	5.01*
S(Occupations)	2461.78	627	3.92	
Aggregate	296.37	8	37.04	93.09*
Aggregate x Occupations	698.23	272	2.57	6.45*
Aggregate x S(Occupations)	1996.17	5016	.40	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.

*p<.05

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Table 6-6c
Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Frequency Scale: Generalized Work Activities

Source of Variation	SS	df	MS	F
Occupations	821.87	34	24.17	2.88*
S(Occupations)	5268.78	627	8.40	
Aggregate	743.07	8	92.88	105.36*
Aggregate x Occupations	1093.33	272	4.02	4.56*
Aggregate x S(Occupations)	4422.24	5016	.88	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.
*p<.05

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Table 6-7
Interrater Agreement Coefficients for Aggregate Descriptors for Each Scale Type: Generalized Work Activities

Scale Type	Number of Raters on Each Variable		
	r_k	r_1	r_{30}
Level	86	39	95
Importance	84	36	94
Frequency	78	27	92

Note. Interrater agreement coefficient estimates are based on 35 occupations with Generalized Work Activities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.91, median = 13, harmonic mean = 9.68). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Aggregate x Occupations" terms from Tables 6-6a, 6-6b, and 6-6c as true variance. Error variance was defined as the "Aggregate x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

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Table 6-8
Means and Standard Deviations of Correlations Between Level, Importance, and Frequency Scales Across Occupations and Descriptors: Generalized Work Activities

	Level			Importance			Frequency		
Scale	n[a]	M	SD	n	M	SD	n	M	SD
Level	--	--	--	35	.93	.11	35	.88	.08
Importance	42	.92	.05	--	--	--	35	.91	.06
Frequency	42	.82	.07	42	.89	.06	--	--	--

Note. All correlations were calculated based on the mean of ratings assigned by raters for a given occupation, descriptor, and scale. Level-importance means above the diagonal were calculated by taking the level scale means on a given occupation for all descriptors, correlating them with importance scale means, for that occupation, and then averaging them with the correlations for other occupations. Level-importance means below the diagonal were calculated by taking the level scale means on a given descriptor for all occupations, correlating them with importance scale means for that descriptor, and averaging them with correlations for other descriptors. Other means in the table were calculated in a similar manner.

[a] Number of correlations averaged, not number of observations on which correlations were calculated.

Table 6-9a

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Getting Information	--																				
2. Identifying Objects	75	--																			
3. Monitoring Processes	67	85	--																		
4. Inspecting Equipment	-01	23	45	--																	
5. Estimating Characteristics	50	66	70	56	--																
6. Judging the Qualities	72	83	74	06	49	--															
7. Evaluating Information	74	92	82	23	62	82	--														
8. Processing Information	65	68	51	-09	37	70	77	--													
9. Analyzing Data	70	84	73	41	77	67	83	63	--												
10. Making Decisions	83	90	80	25	72	84	89	68	88	--											
11. Thinking Creatively	77	74	66	29	74	60	75	53	79	82	--										
12. Using Job Knowledge	73	83	81	36	59	68	88	69	76	81	75	--									
13. Developing Objectives	75	74	71	-03	53	81	71	55	58	80	70	59	--								
14. Scheduling Work	63	52	56	-01	50	63	56	43	37	59	63	47	83	--							
15. Organizing and Planning	75	73	65	-01	48	72	82	64	63	77	78	77	78	71	--						
16. Perform. Phys. Work Tasks	-34	-16	-01	48	01	-13	-23	-60	-10	-12	-07	-12	-22	-16	-19	--					
17. Handling Objects	-24	-18	-14	33	08	-28	-17	-27	-05	-19	00	-05	-43	-27	-16	54	--				
18. Controlling Machines	-19	-21	14	63	17	-39	-22	-50	-10	-22	-07	00	-34	-24	-29	46	47	--			
19. Interacting with Computers	68	51	36	09	56	31	54	57	69	57	71	50	30	28	46	-36	09	-07	--		
20. Operating Vehicles	-20	-11	02	50	10	-20	-08	-46	-08	-03	-14	-02	-23	-18	-19	51	20	55	-17	--	
21. Specifying Equipment	13	24	32	66	55	21	27	15	44	32	38	26	11	12	10	21	25	32	24	24	--
22. Implementing Ideas	69	69	64	40	71	58	66	44	77	77	84	66	61	46	61	-07	02	08	57	01	48
23. Repairing, Mechanical	-09	10	38	85	40	-10	13	-20	22	06	15	26	-17	-12	-08	45	45	76	03	50	59
24. Repairing, Electronic	-02	24	46	83	51	-06	21	-08	45	19	24	33	-14	-17	-07	38	43	65	25	36	46
25. Documenting Information	55	61	55	00	33	74	64	68	47	60	38	51	48	42	45	-18	-11	-28	40	-16	16
26. Interpreting Information	71	79	68	02	54	83	83	75	65	80	69	76	74	57	74	-26	-16	-37	44	-24	22
27. Communicating, Internal	76	81	65	15	51	69	84	64	75	85	74	83	64	56	87	-12	-10	-27	53	-05	14
28. Communicating, External	65	68	49	-11	32	65	73	66	54	73	53	69	67	56	76	-30	-33	-45	37	-02	00
29. Establishing Relationships	54	58	49	02	18	51	59	38	41	61	49	63	57	50	71	07	-19	-23	10	-04	-06
30. Assisting Others	10	26	28	-05	07	46	24	14	08	27	04	17	34	34	24	29	-20	-27	-24	-01	-15

Table 6-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
31. Selling or Influencing	49	47	29	-10	36	54	44	33	49	60	43	41	61	41	47	-06	-23	-37	18	-06	11
32. Resolving Conflicts	53	63	52	-06	26	66	60	33	53	68	35	54	64	42	56	03	-39	-31	08	08	-15
33. Working with the Public	08	21	13	-24	-02	31	16	19	08	25	-05	18	27	17	13	12	-13	-28	-18	-07	-31
34. Coordinating Others' Work	61	63	62	08	52	79	63	42	45	74	58	51	86	80	68	-02	-29	-25	13	-03	16
35. Developing Teams	69	69	64	02	44	78	68	50	52	76	54	58	86	68	72	-14	-37	-24	17	-01	20
36. Teaching Others	58	61	67	13	50	72	61	33	41	59	53	50	74	68	58	01	-17	-07	11	-05	15
37. Directing Subordinates	51	62	63	08	50	75	61	37	44	71	44	49	78	66	60	-03	-38	-21	05	04	05
38. Developing Others	53	66	68	04	50	74	63	37	48	68	47	54	78	67	68	-04	-33	-18	09	-06	-01
39. Providing Consultation	73	82	73	19	77	73	76	57	82	90	78	71	82	64	73	-16	-27	-25	51	-15	18
40. Performing Admin. Tasks	59	59	46	-15	28	70	67	65	49	70	34	53	62	45	63	-39	-50	-50	20	-09	03
41. Staffing Org. Units	39	54	52	24	62	46	48	26	55	62	47	43	55	39	44	-13	-35	-07	26	06	03
42. Monitoring Resources	51	57	63	27	69	58	53	38	55	66	49	43	60	51	44	-16	-22	02	28	-10	28

Table 6-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
22. Implementing Ideas	--																				
23. Repairing, Mechanical	29	--																			
24. Repairing, Electronic	32	86	---																		
25. Documenting Information	27	-07	-01	--																	
26. Interpreting Information	61	-01	-01	65	--																
27. Communicating, Internal	62	-02	08	47	68	--															
28. Communicating, External	36	-27	-18	47	64	80	--														
29. Establishing Relationships	30	-14	-12	31	44	81	70	--													
30. Assisting Others	-15	-18	-16	51	29	25	25	50	--												
31. Selling or Influencing	42	-21	-17	16	54	51	64	44	24	--											
32. Resolving Conflicts	31	-21	-06	33	48	64	73	64	46	71	--										
33. Working with the Public	-17	-36	-21	26	16	19	43	42	62	52	62	--									
34. Coordinating Others' Work	53	-11	-19	49	68	60	59	56	48	58	59	32	--								
35. Developing Teams	56	-12	-19	43	69	65	69	62	35	68	68	32	89	--							
36. Teaching Others	48	07	-02	53	70	42	32	38	48	29	42	10	78	68	--						
37. Directing Subordinates	42	-10	-13	42	61	56	58	54	52	56	71	44	93	85	71	--					
38. Developing Others	38	-12	-07	43	59	60	59	60	60	50	72	45	83	76	75	90	--				
39. Providing Consultation	68	-04	13	44	71	77	67	55	26	61	65	27	74	69	59	75	75	--			
40. Performing Admin. Tasks	33	-28	-27	51	63	69	80	59	35	61	69	38	68	77	40	72	64	63	--		
41. Staffing Org. Units	52	-01	13	17	40	51	43	32	15	44	51	18	65	58	37	76	67	77	55	--	
42. Monitoring Resources	53	09	13	36	43	45	35	28	14	37	39	13	73	63	49	75	65	73	55	77	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 6-9b

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Getting Information	--																				
2. Identifying Objects	67	--																			
3. Monitoring Processes	58	83	--																		
4. Inspecting Equipment	-05	17	41	--																	
5. Estimating Characteristics	53	62	66	45	--																
6. Judging the Qualities	66	70	61	-03	48	--															
7. Evaluating Information	71	82	66	00	44	77	--														
8. Processing Information	40	45	29	-21	32	60	62	--													
9. Analyzing Data	70	74	60	17	67	70	77	58	--												
10. Making Decisions	74	72	64	11	69	72	69	49	85	--											
11. Thinking Creatively	72	69	68	13	67	61	68	37	74	77	--										
12. Using Job Knowledge	62	75	67	22	49	53	70	56	70	65	67	--									
13. Developing Objectives	60	64	67	-12	52	78	60	40	58	74	74	48	--								
14. Scheduling Work	40	42	47	-13	37	59	50	32	27	48	55	34	75	--							
15. Organizing and Planning	54	64	59	-01	41	63	75	50	64	63	75	68	72	69	--						
16. Perform. Phys. Work Tasks	-33	-13	-06	34	-18	-23	-19	-61	-29	-23	-22	-13	-26	-10	-13	--					
17. Handling Objects	-17	-14	-16	30	-07	-33	-04	-16	-13	-29	-11	02	-44	-16	07	44	--				
18. Controlling Machines	-19	-11	10	57	00	-43	-28	-40	-27	-35	-26	08	-39	-27	-27	39	52	--			
19. Interacting with Computers	72	39	25	-18	42	39	53	65	60	53	54	49	30	28	41	-67	-05	-25	--		
20. Operating Vehicles	-11	-06	-01	33	-01	-17	-16	-47	-14	01	-21	-08	-15	-06	-13	46	10	30	-34	--	
21. Specifying Equipment	25	21	28	61	56	18	17	02	35	30	39	17	12	02	12	15	24	24	14	19	--
22. Implementing Ideas	63	63	62	38	71	53	55	24	70	66	75	61	46	32	53	-12	08	04	42	-07	46
23. Repairing, Mechanical	07	23	50	82	33	-06	11	-21	12	02	14	27	-11	-12	02	29	26	67	-14	33	54
24. Repairing, Electronic	16	28	53	81	42	-05	12	-14	30	12	19	33	-12	-22	-02	12	22	62	07	19	47
25. Documenting Information	51	38	39	-11	21	60	51	62	41	43	27	43	37	41	39	-23	-11	-21	49	-17	01
26. Interpreting Information	55	64	62	-02	49	85	69	78	62	65	59	66	74	60	67	-37	-27	-32	45	-30	12
27. Communicating, Internal	59	57	53	-02	31	57	64	44	58	59	66	71	60	56	86	-13	04	-12	46	-07	11
28. Communicating, External	36	46	30	-25	23	50	49	59	48	54	47	58	61	54	68	-34	-25	-39	43	01	-04
29. Establishing Relationships	26	45	38	-11	03	36	43	22	34	45	48	53	53	52	75	13	-01	-16	11	-05	-11

Table 6-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
30. Assisting Others	-05	19	32	15	05	25	15	07	15	25	11	22	22	32	36	42	07	00	-15	05	-13
31. Selling or Influencing	32	33	21	-03	44	44	25	26	57	51	41	42	54	32	49	-08	-22	-26	21	06	21
32. Resolving Conflicts	33	41	27	-26	07	49	42	30	46	49	26	52	54	37	51	05	-25	-21	10	06	-22
33. Working with the Public	-08	12	10	-18	-01	20	11	31	15	18	-06	33	22	25	23	09	-09	-02	00	-03	-36
34. Coordinating Others' Work	52	56	60	14	53	68	52	17	46	72	59	43	76	69	60	13	-21	-15	12	20	21
35. Developing Teams	57	64	61	09	49	77	61	37	60	70	60	52	80	56	70	-06	-26	-28	16	07	22
36. Teaching Others	48	57	70	19	47	60	54	08	41	54	59	39	68	60	57	18	00	00	05	-04	18
37. Directing Subordinates	48	63	66	16	56	73	52	29	54	71	54	48	76	57	54	-03	-35	-19	13	11	10
38. Developing Others	29	57	62	20	45	59	52	30	50	55	39	46	60	52	61	04	00	00	11	03	-05
39. Providing Consultation	58	73	69	12	75	71	65	47	81	87	77	65	80	54	69	-22	-28	-29	41	-12	22
40. Performing Admin. Tasks	35	46	26	-29	10	54	58	62	47	47	28	51	44	42	64	-26	-16	-33	35	01	-12
41. Staffing Org. Units	36	53	55	17	62	49	33	21	52	62	49	39	62	41	46	-19	-32	-14	18	10	09
42. Monitoring Resources	50	50	54	13	59	59	43	35	46	63	42	35	60	42	38	-22	-26	-08	29	-10	19

Table 6-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
22. Implementing Ideas	--																				
23. Repairing, Mechanical	37	--																			
24. Repairing, Electronic	44	88	---																		
25. Documenting Information	13	-09	00	--																	
26. Interpreting Information	42	-04	-02	68	--																
27. Communicating, Internal	50	04	02	41	62	--															
28. Communicating, External	12	-30	-26	39	65	65	--														
29. Establishing Relationships	23	-13	-14	21	42	79	64	--													
30. Assisting Others	-05	03	09	47	32	35	23	57	--												
31. Selling or Influencing	36	-11	-03	06	43	48	61	44	19	--											
32. Resolving Conflicts	16	-26	-20	27	46	57	68	68	38	69	--										
33. Working with the Public	-17	-27	-16	33	36	26	54	46	56	44	74	--									
34. Coordinating Others' Work	45	05	-05	37	57	62	44	52	40	39	48	19	--								
35. Developing Teams	48	02	-03	36	69	69	55	53	27	55	59	18	85	--							
36. Teaching Others	50	21	19	40	58	49	18	43	47	22	28	07	75	64	--						
37. Directing Subordinates	41	07	06	36	64	54	47	43	38	44	56	31	88	86	65	--					
38. Developing Others	33	07	14	40	61	57	46	53	62	36	55	50	71	65	70	80	--				
39. Providing Consultation	64	01	12	32	72	63	58	49	29	61	54	30	72	72	62	80	73	--			
40. Performing Admin. Tasks	10	-23	-26	46	59	67	81	59	25	44	66	42	44	56	20	50	51	48	--		
41. Staffing Org. Units	48	03	10	13	44	50	42	35	18	45	42	17	74	73	44	85	69	77	43	--	
42. Monitoring Resources	45	06	05	28	49	41	28	25	05	26	34	13	74	67	47	76	57	64	40	75	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 6-9c

Intercorrelations of Descriptors for the Frequency Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Getting Information	--																				
2. Identifying Objects	53	--																			
3. Monitoring Processes	37	70	--																		
4. Inspecting Equipment	-12	08	42	--																	
5. Estimating Characteristics	20	43	51	55	--																
6. Judging the Qualities	52	56	28	-09	22	--															
7. Evaluating Information	58	73	44	-13	19	74	--														
8. Processing Information	25	34	08	-20	14	60	56	--													
9. Analyzing Data	64	56	45	03	51	52	60	56	--												
10. Making Decisions	65	58	55	15	42	43	49	26	77	--											
11. Thinking Creatively	48	51	59	-07	22	15	39	00	43	62	--										
12. Using Job Knowledge	33	59	45	09	23	34	46	39	45	35	33	--									
13. Developing Objectives	33	50	55	-12	14	50	53	19	38	58	69	37	--								
14. Scheduling Work	23	31	29	-16	12	37	42	23	17	44	57	30	67	--							
15. Organizing and Planning	45	48	34	-25	05	46	67	55	50	47	50	67	55	60	--						
16. Perform. Phys. Work Tasks	-01	04	13	49	12	-02	08	-25	-25	-06	-04	02	-13	14	-01	--					
17. Handling Objects	04	13	07	18	18	-13	22	15	16	-01	12	29	-22	03	40	45	--				
18. Controlling Machines	-13	-05	24	61	28	-29	-19	-16	-10	-15	-23	30	-29	-18	-14	50	41	--			
19. Interacting with Computers	64	32	16	-29	15	32	43	60	68	42	32	31	08	16	50	-40	18	-17	--		
20. Operating Vehicles	02	-04	-01	38	11	-12	-07	-37	-13	15	-15	13	-09	00	-07	23	00	24	-30	--	
21. Specifying Equipment	24	09	19	48	44	12	08	-01	21	24	12	05	04	-06	-11	15	08	17	-05	27	--
22. Implementing Ideas	53	46	50	32	54	31	32	16	56	40	37	41	12	04	24	00	24	24	44	00	38
23. Repairing, Mechanical	-03	25	50	73	41	-11	07	-12	08	13	04	23	-04	-11	-09	29	20	60	-19	34	47
24. Repairing, Electronic	-04	24	62	74	53	-21	-04	-05	25	22	20	24	-05	-18	-07	19	26	58	04	16	31
25. Documenting Information	46	37	10	-16	07	67	54	67	51	43	11	27	21	27	45	-11	03	-20	49	-05	-01
26. Interpreting Information	44	63	42	-05	14	82	71	70	56	51	34	60	57	46	68	-04	06	-16	38	-17	03
27. Communicating, Internal	44	35	23	-05	10	34	37	35	36	41	31	62	20	42	77	13	41	07	38	05	-05
28. Communicating, External	20	27	04	-25	-06	35	37	53	35	40	21	60	33	40	66	-14	17	-19	29	13	-04
29. Establishing Relationships	28	32	18	-07	-03	19	35	25	27	33	32	44	19	39	62	31	49	09	21	-13	-22
30. Assisting Others	-16	11	16	09	00	29	12	14	-01	15	10	12	29	46	34	42	18	07	-24	-10	-18

Table 6-9c (continued)
Intercorrelations of Descriptors for the Frequency Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
31. Selling or Influencing	27	26	11	-06	36	38	18	20	42	38	24	38	30	25	36	10	14	-10	08	00	15
32. Resolving Conflicts	39	39	16	-21	-08	52	49	21	30	49	29	39	47	48	49	28	04	-15	07	09	-21
33. Working with the Public	-14	11	-03	00	19	27	12	35	18	10	-15	33	06	19	23	27	21	19	-05	-09	-29
34. Coordinating Others' Work	35	49	44	28	34	46	43	-03	29	60	36	31	52	55	37	31	00	03	-06	30	05
35. Developing Teams	45	58	46	05	27	70	57	23	42	52	33	52	63	41	55	-03	-12	-21	06	20	18
36. Teaching Others	25	33	44	08	05	29	37	-15	02	24	46	11	57	52	28	40	05	11	-14	02	-04
37. Directing Subordinates	23	49	45	10	35	56	46	16	36	57	34	32	71	52	37	-09	-28	-22	-02	14	02
38. Developing Others	13	45	49	09	22	42	47	13	26	42	40	35	66	57	46	17	02	01	-01	06	-14
39. Providing Consultation	38	56	46	-02	37	38	44	09	55	68	59	43	68	42	48	-07	-04	-19	17	-03	-04
40. Performing Admin. Tasks	41	33	-02	-38	-08	61	56	62	48	38	02	44	30	25	59	-31	-11	-36	47	02	-12
41. Staffing Org. Units	-10	02	17	17	40	03	-17	-20	23	20	02	02	17	-12	-13	-41	-40	-16	-11	14	05
42. Monitoring Resources	43	31	34	25	52	35	26	18	37	38	01	11	21	12	04	-07	-26	11	29	01	20

Table 6-9c (continued)

Intercorrelations of Descriptors for the Frequency Scale (Occupation-Level Data): Generalized Work Activities

Descriptor	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
22. Implementing Ideas	--																				
23. Repairing, Mechanical	41	--																			
24. Repairing, Electronic	42	78	---																		
25. Documenting Information	17	-08	-10	--																	
26. Interpreting Information	36	08	05	65	--																
27. Communicating, Internal	27	-07	01	44	54	--															
28. Communicating, External	-07	-23	-15	46	56	67	--														
29. Establishing Relationships	06	-14	-07	31	39	77	50	--													
30. Assisting Others	-21	-07	-03	26	36	40	22	53	--												
31. Selling or Influencing	21	-13	01	13	44	46	53	31	25	--											
32. Resolving Conflicts	-04	-26	-25	35	53	49	58	52	42	56	--										
33. Working with the Public	-20	-22	-05	24	31	34	50	47	54	55	56	--									
34. Coordinating Others' Work	19	16	01	28	37	38	15	34	46	16	47	15	--								
35. Developing Teams	31	07	-08	33	63	46	37	23	26	42	49	10	72	--							
36. Teaching Others	18	13	09	06	31	17	-15	15	42	04	32	-10	53	34	--						
37. Directing Subordinates	11	03	-03	22	47	26	25	15	32	28	46	17	80	80	41	--					
38. Developing Others	09	-03	13	08	46	33	23	26	50	28	52	26	62	54	73	73	--				
39. Providing Consultation	31	-12	05	04	42	37	28	32	26	48	53	21	60	60	45	72	74	--			
40. Performing Admin. Tasks	10	-28	-28	53	61	54	69	31	07	39	51	27	20	49	-04	44	32	39	--		
41. Staffing Org. Units	09	01	14	-13	-10	-05	-08	-23	-04	16	-15	-01	32	40	-12	55	21	42	11	--	
42.. Monitoring Resources	30	20	12	08	15	05	-11	-10	-16	05	-01	-04	46	36	10	54	23	32	29	37	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 6-10a

ercorrelations of Descriptors for the Level Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Getting Information	--																				
2. Identifying Objects	70	--																			
3. Monitoring Processes	55	62	--																		
4. Inspecting Equipment	22	27	43	--																	
5. Estimating Characteristics	43	46	56	44	--																
6. Judging the Qualities	64	68	57	28	49	--															
7. Evaluating Information	56	64	57	36	48	66	--														
8. Processing Information	48	52	37	20	43	63	56	--													
9. Analyzing Data	59	70	61	41	52	68	66	61	--												
10. Making Decisions	76	64	54	34	52	75	60	57	72	--											
11. Thinking Creatively	60	56	54	34	56	61	57	47	68	72	--										
12. Using Job Knowledge	56	54	46	30	38	54	58	59	56	64	60	--									
13. Developing Objectives	56	50	44	22	49	57	51	52	64	69	66	50	--								
14. Scheduling Work	48	36	29	26	43	50	43	47	49	54	54	37	62	--							
15. Organizing and Planning	49	48	33	24	37	54	51	48	52	64	62	66	62	54	--						
16. Performing Physical Work Tasks	18	23	26	46	31	32	29	16	26	39	30	28	15	16	29	--					
17. Handling Objects	24	29	24	35	29	35	30	31	23	37	37	35	09	16	32	56	--				
18. Controlling Machines	02	-07	24	43	24	-07	-01	-07	09	07	20	10	02	12	05	37	37	--			
19. Interacting with Computers	44	44	35	13	52	30	43	46	52	41	54	43	41	34	34	03	33	20	--		
20. Operating Vehicles	05	09	19	44	30	08	21	06	18	25	16	21	18	10	23	55	25	43	15	--	
21. Specifying Equipment	19	20	34	32	39	21	28	18	36	34	43	26	36	27	32	27	11	29	24	39	--
22. Implementing Ideas	42	38	44	27	57	42	40	30	49	55	63	47	57	47	49	16	17	20	51	20	38
23. Repairing, Mechanical	02	-02	30	49	23	00	14	-02	16	13	28	18	09	15	10	38	24	69	15	49	46
24. Repairing, Electronic	08	09	33	41	20	01	22	07	31	17	29	26	13	11	12	36	28	53	36	46	40
25. Documenting Information	46	45	44	24	28	52	40	52	44	58	40	56	45	33	52	35	32	07	30	19	13
26. Interpreting Information	40	41	37	21	43	56	56	51	53	53	61	50	55	46	54	22	20	11	41	17	33
27. Communicating, Internal	59	52	45	21	34	59	57	46	53	64	56	67	49	46	58	29	29	00	36	16	19
28. Communicating, External	54	51	37	07	32	56	52	51	48	56	52	53	47	45	58	10	16	-16	36	12	21
29. Establishing Relationships	43	37	21	03	06	35	41	38	34	43	27	41	35	36	48	25	07	-04	09	17	11
30. Assisting Others	25	14	17	06	09	26	31	18	12	29	19	32	26	26	36	37	16	03	02	18	13
31. Selling or Influencing	43	48	33	06	34	56	47	45	47	53	57	42	52	37	49	23	18	-08	31	18	26
32. Resolving Conflicts	44	44	40	20	29	54	55	36	47	55	50	45	46	47	54	34	17	04	23	24	25
33. Working with the Public	30	16	19	-03	17	28	27	29	16	34	26	36	28	27	37	31	18	-02	08	19	13

ıble 6-10a (continued)

tercorrelations of Descriptors for the Level Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
34. Coordinating Others' Work	46	36	41	17	47	51	49	36	41	53	51	43	53	59	44	18	14	00	30	15	23
35. Developing Teams	57	42	45	21	40	50	55	50	51	61	52	52	62	54	56	19	17	06	35	19	30
36. Teaching Others	29	22	38	19	27	35	37	29	29	37	42	42	35	42	34	30	24	19	32	17	18
37. Directing Subordinates	44	38	40	21	38	56	55	39	46	55	46	42	58	61	52	16	13	00	30	13	14
38. Developing Others	41	40	44	12	41	48	47	36	43	52	52	47	47	49	49	24	16	10	32	14	19
39. Providing Consultation	33	37	35	17	38	40	51	32	51	42	52	39	44	37	41	07	08	07	36	-01	33
40. Performing Admin. Tasks	38	33	27	07	23	45	51	41	40	53	42	38	50	38	41	10	05	-10	34	13	24
41. Staffing Org. Units	29	27	36	21	42	33	35	24	42	41	45	25	47	48	36	08	03	15	36	10	36
42. Monitoring Resources	34	34	31	16	41	26	34	32	40	40	41	24	44	47	36	00	05	13	44	09	27

Table 6-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
22. Implementing Ideas	--																				
23. Repairing, Mechanical	27	--																			
24. Repairing, Electronic	30	73	---																		
25. Documenting Information	42	06	23	--																	
26. Interpreting Information	57	22	14	38	--																
27. Communicating, Internal	47	12	19	46	54	--															
28. Communicating, External	38	-01	09	46	55	72	--														
29. Establishing Relationships	27	02	11	46	34	51	45	--													
30. Assisting Others	18	08	17	43	37	39	30	54	--												
31. Selling or Influencing	40	01	13	38	46	44	54	41	29	--											
32. Resolving Conflicts	37	18	25	43	54	57	66	51	50	58	--										
33. Working with the Public	16	07	17	36	36	43	48	45	51	46	57	--									
34. Coordinating Others' Work	49	14	15	30	52	53	47	31	35	34	61	36	--								
35. Developing Teams	50	10	16	46	57	57	57	48	37	45	59	36	65	--							
36. Teaching Others	42	19	31	40	47	42	28	28	49	37	42	32	52	44	--						
37. Directing Subordinates	38	05	15	38	46	55	55	35	32	42	64	34	69	64	42	--					
38. Developing Others	48	11	22	40	53	59	58	41	52	50	61	52	64	59	63	64	--				
39. Providing Consultation	37	12	20	17	46	45	42	25	30	45	45	24	50	35	40	40	50	--			
40. Performing Admin. Tasks	38	05	14	37	41	49	45	38	27	41	52	33	50	55	33	56	36	34	--		
41. Staffing Org. Units	36	25	29	19	43	38	40	20	13	36	44	25	49	46	34	58	46	48	37	--	
42. Monitoring Resources	37	19	21	24	34	34	40	20	06	29	38	24	45	44	21	56	45	38	43	61	--

Note. N = 140 (four incumbents selected at random from each of 34 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale.

ble 6-10b

ercorrelations of Descriptors for the Importance Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Getting Information	--																				
2. Identifying Objects	68	--																			
3. Monitoring Processes	48	64	--																		
4. Inspecting Equipment	24	32	45	--																	
5. Estimating Characteristics	46	42	50	46	--																
6. Judging the Qualities	58	58	49	25	49	--															
7. Evaluating Information	53	57	56	33	42	60	--														
8. Processing Information	39	43	32	23	33	52	49	--													
9. Analyzing Data	53	62	54	23	41	57	52	56	--												
10. Making Decisions	65	56	48	33	51	68	54	53	69	--											
11. Thinking Creatively	60	57	53	27	47	56	53	40	63	65	--										
12. Using Job Knowledge	46	47	49	24	35	45	53	52	48	50	55	--									
13. Developing Objectives	46	40	39	07	37	51	37	41	53	55	62	39	--								
14. Scheduling Work	42	32	30	28	40	46	41	42	39	48	51	29	50	--							
15. Organizing and Planning	39	46	32	16	30	44	46	42	43	52	49	56	48	51	--						
16. Performing Physical Work Tasks	16	23	17	39	20	15	20	06	05	17	14	15	00	17	18	--					
17. Handling Objects	24	28	20	38	21	27	27	31	16	31	26	30	01	24	35	51	--				
18. Controlling Machines	05	03	22	29	16	-08	-01	02	01	01	03	20	-08	11	03	27	37	--			
19. Interacting with Computers	50	39	32	12	42	40	41	49	50	48	46	36	34	36	31	-10	32	14	--		
20. Operating Vehicles	03	08	11	33	20	-02	02	01	08	15	02	07	11	06	-02	36	12	12	-03	--	
21. Specifying Equipment	19	21	27	21	31	11	20	11	24	23	34	18	29	18	22	10	00	09	11	22	--
22. Implementing Ideas	35	35	41	24	44	32	35	25	38	41	57	41	38	43	42	07	17	24	41	09	33
23. Repairing, Mechanical	12	13	37	46	25	-01	25	01	08	09	21	28	-01	14	06	27	18	48	04	29	27
24. Repairing, Electronic	17	14	35	45	24	02	22	03	19	16	21	25	02	11	05	24	20	45	26	28	25
25. Documenting Information	47	47	37	28	27	45	38	54	39	48	29	46	28	35	44	24	35	07	35	06	-02
26. Interpreting Information	39	40	34	20	29	51	44	49	46	43	44	45	43	53	48	-02	11	03	34	-04	17
27. Communicating, Internal	48	42	31	17	28	43	47	43	38	46	41	56	38	45	60	28	35	06	33	02	10
28. Communicating, External	46	43	24	03	24	55	45	50	41	46	44	47	45	41	51	-02	18	-17	46	06	07
29. Establishing Relationships	30	33	23	00	10	26	29	33	26	23	20	35	27	31	43	23	15	09	09	11	08
30. Assisting Others	12	09	13	15	09	15	20	07	12	16	09	23	09	21	26	28	04	12	-06	08	08
31. Selling or Influencing	30	36	26	04	27	43	26	26	40	38	45	26	42	34	34	13	12	-05	31	16	15
32. Resolving Conflicts	33	32	25	11	17	38	40	28	28	35	30	35	32	36	39	12	10	05	24	01	04
33. Working with the Public	22	20	19	07	17	23	33	38	18	24	16	37	21	39	34	23	21	15	20	13	-02

Table 6-10b (continued)

ercorrelations of Descriptors for the Importance Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
34. Coordinating Others' Work	34	25	37	24	41	41	40	22	27	39	34	27	35	47	31	17	10	03	19	09	13
35. Developing Teams	39	34	40	20	33	44	39	35	43	51	41	34	46	43	43	-01	13	-08	27	08	14
36. Teaching Others	15	13	28	18	17	26	29	15	27	26	29	26	21	35	21	22	13	22	17	08	06
37. Directing Subordinates	33	27	38	28	37	51	43	30	42	51	42	27	46	54	38	00	09	-01	32	04	05
38. Developing Others	25	28	38	20	35	38	36	26	33	42	37	36	29	38	36	09	08	16	23	04	07
39. Providing Consultation	34	34	36	16	40	42	49	33	45	45	45	35	41	30	38	05	07	09	32	-03	29
40. Performing Admin. Tasks	23	29	21	16	10	31	44	40	33	33	26	30	25	34	27	11	12	11	40	04	05
41. Staffing Org. Units	18	17	27	11	24	31	21	17	25	28	28	07	43	34	20	-13	-09	02	23	-03	23
42. Monitoring Resources	32	31	28	13	32	27	37	39	40	39	31	20	35	42	35	-12	03	08	40	-06	15

ble 6-10b (continued)
ercorrelations of Descriptors for the Importance Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
22. Implementing Ideas	--																				
23. Repairing, Mechanical	32	--																			
24. Repairing, Electronic	38	71	---																		
25. Documenting Information	33	07	19	--																	
26. Interpreting Information	42	11	10	46	--																
27. Communicating, Internal	36	14	15	44	46	--															
28. Communicating, External	28	-10	00	36	49	56	--														
29. Establishing Relationships	22	09	02	28	28	48	36	--													
30. Assisting Others	09	13	23	19	26	29	19	36	--												
31. Selling or Influencing	39	-03	08	22	31	25	46	30	21	--											
32. Resolving Conflicts	27	09	14	30	43	37	51	34	44	45	--										
33. Working with the Public	18	09	17	35	37	39	49	40	41	34	55	--									
34. Coordinating Others' Work	27	21	21	19	28	44	35	33	33	22	41	29	--								
35. Developing Teams	36	01	11	23	40	43	48	26	30	37	38	22	53	--							
36. Teaching Others	24	21	32	26	29	26	14	21	46	30	27	26	45	35	--						
37. Directing Subordinates	26	08	13	20	40	41	45	17	22	33	41	23	55	63	36	--					
38. Developing Others	36	17	25	23	38	43	42	32	42	33	45	48	57	45	54	53	--				
39. Providing Consultation	33	10	15	18	32	32	33	18	19	32	25	17	33	23	25	40	38	--			
40. Performing Admin. Tasks	24	05	14	30	26	24	36	28	17	33	48	33	27	30	26	32	26	23	--		
41. Staffing Org. Units	28	03	16	03	32	19	26	04	07	25	32	15	39	41	28	52	35	35	22	--	
42. Monitoring Resources	32	05	15	27	36	35	32	15	01	12	31	28	39	34	14	49	34	40	34	50	--

Note. N = 140 (four incumbents selected at random from each of 34 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale.

Table 6-10c

ercorrelations of Descriptors for the Frequency Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Getting Information	--																				
2. Identifying Objects	62	--																			
3. Monitoring Processes	45	57	--																		
4. Inspecting Equipment	37	35	48	--																	
5. Estimating Characteristics	50	46	51	42	--																
6. Judging the Qualities	56	58	42	31	50	--															
7. Evaluating Information	53	62	52	38	40	59	--														
8. Processing Information	32	40	27	27	36	55	52	--													
9. Analyzing Data	47	55	46	33	49	56	59	65	--												
10. Making Decisions	63	56	45	41	51	67	56	52	64	--											
11. Thinking Creatively	46	42	45	23	38	40	46	32	54	61	--										
12. Using Job Knowledge	36	32	35	22	25	40	47	45	38	40	48	--									
13. Developing Objectives	38	35	31	13	28	48	37	32	50	50	56	40	--								
14. Scheduling Work	32	29	30	23	24	39	38	35	37	50	50	20	43	--							
15. Organizing and Planning	36	40	27	22	27	48	48	44	35	56	34	44	35	42	--						
16. Performing Physical Work Tasks	38	33	28	43	38	38	38	30	27	42	30	16	15	34	33	--					
17. Handling Objects	33	37	29	38	35	41	40	39	31	46	32	29	13	28	48	58	--				
18. Controlling Machines	11	06	26	33	25	03	05	14	10	16	12	13	03	12	18	39	39	--			
19. Interacting with Computers	39	37	27	07	35	38	46	40	47	38	34	24	21	22	34	11	36	14	--		
20. Operating Vehicles	17	10	14	33	21	09	06	08	16	21	05	10	13	05	07	23	08	12	-15	--	
21. Specifying Equipment	14	16	21	07	15	08	15	06	13	19	24	12	30	10	10	11	-01	09	-03	25	--
22. Implementing Ideas	32	35	41	23	45	34	35	25	38	45	51	34	39	34	37	25	28	36	32	09	28
23. Repairing, Mechanical	11	08	36	32	25	00	19	05	07	19	15	15	04	14	08	29	20	47	-02	27	27
24. Repairing, Electronic	21	19	43	32	33	09	20	07	21	29	24	22	12	15	15	25	23	39	19	19	25
25. Documenting Information	50	48	34	33	36	53	52	57	48	59	32	41	30	34	57	41	42	13	32	17	04
26. Interpreting Information	34	32	38	21	28	47	51	44	37	41	35	39	37	42	43	18	23	08	34	04	18
27. Communicating, Internal	45	34	32	33	39	45	44	46	30	50	38	46	25	34	50	45	51	22	25	10	08
28. Communicating, External	42	32	23	12	31	45	37	46	29	41	42	41	37	33	38	10	25	-08	32	12	04
29. Establishing Relationships	30	31	16	08	12	28	36	33	27	35	26	29	21	32	44	41	28	22	08	09	06
30. Assisting Others	15	13	10	20	08	21	19	13	03	16	14	28	17	30	33	40	22	16	-09	-06	04
31. Selling or Influencing	26	33	21	04	19	41	27	33	31	39	45	27	37	38	37	26	23	00	23	07	20
32. Resolving Conflicts	36	33	29	17	17	39	40	25	25	43	33	32	31	45	38	28	15	01	14	03	07
33. Working with the Public	21	20	20	09	22	26	32	42	26	34	26	30	25	37	30	37	31	21	18	04	02

ıble 6-10c (continued)

tercorrelations of Descriptors for the Frequency Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
34. Coordinating Others' Work	28	25	38	23	33	34	34	21	21	42	33	21	35	41	27	27	21	16	08	09	10
35. Developing Teams	32	26	36	23	24	40	32	28	32	39	42	42	47	35	31	09	21	01	15	09	20
36. Teaching Others	10	10	32	14	13	18	30	13	20	20	41	25	30	39	19	28	14	26	15	-02	06
37. Directing Subordinates	18	16	32	25	19	33	37	24	27	37	27	21	44	45	33	12	20	06	19	02	04
38. Developing Others	18	21	39	23	19	33	34	23	24	34	42	34	40	45	31	20	15	20	14	01	08
39. Providing Consultation	23	20	29	11	27	36	40	19	32	38	40	27	35	30	25	14	07	06	17	-04	15
40. Performing Admin. Tasks	27	32	20	12	13	39	49	41	39	33	26	26	31	29	34	24	21	06	45	01	11
41. Staffing Org. Units	05	-04	19	13	21	09	17	06	13	11	18	09	25	14	-04	-05	01	05	08	-02	22
42. Monitoring Resources	27	33	26	23	21	21	38	26	30	27	22	05	15	33	26	13	16	19	28	02	14

Table 6-10c (continued)

ercorrelations of Descriptors for the Frequency Scale (Incumbent-Level Data): Generalized Work Activities

Descriptor	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
22. Implementing Ideas	--																				
23. Repairing, Mechanical	32	--																			
24. Repairing, Electronic	39	59	---																		
25. Documenting Information	35	11	19	--																	
26. Interpreting Information	37	21	25	47	--																
27. Communicating, Internal	34	21	22	44	41	--															
28. Communicating, External	21	-09	07	38	43	53	--														
29. Establishing Relationships	30	12	09	43	26	39	30	--													
30. Assisting Others	15	07	16	29	31	32	17	42	--												
31. Selling or Influencing	35	-05	10	30	32	23	38	30	27	--											
32. Resolving Conflicts	23	13	18	34	49	41	53	39	46	40	--										
33. Working with the Public	26	12	19	35	47	39	45	45	39	40	52	--									
34. Coordinating Others' Work	29	27	24	21	38	35	27	22	34	24	40	28	--								
35. Developing Teams	30	05	14	24	40	32	39	18	23	35	33	22	54	--							
36. Teaching Others	29	22	24	12	34	30	14	19	43	22	33	24	53	39	--						
37. Directing Subordinates	21	07	13	20	41	32	29	08	22	25	41	25	52	59	42	--					
38. Developing Others	27	15	24	15	43	41	36	20	39	30	50	42	54	49	72	59	--				
39. Providing Consultation	27	05	18	19	34	22	24	18	26	33	30	19	43	28	44	39	52	--			
40. Performing Admin. Tasks	29	03	10	33	35	29	41	25	12	32	49	37	20	26	18	31	23	21	--		
41. Staffing Org. Units	13	10	16	01	33	05	11	-05	16	22	20	22	26	28	26	38	31	38	13	--	
42. Monitoring Resources	24	15	21	22	25	22	15	19	12	15	23	28	22	19	14	29	25	27	30	22	--

Note. N = 140 (four incumbents selected at random from each of 34 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale.

Table 6-11
Principal Components Analysis Pattern Matrix for the Incumbent Level Scale: Generalized Work Activities

Descriptor	Factor F1	F2	F3	Communality
1. Getting Information	.82	.30	-.17	.78
2. Identifying Objects	.81	.44	.05	.85
3. Monitoring Processes	.69	.47	.33	.81
4. Inspecting Equipment	.24	.00	.90	.86
5. Estimating Characteristics	.70	.23	.46	.76
6. Judging the Qualities	.65	.61	-.12	.81
7. Evaluating Information	.84	.40	.02	.87
8. Processing Information	.78	.12	-.40	.79
9. Analyzing Data	.87	.21	.20	.83
10. Making Decisions	.82	.50	.06	.94
11. Thinking Creatively	.86	.20	.14	.80
12. Using Job Knowledge	.80	.33	.15	.76
13. Developing Objectives	.61	.65	-.16	.82
14. Scheduling Work	.49	.54	-.11	.55
15. Organizing and Planning	.73	.45	-.15	.75
16. Performing Phys. Work Tasks	-.39	.22	.68	.67
17. Handling Objects	-.06	-.35	.51	.38
18. Controlling Machines	-.15	-.21	.82	.75
19. Interacting with Computers	.82	-.27	-.05	.75
20. Operating Vehicles	-.24	.14	.63	.48
21. Specifying Equipment	.41	-.12	.56	.49
22. Implementing Ideas	.81	.14	.28	.75
23. Repairing, Mechanical	.15	-.18	.89	.85
24. Repairing, Electronic	.27	-.21	.82	.80
25. Documenting Information	.52	.32	-.15	.40
26. Interpreting Information	.75	.40	-.14	.75
27. Communicating, Internal	.75	.43	-.05	.75
28. Communicating, External	.57	.53	-.31	.70
29. Establishing Relationships	.35	.63	-.10	.53
30. Assisting Others	-.13	.74	-.06	.57
31. Selling or Influencing	.35	.57	-.17	.47
32. Resolving Conflicts	.29	.78	-.12	.70
33. Working with the Public	-.15	.66	-.22	.50
34. Coordinating Others' Work	.44	.80	-.01	.84
35. Developing Teams	.50	.74	-.09	.80
36. Teaching Others	.42	.61	.10	.56
37. Directing Subordinates	.34	.88	.01	.89
38. Developing Others	.36	.85	-.01	.84

Table 6-11 (continued)
Principal Components Analysis Pattern Matrix for the Incumbent Level Scale: Generalized Work Activities

Descriptor	Factor F1	F2	F3	Communality
39. Providing Consultation	.73	.54	.02	.83
40. Performing Admin. Tasks	.47	.61	-.35	.72
41. Staffing Org. Units	.42	.54	.13	.48
42. Monitoring Resources	.50	.48	.16	.51
Percent of Variance	48	14	8	
Eigenvalue	20.23	6.08	3.41	

Note. N = 35. The correlation matrix was based on means calculated at the occupation level. F1 = Working with Information, F2 = Working with and Directing the Activities of Others, and F3 = Manual and Physical Activities: Performing Repair and Other Physical Work. These loadings are based on an orthogonal varimax rotation.

Table 6-12a

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Generalized Work Activities

Descriptor	General Managers & Top Executives (n=43)		Computer Programmers (n=7)		Registered Nurses (n=25)		Police Patrol Officers (n=24)		Janitors & Cleaners[a] (n=30)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Getting Information	5.48	0.93	6.00	1.15	3.56	2.41	4.00	1.88	2.20	2.29	3.40	2.09
2. Identifying Objects	4.23	1.91	4.57	2.50	3.84	2.49	3.87	2.36	0.80	1.32	3.00	1.88
3. Monitoring Processes	4.37	2.03	2.71	2.62	4.00	2.54	3.29	2.42	1.50	1.92	3.48	1.80
4. Inspecting Equipment	2.32	2.39	1.85	2.47	2.56	2.20	1.62	1.68	2.76	2.14	3.77	2.15
5. Estimating Characteristics	2.79	2.08	2.71	2.05	2.04	1.98	1.33	1.73	1.10	1.37	2.33	2.43
6. Judging the Qualities	4.39	2.19	3.28	2.49	4.00	2.54	3.62	2.31	1.73	2.14	2.85	2.16
7. Evaluating Information	4.13	2.04	4.71	1.88	3.84	2.33	3.54	2.08	0.70	1.31	2.92	2.18
8. Processing Information	3.58	2.14	5.00	1.41	2.84	2.33	1.91	2.48	0.90	1.70	2.18	2.25
9. Analyzing Data	4.13	1.71	4.71	2.42	3.12	2.27	2.70	2.21	0.36	0.88	2.25	2.41
10. Making Decisions	5.16	1.47	4.85	1.77	3.52	2.45	4.08	2.50	1.53	2.02	3.44	2.20
11. Thinking Creatively	3.90	1.99	6.71	0.75	2.92	2.05	2.62	2.12	2.13	2.37	2.81	2.16
12. Using Job Knowledge	4.95	1.77	5.71	1.70	5.12	2.22	4.29	2.29	2.66	2.49	4.22	1.86
13. Developing Objectives	4.04	1.87	2.85	2.47	3.56	2.38	1.83	1.83	1.16	1.68	2.25	2.34
14. Scheduling Work	4.09	1.90	3.14	1.67	3.64	2.25	1.33	1.73	2.10	2.52	2.59	2.20
15. Organizing and Planning	5.32	1.20	5.28	1.25	4.76	1.92	3.83	2.18	2.86	2.25	3.88	2.06
16. Perform. Phys. Work Tasks	1.60	1.49	0.42	1.13	3.48	1.93	4.50	2.50	4.26	2.65	4.00	2.51
17. Handling Objects	1.67	1.91	3.71	2.69	2.60	2.46	3.29	2.44	4.03	2.79	4.29	2.23
18. Controlling Machines	0.41	0.98	0.00	0.00	1.52	2.08	1.62	1.90	2.53	2.38	3.18	2.45
19. Interacting with Computers	2.27	1.99	6.71	0.48	1.12	1.90	2.08	1.95	0.60	1.54	1.55	1.98
20. Operating Vehicles	0.74	1.41	0.00	0.00	1.24	2.18	4.50	2.10	1.60	2.04	3.44	1.84
21. Specifying Equipment	0.81	1.40	0.85	2.26	0.56	1.55	0.75	1.72	0.50	1.43	2.25	2.36
22. Implementing Ideas	2.69	2.34	4.28	2.56	1.68	2.05	1.04	1.45	1.23	1.54	2.51	2.24

Table 6-12a (continued)

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Generalized Work Activities

	Occupations											
	General Managers & Top Executives (n=43)		Computer Programmers (n=7)		Registered Nurses (n=25)		Police Patrol Officers (n=24)		Janitors & Cleaners[a] (n=30)		Maintenance Repairers, General Utility (n=27)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
23. Repairing, Mechanical	0.46	1.33	0.42	1.13	0.64	1.15	0.58	1.31	2.00	2.40	3.81	2.88
24. Repairing, Electronic	0.32	0.99	0.85	1.21	0.88	1.64	0.91	1.79	1.00	1.57	2.37	2.69
25. Documenting Information	2.25	2.01	3.28	2.75	4.04	2.35	4.25	2.04	1.43	2.44	2.66	2.27
26. Interpreting Information	3.20	1.90	4.00	2.30	3.28	2.09	2.41	2.39	1.36	1.82	2.37	2.07
27. Communicating, Internal	5.55	1.05	5.57	1.27	4.96	1.67	4.58	2.06	3.00	1.78	4.50	2.06
28. Communicating, External	4.30	1.76	3.57	2.14	3.52	1.98	4.70	2.27	1.83	2.29	2.70	2.43
29. Establishing Relationships	5.26	1.09	4.42	1.27	5.40	1.22	5.29	1.42	3.60	1.81	4.44	1.69
30. Assisting Others	3.23	2.14	1.85	1.77	5.24	2.00	5.04	1.85	3.10	1.76	2.55	2.10
31. Selling or Influencing	3.20	2.27	1.71	1.49	2.60	2.23	2.25	2.50	2.03	2.02	1.51	1.69
32. Resolving Conflicts	4.51	1.86	1.28	1.60	3.92	1.99	5.00	2.26	1.68	2.30	1.77	1.92
33. Working with the Public	2.76	2.36	0.14	0.37	3.52	2.51	5.29	1.96	1.60	2.02	1.66	1.98
34. Coordinating Others' Work	4.58	1.77	2.57	1.90	3.96	2.11	2.29	1.62	2.72	2.09	2.40	2.04
35. Developing Teams	4.44	1.60	2.00	1.52	3.36	2.27	2.37	2.14	1.83	1.72	2.00	2.07
36. Teaching Others	3.34	1.78	3.14	1.46	4.24	2.20	2.65	2.49	1.86	1.87	2.59	1.82
37. Directing Subordinates	4.88	1.89	1.14	1.46	3.44	2.36	2.45	2.41	1.96	2.05	2.00	1.77
38. Developing Others	3.88	2.06	1.85	2.03	4.12	1.92	3.37	2.08	2.23	2.04	2.22	1.80
39. Providing Consultation	4.32	2.03	3.42	2.63	3.28	2.47	2.25	2.34	1.34	1.84	2.29	2.33
40. Performing Admin. Tasks	4.18	1.94	1.57	1.90	3.00	2.08	2.83	1.94	1.33	1.86	2.37	2.63
41. Staffing Org. Units	3.46	2.27	1.71	1.70	2.20	2.19	0.70	1.57	1.66	2.13	0.77	1.84
42. Monitoring Resources	4.07	2.17	0.85	1.46	1.56	2.10	0.66	1.60	2.00	2.25	1.37	2.32

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 6-12b

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Occupations: Generalized Work Activities

	Occupations											
	General Managers & Top Executives (n=43)		Computer Programmers (n=7)		Registered Nurses (n=25)		Police Patrol Officers (n=24)		Janitors & Cleaners[a] (n=30)		Maintenance Repairers, General Utility (n=27)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Getting Information	4.00	0.75	4.28	0.75	2.84	1.28	3.79	1.28	2.40	1.32	3.11	1.25
2. Identifying Objects	3.32	1.08	3.42	1.39	2.96	1.39	2.95	1.36	1.43	0.81	2.85	1.13
3. Monitoring Processes	3.41	1.15	2.71	1.70	3.12	1.42	2.79	1.31	1.93	1.14	3.07	1.10
4. Inspecting Equipment	2.41	1.41	2.14	1.46	2.56	1.26	2.16	1.30	3.30	1.41	3.40	1.24
5. Estimating Characteristics	2.59	1.27	2.85	1.34	2.04	1.09	1.79	1.14	2.03	1.15	2.22	1.31
6. Judging the Qualities	3.27	1.25	2.71	1.38	3.00	1.29	2.70	1.30	2.03	1.21	2.59	1.11
7. Evaluating Information	3.32	1.24	3.42	1.13	3.08	1.22	3.25	1.35	1.66	1.21	2.77	1.18
8. Processing Information	2.90	1.10	3.28	0.75	2.58	1.28	2.00	1.31	1.50	0.90	2.18	1.17
9. Analyzing Data	3.26	1.02	3.57	1.27	2.64	1.28	2.70	1.36	1.26	0.69	2.25	1.25
10. Making Decisions	3.90	0.89	4.14	0.89	3.04	1.33	3.37	1.49	2.00	1.17	3.14	1.19
11. Thinking Creatively	3.06	1.20	4.42	0.78	2.56	1.08	2.41	1.28	2.03	1.09	2.62	1.24
12. Using Job Knowledge	3.53	1.09	4.14	0.69	3.64	1.25	3.54	1.38	2.50	1.25	3.37	1.18
13. Developing Objectives	3.37	1.06	2.57	1.39	3.08	1.32	2.00	1.06	1.76	1.04	2.22	1.31
14. Scheduling Work	3.16	1.02	2.57	0.78	3.04	1.33	1.87	1.03	2.23	1.35	2.40	1.15
15. Organizing and Planning	3.88	0.69	3.57	1.13	3.76	1.05	3.16	1.23	2.96	1.24	3.18	1.17
16. Perform. Phys. Work Tasks	1.95	1.11	1.28	0.75	3.00	1.19	3.54	1.28	3.10	1.39	3.22	1.39
17. Handling Objects	1.90	1.15	2.71	1.38	2.44	1.35	2.79	1.35	3.00	1.48	3.14	1.13
18. Controlling Machines	1.23	0.64	1.00	0.00	2.00	1.15	2.00	1.02	2.63	1.32	2.81	1.38
19. Interacting with Computers	2.53	1.24	4.42	0.53	1.68	1.14	2.62	1.40	1.40	0.96	2.11	1.25
20. Operating Vehicles	1.48	0.96	1.00	0.00	1.80	1.25	4.08	1.10	2.10	1.34	3.03	1.05
21. Specifying Equipment	1.51	1.00	1.57	1.51	1.24	0.72	1.41	1.01	1.30	0.74	2.29	1.35
22. Implementing Ideas	2.44	1.27	3.42	1.39	1.96	1.13	1.62	0.96	1.90	1.02	2.51	1.31
23. Repairing, Mechanical	1.32	0.94	1.14	0.37	1.56	1.00	1.41	1.01	2.20	1.37	3.14	1.53
24. Repairing, Electronic	1.13	0.46	1.42	0.78	1.68	1.06	1.66	1.23	1.76	1.16	2.25	1.45

Table 6-12b (continued)

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Occupations: Generalized Work Activities

Descriptor	General Managers & Top Executives (n=43) M	SD	Computer Programmers (n=7) M	SD	Registered Nurses -(n=25) M	SD	Police Patrol Officers (n=24) M	SD	Janitors & Cleaners[a] (n=30) M	SD	Maintenance Repairers, General Utility (n=27) M	SD
25. Documenting Information	2.58	1.48	2.71	1.49	3.56	1.38	3.79	1.25	1.90	1.39	2.55	1.21
26. Interpreting Information	2.95	1.15	2.85	1.34	3.16	1.14	2.37	1.27	1.96	1.15	2.55	1.25
27. Communicating, Internal	4.09	0.81	3.71	0.95	3.96	0.88	3.75	1.15	3.20	1.09	3.51	1.08
28. Communicating, External	3.37	1.04	2.85	0.69	3.04	1.09	3.83	1.34	2.03	1.27	2.59	1.39
29. Establishing Relationships	4.13	0.74	3.42	0.53	4.16	0.55	4.12	0.74	3.46	1.16	3.33	1.14
30. Assisting Others	2.90	1.21	2.42	1.13	4.08	1.18	4.00	1.06	3.27	1.17	2.85	1.32
31. Selling or Influencing	2.97	1.43	2.00	0.81	2.48	1.19	2.29	1.42	2.26	1.17	2.07	1.14
32. Resolving Conflicts	3.55	1.14	1.57	0.78	3.16	1.06	3.83	1.30	2.20	1.47	2.11	1.18
33. Working with the Public	2.55	1.27	1.14	0.37	3.20	1.52	4.00	1.25	2.36	1.47	1.96	1.12
34. Coordinating Others' Work	3.62	1.00	2.71	1.25	3.20	1.15	2.91	1.24	2.86	1.19	2.66	1.30
35. Developing Teams	3.72	0.82	2.28	0.75	2.96	1.27	2.45	1.31	2.51	1.32	2.55	1.42
36. Teaching Others	2.95	1.02	2.85	0.69	3.54	1.18	2.73	1.50	2.51	1.32	2.85	1.26
37. Directing Subordinates	3.83	1.15	2.14	1.06	2.88	1.36	2.58	1.31	2.63	1.54	2.51	1.25
38. Developing Others	3.27	1.16	2.14	1.06	3.32	0.98	3.08	1.21	2.76	1.33	2.48	1.25
39. Providing Consultation	3.30	1.12	3.00	1.15	2.84	1.37	2.29	1.39	1.82	1.05	2.18	1.27
40. Performing Admin. Tasks	3.34	1.08	1.85	1.21	2.76	1.23	3.12	1.32	1.82	1.08	2.44	1.42
41. Staffing Org. Units	3.00	1.32	1.85	0.89	2.24	1.16	1.45	0.97	2.00	1.25	1.40	0.93
42. Monitoring Resources	3.48	1.33	1.57	0.78	1.84	1.10	1.41	0.97	2.56	1.47	1.88	1.39

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 6-12c

Descriptor Means and Standard Deviations on the Frequency Scale on Six Example Occupations: Generalized Work Activities

Descriptor	Occupations: General Managers & Top Executives (n=43)		Computer Programmers (n=7)		Registered Nurses (n=25)		Police Patrol Officers (n=24)		Janitors & Cleaners[a] (n=30)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Getting Information	4.97	1.37	4.85	0.69	3.72	2.13	5.08	1.69	2.56	1.86	3.88	1.73
2. Identifying Objects	4.27	1.54	4.57	1.98	4.12	2.06	4.25	2.00	2.06	1.79	3.70	1.70
3. Monitoring Processes	4.52	1.73	3.42	2.29	3.92	2.03	3.95	2.13	2.60	2.06	3.85	1.83
4. Inspecting Equipment	2.86	1.80	2.28	1.88	3.36	1.89	3.00	2.04	3.96	1.67	4.18	1.71
5. Estimating Characteristics	3.13	1.72	2.42	1.39	3.08	1.82	2.29	1.89	2.76	2.04	3.22	2.20
6. Judging the Qualities	3.79	1.79	3.00	2.00	4.24	1.94	3.83	1.99	2.26	1.74	3.48	1.96
7. Evaluating Information	3.95	1.49	3.85	1.34	4.24	1.87	4.37	1.83	1.80	1.44	3.74	1.78
8. Processing Information	3.58	1.63	3.42	1.13	3.54	1.95	2.58	2.10	1.90	1.70	3.11	2.06
9. Analyzing Data	3.78	1.24	4.14	1.95	3.36	1.86	3.29	2.01	1.26	0.82	3.00	1.94
10. Making Decisions	4.60	1.34	4.42	1.13	4.16	2.03	4.79	2.18	2.36	1.80	4.11	1.82
11. Thinking Creatively	3.67	1.59	5.00	1.41	3.24	1.58	3.04	1.85	2.00	1.48	3.29	1.75
12. Using Job Knowledge	3.88	1.40	3.85	1.77	4.24	1.69	3.79	1.95	2.50	1.50	3.88	1.50
13. Developing Objectives	2.97	1.16	2.57	1.51	3.28	1.69	2.29	1.42	1.80	1.32	2.59	1.71
14. Scheduling Work	4.11	1.36	2.57	0.97	4.00	1.77	2.33	1.49	2.23	1.63	3.33	1.88
15. Organizing and Planning	4.69	1.03	4.28	1.11	4.96	1.42	4.50	1.81	3.43	1.73	4.14	1.53
16. Perform. Phys. Work Tasks	3.48	2.30	1.71	1.88	4.72	1.94	4.91	1.95	4.50	2.22	4.22	2.02
17. Handling Objects	3.51	2.32	4.42	2.50	3.64	2.48	4.33	2.11	4.40	2.44	4.55	1.64
18. Controlling Machines	1.51	1.29	1.00	0.00	2.88	2.14	2.83	2.05	3.50	2.06	3.74	2.08
19. Interacting with Computers	4.11	2.11	6.42	0.97	2.16	1.88	3.66	2.38	1.63	1.42	2.66	1.73
20. Operating Vehicles	2.04	1.75	1.00	0.00	2.52	2.29	6.04	1.54	2.60	1.86	4.33	1.75
21. Specifying Equipment	1.44	0.90	1.28	0.75	1.28	1.06	1.54	1.28	1.40	1.06	2.62	1.88
22. Implementing Ideas	2.55	1.51	3.71	1.49	2.36	1.68	1.91	1.47	2.36	1.84	3.00	1.98
23. Repairing, Mechanical	1.32	0.89	1.28	0.75	1.88	1.56	1.50	1.17	2.36	1.84	3.77	2.04
24. Repairing, Electronic	1.20	0.63	1.71	1.25	1.96	1.69	1.91	1.61	1.86	1.40	2.66	1.96

Table 6-12c (continued)

Descriptor Means and Standard Deviations on the Frequency Scale on Six Example Occupations: Generalized Work Activities

Descriptor	General Managers & Top Executives (n=43)		Computer Programmers (n=7)		Registered Nurses (n=25)		Police Patrol Officers (n=24)		Janitors & Cleaners[a] (n=30)		Maintenance Repairers, General Utility (n=27)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
25. Documenting Information	3.25	1.98	3.85	2.34	4.96	2.03	5.08	1.76	2.06	1.68	3.62	2.00
26. Interpreting Information	3.62	1.64	3.71	1.60	4.60	1.80	3.37	1.99	2.26	1.65	3.48	1.92
27. Communicating, Internal	5.06	1.45	4.14	0.89	5.44	1.38	5.16	1.65	4.27	1.50	4.62	1.49
28. Communicating, External	4.06	1.56	3.14	0.69	3.80	1.63	5.12	2.00	2.36	1.86	3.40	1.96
29. Establishing Relationships	5.46	1.03	5.14	0.89	5.83	0.89	5.41	1.17	4.56	1.59	4.59	1.52
30. Assisting Others	3.74	1.87	2.57	1.27	5.56	1.75	4.37	1.31	4.25	1.52	3.74	1.89
31. Selling or Influencing	3.48	1.85	2.00	1.15	3.36	1.89	3.00	1.91	2.40	1.63	2.51	1.69
32. Resolving Conflicts	3.79	1.56	2.00	1.15	3.56	1.60	4.91	1.81	2.26	1.70	2.33	1.44
33. Working with the Public	2.93	1.86	1.28	0.75	4.36	2.28	4.50	1.86	3.00	2.14	2.51	1.78
34. Coordinating Others' Work	4.18	1.57	3.00	1.29	4.68	1.72	3.70	1.80	3.34	1.66	3.37	1.88
35. Developing Teams	4.11	1.41	2.71	0.95	4.12	1.98	3.20	2.06	2.75	1.67	3.11	1.96
36. Teaching Others	3.09	1.23	2.42	0.97	4.28	1.74	3.04	2.07	2.20	1.26	3.18	1.59
37. Directing Subordinates	4.37	1.49	2.00	1.00	4.20	2.17	2.70	1.80	2.73	2.01	2.96	1.78
38. Developing Others	3.58	1.48	2.28	1.38	4.16	1.54	3.41	1.69	2.40	1.45	2.70	1.58
39. Providing Consultation	3.46	1.51	3.00	1.29	3.72	1.92	2.79	1.93	2.03	1.44	2.48	1.78
40. Performing Admin. Tasks	4.55	1.38	2.85	1.86	4.00	1.82	4.37	1.92	2.40	1.77	3.14	2.03
41. Staffing Org. Units	2.23	1.19	1.57	0.78	2.44	1.75	1.50	1.10	1.93	1.52	1.55	1.33
42. Monitoring Resources	3.60	1.63	1.71	0.95	2.20	1.70	1.58	1.41	2.80	1.74	2.37	2.11

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 6-13
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for the Level Scale: Generalized Work Activities

Descriptor	Functions					
	F1	F2	F3	F4	ΣF^2	η^2
1. Getting Information	.25	.34	.04	-.01	.17	.24
3. Monitoring Processes	.32	.15	-.01	.16	.15	.21
2. Identifying Objects	.26	.23	.06	.07	.13	.21
4. Inspecting Equipment	.17	-.07	.04	.41	.20	.19
5. Estimating Characteristics	.21	.14	.03	.20	.10	.13
6. Judging the Qualities	.37	.11	.03	.01	.15	.24
8. Processing Information	.08	.32	-.08	-.01	.12	.19
7. Evaluating Information	.21	.35	.04	.08	.17	.24
9. Analyzing Data	.23	.39	.07	.16	.24	.28
11. Thinking Creatively	:20	.27	-.02	.10	.12	.21
10. Making Decisions	.31	.30	.14	.10	.21	.25
12. Using Job Knowledge	.20	.23	.05	.11	.11	.18
13. Developing Objectives	.45	.14	-.00	-.02	.22	.28
14. Scheduling Work	.32	.14	-.09	-.05	.13	.22
16. Performing Phys. Work Tasks	-.04	-.37	.12	.09	.16	.25
15. Organizing and Planning	.20	.30	-.04	-.03	.13	.21
17. Handling Objects	-.19	-.05	-.04	.07	.05	.01
18. Controlling Machines	-.04	-.19	.05	.38	.19	.25
19. Interacting with Computers	-.10	.48	.01	.02	.24	.26
20. Operating Vehicles	-.10	-.10	.61	.35	.51	.04
21. Specifying Equipment	.07	.06	.03	.39	.16	.22
22. Implementing Ideas	.21	.18	.03	.20	.12	.16
24. Repairing, Electronic	-.01	.03	.01	.45	.20	.22
25. Documenting Information	.04	.10	-.01	-.04	.01	.14
26. Interpreting Information	.21	.16	-.02	.05	.07	.14
27. Communicating, Internal	.16	.35	.07	.02	.15	.21
28. Communicating, External	.10	.34	.19	-.14	.18	.24
29. Establishing Relationships	.13	.17	.06	-.11	.06	.17
30. Assisting Others	.13	-.16	.04	-.14	.06	.16
31. Selling or Influencing	.20	.10	.19	-.10	.10	.22
32. Resolving Conflicts	.28	.14	.26	-.16	.20	.27
33. Working with the Public	.03	-.07	.23	-.30	.15	.22
34. Coordinating Others' Work	.49	.07	.01	.02	.24	.27
36. Teaching Others	.34	-.01	-.06	.06	.12	.18
35. Developing Teams	.38	.13	.06	.01	.16	.21
38. Developing Others	.40	.05	.03	-.04	.16	.23
37. Directing Subordinates	.61	.09	.10	.04	.39	.37
37. Directing Subordinates	.61	.09	.10	.04	.39	.37
39. Providing Consultation	.36	.22	.08	.06	.19	.23
40. Performing Admin. Tasks	.19	.30	.08	-.06	.14	.21
42. Monitoring Resources	.43	.16	-.04	.12	.23	.25
41. Staffing Org. Units	.50	.15	.08	.10	.29	.31

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Table 6-13 (continued)
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for the Level Scale: Generalized Work Activities

	Functions					
Descriptor	F1	F2	F3	F4	ΣF^2	η^2
Rc			.78	.77	.68	.64
Percent of Variance	18	17	10	8		
Eigenvalues	1.56	1.48	.85	.69		

Note. Statistics are based on 35 occupations with Generalized Work Activities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.9, median = 13, harmonic mean = 9.68). F1 = Supervisory/Management; F2 = Information Processing; F3 = Operating Vehicles; F4 = Manual/Physical Activities/Repair Related Activities.
ΣF^2 = Sum of squared rotated standardized discriminant function coefficients across four functions.
η^2 = Variance in Generalized Work Activity Level Scale ratings accounted for by occupations.

Table 6-14a

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Level Scale: Generalized Work Activities

Descriptor	Incumbent M	Incumbent SD	Incumbent r_k	Analyst M	Analyst SD	Analyst r_k	t	F	r_{ia}	d^2
1. Getting Information	3.47	1.35	.83	3.55	1.14	.95	-0.57	1.40	.79	0.67
2. Identifying Objects	2.92	1.28	.80	3.21	1.01	.89	-1.80	1.60	.68	0.95
3. Monitoring Processes	2.77	1.23	.79	2.95	0.91	.90	-1.41	1.85	.77	0.64
4. Inspecting Equipment	1.91	1.10	.77	2.05	0.99	.92	-1.12	1.22	.76	0.54
5. Estimating Characteristics	1.76	0.83	.64	2.32	0.86	.90	-4.87*	1.09	.68	0.76
6. Judging the Qualities	2.58	1.30	.82	2.75	1.01	.92	-1.27	1.68	.80	0.63
7. Evaluating Information	2.72	1.27	.83	2.89	0.87	.91	-1.07	2.15*	.69	0.84
8. Processing Information	2.54	1.27	.76	2.89	1.12	.94	-2.83*	1.29	.82	0.65
9. Analyzing Data	2.37	1.54	.86	2.90	1.20	.96	-2.67*	1.67	.68	1.57
10. Making Decisions	3.12	1.34	.84	2.76	1.17	.95	2.65*	1.31	.80	0.78
11. Thinking Creatively	2.78	1.33	.79	2.28	1.27	.94	3.18*	1.09	.74	1.10
12. Using Job Knowledge	3.80	1.22	.75	2.96	1.21	.94	4.86*	1.01	.64	1.74
13. Developing Objectives	2.19	1.28	.86	1.58	1.37	.94	5.52*	1.15	.88	0.79
14. Scheduling Work	2.44	1.18	.81	1.91	1.36	.92	3.30*	1.34	.73	1.17
15. Organizing and Planning	3.80	1.18	.80	2.73	1.16	.93	6.58*	1.02	.66	2.04
16. Perform. Phys. Work Tasks	2.70	1.35	.84	2.82	1.21	.93	-0.75	1.25	.72	0.93
17. Handling Objects	3.40	0.91	.51	3.32	0.89	.87	0.53	1.04	.47	0.85
18. Controlling Machines	1.70	1.54	.84	1.95	1.15	.92	-1.78	1.80	.85	0.74
19. Interacting with Computers	2.01	1.39	.85	1.89	1.13	.94	0.76	1.50	.76	0.82
20. Operating Vehicles	1.53	1.54	.92	1.01	1.24	.95	4.13*	1.54	.87	0.82
21. Specifying Equipment	0.87	0.92	.81	0.84	1.19	.95	0.15	1.69	.63	0.86
22. Implementing Ideas	2.02	1.00	.71	2.37	1.09	.89	-2.54*	1.18	.68	0.80
23. Repairing, Mechanical	1.11	1.25	.86	1.44	1.33	.95	-2.42*	1.13	.80	0.76
24. Repairing, Electronic	1.04	1.25	.80	1.19	0.64	.75	-0.85	3.76*	.58	1.03
25. Documenting Information	2.45	1.05	.67	2.80	0.89	.88	-2.34*	1.40	.59	0.88
26. Interpreting Information	2.32	0.93	.66	2.29	1.01	.91	0.17	1.20	.55	0.84
27. Communicating, Internal	4.14	1.14	.80	3.24	1.20	.94	5.74*	1.10	.69	1.64
28. Communicating, External	3.09	1.35	.83	3.01	1.37	.93	0.39	1.03	.68	1.16
29. Establishing Relationships	4.48	0.93	.73	3.44	1.01	.93	6.21*	1.17	.47	2.06
30. Assisting Others	3.08	1.05	.72	2.18	1.29	.94	5.35*	1.51	.65	1.79
31. Selling or Influencing	2.07	1.18	.81	1.90	1.32	.93	1.22	1.25	.79	0.68
32. Resolving Conflicts	2.82	1.25	.85	2.44	1.41	.95	2.38*	1.26	.75	1.02
33. Working with the Public	2.58	1.49	.81	2.28	1.41	.91	2.20*	1.12	.85	0.73
34. Coordinating Others' Work	2.43	1.24	.86	2.31	1.31	.93	0.68	1.11	.67	1.05
35. Developing Teams	2.46	1.09	.80	1.63	1.44	.93	4.51*	1.75	.66	1.83
36. Teaching Others	2.48	0.97	.76	1.94	1.32	.93	3.04*	1.86	.62	1.34
37. Directing Subordinates	2.01	1.34	.91	1.49	1.68	.96	2.57*	1.58	.72	1.61

Table 6-14a (continued)

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Level Scale: Generalized Work Activities

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
38. Developing Others	2.58	1.07	.82	1.89	1.38	.93	3.88*	1.68	.66	1.55
39. Providing Consultation	2.17	1.15	.82	2.40	1.47	.95	-1.26	1.64	.69	1.16
40. Performing Admin. Tasks	2.38	1.18	.80	2.55	1.12	.93	-1.13	1.10	.70	0.79
41. Staffing Org. Units	1.19	1.12	.88	0.96	1.52	.97	1.41	1.83	.76	1.00
42. Monitoring Resources	1.41	1.17	.84	2.56	1.06	.87	-7.54*	1.21	.67	2.12

Note. Incumbent statistics are based on 35 occupations with Generalized Work Activities questionnaire responses from at least four incumbents (mean number of incumbents = 18.91, median = 13, harmonic mean = 9.68). Analyst statistics are based on the same 35 occupations with Generalized Work Activities questionnaire responses from at least six analysts (mean number of analysts = 10.11, median = 12, harmonic mean = 8.37).

The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

The t statistic tests for differences in the incumbent and analyst group means.

The F statistic tests for differences in the incumbent and analyst group standard deviations.

The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.

The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.

* $p < .05$

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Table 6-14b

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Importance Scale: Generalized Work Activities

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
1. Getting Information	3.15	0.70	.75	4.06	0.48	.77	-11.49	2.08	.74	1.05
2. Identifying Objects	2.75	0.73	.75	3.51	0.60	.71	-6.09	1.49	.40	1.10
3. Monitoring Processes	2.65	0.71	.75	3.46	0.67	.82	-7.64	1.12	.58	1.06
4. Inspecting Equipment	2.31	0.69	.78	2.58	0.99	.91	-2.36	2.06	.71	0.54
5. Estimating Characteristics	2.09	0.50	.57	2.93	0.71	.76	-7.75	2.04	.47	1.12
6. Judging the Qualities	2.47	0.72	.78	3.19	0.64	.77	-6.87	1.24	.59	0.89
7. Evaluating Information	2.82	0.72	.77	3.45	0.60	.72	-6.66	1.43	.65	0.70
8. Processing Information	2.54	0.74	.77	3.41	0.81	.85	-8.91	1.19	.73	1.09
9. Analyzing Data	2.41	0.77	.82	3.29	0.77	.88	-7.77	1.01	.62	1.21
10. Making Decisions	2.90	0.73	.80	3.15	0.81	.89	-2.04	1.24	.58	0.55
11. Thinking Creatively	2.51	0.72	.78	2.43	1.04	.93	0.53	2.12	.63	0.65
12. Using Job Knowledge	3.19	0.68	.72	3.21	0.76	.83	-0.14	1.24	.48	0.53
13. Developing Objectives	2.26	0.75	.87	2.13	1.12	.93	1.30	2.22*	.90	0.32
14. Scheduling Work	2.46	0.67	.79	2.33	0.98	.90	0.97	2.13	.59	0.64
15. Organizing and Planning	3.26	0.73	.80	3.02	0.83	.86	1.70	1.29	.43	0.74
16. Perform. Phys. Work Tasks	2.51	0.76	.82	3.04	1.00	.92	-4.58	1.74	.73	0.75
17. Handling Objects	2.86	0.54	.56	3.45	0.74	.86	-4.79	1.84	.39	0.85
18. Controlling Machines	2.17	0.83	.80	2.69	1.09	.92	-4.45	1.72	.77	0.75
19. Interacting with Computers	2.50	0.86	.87	2.68	1.04	.92	-1.77	1.45	.79	0.42
20. Operating Vehicles	1.96	0.95	.92	1.88	1.21	.96	0.87	1.60	.90	0.29
21. Specifying Equipment	1.48	0.55	.81	1.62	0.90	.94	-1.17	2.69*	.64	0.48
22. Implementing Ideas	2.25	0.62	.71	3.04	0.74	.74	-7.09	1.41	.54	1.06
23. Repairing, Mechanical	1.63	0.74	.86	1.93	1.17	.96	-2.14	2.54*	.69	0.79
24. Repairing, Electronic	1.62	0.69	.78	1.63	0.56	.78	-0.12	1.50	.64	0.29
25. Documenting Information	2.67	0.65	.65	3.69	0.80	.85	-8.65	1.52	.55	1.52
26. Interpreting Information	2.48	0.57	.63	2.90	0.94	.89	-3.58	2.72*	.67	0.65
27. Communicating, Internal	3.54	0.57	.73	3.53	0.70	.85	0.05	1.47	.55	0.37
28. Communicating, External	2.88	0.83	.84	3.29	1.15	.93	-2.59	1.92	.59	1.04
29. Establishing Relationships	3.76	0.63	.73	3.52	0.84	.91	1.78	1.81	.44	0.68
30. Assisting Others	3.11	0.58	.59	2.52	1.06	.94	4.06	3.28*	.58	1.08
31. Selling or Influencing	2.31	0.69	.79	2.18	1.11	.94	1.00	2.55*	.69	0.65
32. Resolving Conflicts	2.77	0.75	.81	2.69	1.02	.93	0.66	1.86	.68	0.55
33. Working with the Public	2.65	0.90	.77	2.77	1.20	.91	-1.00	1.76	.81	0.50
34. Coordinating Others' Work	2.57	0.65	.78	2.59	0.98	.90	-0.18	2.29*	.51	0.71
35. Developing Teams	2.56	0.60	.76	1.92	1.05	.93	4.58	3.05*	.61	1.08
36. Teaching Others	2.70	0.55	.64	2.28	1.22	.95	2.35	4.97*	.52	1.23
37. Directing Subordinates	2.30	0.73	.87	1.96	1.22	.96	2.13	2.80*	.66	0.94

Table 6-14b (continued)

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Importance Scale: Generalized Work Activities

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
38. Developing Others	2.66	0.61	.74	2.06	1.03	.93	3.64	2.86*	.39	1.28
39. Providing Consultation	2.28	0.61	.78	2.57	1.08	.93	-1.94	3.13*	.56	0.86
40. Performing Admin. Tasks	2.59	0.64	.77	3.27	0.81	.82	-6.19	1.64	.61	0.89
41. Staffing Org. Units	1.73	0.66	.89	1.58	1.07	.98	1.22	2.64*	.75	0.53
42. Monitoring Resources	1.85	0.72	.84	3.03	0.73	.76	-8.76	1.02	.39	2.02

Note. Incumbent statistics are based on 35 occupations with Generalized Work Activities questionnaire responses from at least four incumbents (mean number of incumbents = 18.91, median = 13, harmonic mean = 9.68). Analyst statistics are based on the same 35 occupations with Generalized Work Activities questionnaire responses from at least six analysts (mean number of analysts = 10.11, median = 12, harmonic mean = 8.37).

The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

The t statistic tests for differences in the incumbent and analyst group means.

The F statistic tests for differences in the incumbent and analyst group standard deviations.

The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.

The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.

* $p < .05$

Table 6-15
Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Generalized Work Activities

	Incumbent			Analyst			
Descriptor	M	SD	r_k[a]	M	SD	r_k	t
1. Getting Information	.77	.20	.67	1.00	.00	n/a	-6.08*
2. Identifying Objects	.70	.22	.68	0.98	.05	.21	-6.56*
3. Monitoring Processes	.67	.22	.70	0.98	.04	.00	-7.33*
4. Inspecting Equipment	.54	.21	.69	0.82	.19	.70	-5.23*
5. Estimating Characteristics	.54	.19	.48	0.91	.12	.44	-8.71*
6. Judging the Qualities	.63	.22	.67	0.95	.08	.25	-7.23*
7. Evaluating Information	.71	.23	.79	0.98	.05	.33	-6.07*
8. Processing Information	.61	.25	.76	0.97	.09	.62	-7.16*
9. Analyzing Data	.61	.26	.81	0.98	.07	.57	-7.27*
10. Making Decisions	.71	.20	.70	0.98	.06	.45	-6.84*
11. Thinking Creatively	.69	.24	.77	0.89	.15	.55	-3.74*
12. Using Job Knowledge	.81	.20	.70	0.98	.04	.00	-4.41*
13. Developing Objectives	.56	.25	.81	0.61	.33	.83	-0.64
14. Scheduling Work	.63	.25	.82	0.69	.28	.78	-0.85
15. Organizing and Planning	.83	.19	.78	0.98	.06	.52	-3.98*
16. Perform. Phys. Work Tasks	.71	.23	.61	0.91	.12	.36	-4.08*
17. Handling Objects	.75	.16	.46	0.98	.05	.08	-7.26*
18. Controlling Machines	.46	.27	.72	0.81	.24	.77	-5.12*
19. Interacting with Computers	.58	.29	.87	0.82	.28	.88	-3.15*
20. Operating Vehicles	.38	.31	.88	0.39	.35	.90	-0.11
21. Specifying Equipment	.23	.22	.76	0.31	.31	.87	-1.11*
22. Implementing Ideas	.57	.22	.68	0.85	.15	.34	-5.56*
23. Repairing, Mechanical	.28	.25	.78	0.63	.27	.74	-5.03*
24. Repairing, Electronic	.31	.23	.61	0.64	.21	.52	-5.60*
25. Documenting Information	.63	.21	.64	0.96	.11	.74	-7.36*
26. Interpreting Information	.67	.21	.58	0.89	.20	.83	-4.01*
27. Communicating, Internal	.90	.15	.64	1.00	.00	n/a	-3.53*
28. Communicating, External	.73	.23	.81	0.90	.21	.84	-2.89*
29. Establishing Relationships	.92	.16	.75	0.99	.06	.65	-2.17*
30. Assisting Others	.81	.16	.33	0.83	.18	.62	-0.44
31. Selling or Influencing	.58	.22	.60	0.71	.23	.66	-2.16*
32. Resolving Conflicts	.69	.23	.77	0.83	.24	.81	-2.23*
33. Working with the Public	.59	.27	.70	0.73	.29	.84	-1.87
34. Coordinating Others' Work	.65	.22	.73	0.87	.16	.45	-4.28*
35. Developing Teams	.66	.20	.70	0.60	.27	.68	0.94
36. Teaching Others	.72	.19	.54	0.76	.20	.55	-0.77
37. Directing Subordinates	.53	.24	.81	0.49	.33	.83	0.52
38. Developing Others	.72	.18	.55	0.73	.22	.60	-0.19

Table 6-15 (continued)
Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Generalized Work Activities

	Incumbent			Analyst			
Descriptor	M	SD	r_k[a]	M	SD	r_k	t
39. Providing Consultation	.63	.20	.64	0.83	.23	.78	-3.47*
40. Performing Admin. Tasks	.66	.21	.75	0.93	.12	.63	-5.90*
41. Staffing Org. Units	.33	.25	.85	0.30	.35	.92	0.37
42. Monitoring Resources	.39	.25	.79	0.89	.14	.45	-9.23*

Note. Incumbent statistics are based on 35 occupations with Generalized Work Activities questionnaire responses from at least four incumbents (mean number of incumbents = 18.91, median = 13, harmonic mean = 9.68). Analyst statistics are based on the same 35 occupations with Generalized Work Activities questionnaire responses from at least six analysts (mean number of analysts = 10.11, median = 12, harmonic mean = 8.37).
The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
The t statistic tests for differences in the incumbent and analyst group means.
*$p < .05$

Table 6-16

Principal Components Analysis Pattern Matrix for the Analyst Level Scale: Generalized Work Activities

Descriptor	Factor F1	F2	F3	Communality
1. Getting Information	.94	.12	-.14	.91
2. Identifying Objects	.88	.17	-.15	.83
4. Inspecting Equipment	.33	-.50	.71	.86
5. Estimating Characteristics	.88	-.04	.16	.80
3. Monitoring Processes	.82	.05	.37	.81
6. Judging the Qualities	.92	.17	-.04	.87
7. Evaluating Information	.85	.05	-.27	.80
8. Processing Information	.78	.00	-.53	.89
9. Analyzing Data	.92	.09	-.25	.92
10. Making Decisions	.92	.13	-.22	.90
11. Thinking Creatively	.86	.01	-.02	.75
12. Using Job Knowledge	.92	-.09	-.01	.86
13. Developing Objectives	.87	.31	-.12	.87
16. Performing Phys. Work Tasks	-.10	.03	.92	.86
14. Scheduling Work	.79	.37	-.22	.81
17. Handling Objects	-.27	-.29	.77	.75
15. Organizing and Planning	.91	.24	-.09	.90
18. Controlling Machines	-.18	-.53	.58	.65
19. Interacting with Computers	.70	-.23	-.51	.80
20. Operating Vehicles	-.22	.06	.66	.48
21. Specifying Equipment	.58	-.62	.13	.74
22. Implementing Ideas	.94	.00	.08	.89
23. Repairing, Mechanical	-.06	-.55	.72	.83
24. Repairing, Electronic	.37	-.50	.58	.72
25. Documenting Information	.81	.16	-.37	.82
26. Interpreting Information	.85	.20	-.32	.87
27. Communicating, Internal	.89	.19	-.27	.91
28. Communicating, External	.55	.64	-.38	.85
29. Establishing Relationships	.57	.64	-.33	.85
31. Selling or Influencing	.43	.61	-.20	.60
30. Assisting Others	.17	.61	.14	.42
32. Resolving Conflicts	.64	.68	-.17	.90
33. Working with the Public	.15	.79	-.24	.71
34. Coordinating Others' Work	.87	.39	-.09	.92
35. Developing Teams	.86	.40	-.05	.89
36. Teaching Others	.79	.40	-.01	.79
37. Directing Subordinates	.82	.40	-.08	.83
39. Providing Consultation	.93	.19	-.17	.93
40. Performing Admin. Tasks	.76	.35	-.43	.89
38. Developing Others	.82	.45	.01	.87
41. Staffing Org. Units	.71	.38	-.09	.65
42. Monitoring Resources	.66	.46	-.13	.66
Percent of Variance	52	14	13	
Eigenvalue	25.02	6.14	2.71	

Table 6-16 (continued)
Principal Components Analysis Pattern Matrix for the Analyst Level Scale: Generalized Work Activities

Note. N = 35. The correlation matrix was based on means calculated at the job level. F1 = Working with Information, F2 = Working with and Directing the Activities of Others, and F3 = Manual and Physical Activities: Performing Repair and Other Physical Work. These loadings are based on an orthogonal varimax rotation.

Table 6-17

Correlations Among Group Mean Ratings Profiles and Within Three Example Occupations: Generalized Work Activities

	Occ. 1 Group 1 (n = 30)	Occ. 1 Group 2 (n = 29)	Occ. 2 Group 1 (n = 33)	Occ. 2 Group 2 (n = 32)	Occ. 3 Group 1 (n = 44)	Occ. 3 Group 2 (n = 44)
Occ. 1 Group 1	1.00					
Occ. 1 Group 2	.96	1.00				
Occ. 2 Group 1	.70	.71	1.00			
Occ. 2 Group 2	.72	.72	.96	1.00		
Occ. 3 Group 1	.71	.72	.96	.93	1.00	
Occ. 3 Group 2	.72	.73	.95	.94	.98	1.00

Note. Within each occupation, raters were randomly grouped into halves.
Occ. 1 = First-line Supervisors and Managers/Supervisors, Clerical and Administrative Support Workers, Occ. 2 = Secretaries Except Legal and Medical, Occ. 3 = General Office Clerks.

TM

O*NET Final Technical Report

The Occupational Information Network

TM

Volume II

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Notice

The American Institutes for Research and its subcontractors, Personnel Decisions Research Institutes, Inc., Management Research Institute, Inc., Jeanneret & Associates, Inc., and Westat, Inc., performed the work described herein under Contract Number 94-542, administered by the Utah Department of Employment Security, on behalf of the U.S. Department of Labor.

Under this contract, the American Institutes for Research and its subcontractors developed an operational prototype for an occupational data collection, analysis, and dissemination system--the Occupational Information Network or O*NET--to replace the Department of Labor's *Dictionary of Occupational Titles*. This report, *O*NET Final Technical Report,* submitted by the American Institutes for Research as a major deliverable under this contract, describes the empirical evidence provided by the preliminary data collection effort for the meaningfulness of the prototype system. An earlier report, *Development of Prototype Occupational Information Network (O*NET) Content Model*, described the development of the model underlying the O*NET and the design of the questionnaires used to collect the occupational information. A separate report, *O*NET: An Information System for the Workplace. Designing an Electronic Infrastructure* (Rose, Hesse, Silver, & Dumas, 1996), describes the development of the electronic database and provides technical documentation for the database.

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Please note that the analysis results tables in Chapters 3 through 11 are numbered uniformly across chapters. Because some analyses are not appropriate for every domain, some domains are missing certain table numbers. This is intentional. Please refer to chapter 2 and, particularly, Figure 2-17 for a listing of what tables should appear in each chapter.

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Chapter 7

Work Context

Evidence for the Reliability and Validity of the Measures

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The work environment is one of the most salient aspects of a person's job, and the study of this environment, or work context, is a vital component of job analysis. A full understanding of how work actually gets accomplished requires consideration of the environment in which the work occurs. The need for such study is widely recognized in the literature, and there are few job analysis instruments that do not measure some aspect of the context in which work takes place (Gael, 1988; Ghorpade, 1988).

Although many job analysis instruments include assessment of some aspects of the psychosocial and physical work environment, no single instrument captures the full range of work context factors or provides a theoretical framework for contextual occupational characteristics. The taxonomy described herein attempts to organize these factors into a coherent structure in order to account more fully for the variables in the analysis of jobs throughout the world of work. Many of the variables in the taxonomy have been assessed by standardized job analysis procedures or have been examined in other research forums. Even variables we have included to reflect current technology (such as the use of Electronic Mail [Descriptor #2h] as a communication method) have, in some cases, been assessed elsewhere. Thus, the objective was to integrate the existing body of research regarding contextual variables into an organized structure that included meaningful constructs differentiating between occupations.

Background

Researchers familiar with job analysis and the nature of work have argued that individuals must adapt to the physical and social environment rather than simply respond to them (Cunningham, 1988; Frost, 1972; Kochhar & Armstrong, 1988; Lopez, 1988; McCormick, Jeanneret, & Mecham, 1969a, 1969b, 1972; Rohmert, 1988). This position suggests that work context may be conceptualized as a set of moderator variables affecting or altering worker behavior. This view requires that the physical and social contexts of work be subjected to thorough examination since they represent the pervading contexts in which the work stimulus impacts the worker and in which the worker responds (see Figure 7-1) (Boese & Cunningham, 1975). All work activities occur within structural, physical, and social contexts involving interactions and relationships with other individuals and the work environment. These structural, social, and physical characteristics of the work environment are addressed as contextual factors within this chapter. The interactions with other workers that occur during the accomplishment of work have been included as Generalized Work Activities (GWAs) as described in Chapter 6.

The goal for the taxonomic structure is to provide a systematic approach to the study of work context variables that will provide valuable information and help differentiate occupations. This work context taxonomy is similar to McGrath's (1976) global division of organizational

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factors into tasks, roles, and settings. Work context is defined here as non-task-related factors of work which affect intrapersonal, interpersonal, or work outcomes. Based on previous job analysis work, research literature, and earlier taxonomic efforts, work context has been divided into three higher-order dimensions: (a) Interpersonal Relationships, (b) Physical Work Conditions, and (c) Structural Job Characteristics. That is, in addition to those variables mediated by the work activities and the organization, there are three broad categories of variables that can be said to impinge on the worker in the immediate work environment: people, physical conditions, and the structure of the work. The Interpersonal Relationships dimension includes aspects of the context such as communications, role relationships, and responsibility for others, which comprise the social environment in which the work takes place. Physical Work Conditions are the actual environmental conditions in which the work is conducted (e.g., temperature, pollutants), the hazards associated with the occupation and possible injuries (e.g., exposure to electricity or high places), and the demands placed on the worker in terms of body positioning or required safety equipment. Structural Job Characteristics are based on the nature of the work and its accomplishment, including the criticality of the work, how routine the work is, and the pace and scheduling of work activities.

Taxonomy

After a review of the research literature describing individual facets of work context, the three first-order dimensions were further articulated into subcategories to create a preliminary second-order taxonomy. Also, many job analysis instruments contain items which, though perhaps not labeled as such, relate to constructs within the domain of work context. An examination of these items and the related literature allowed further refinement and, in some cases, redefinition of aspects of the taxonomy. This review of the literature and job analysis instruments was utilized both to assess the specific individual factors that fell within the domain of the three higher-order dimensions, as well as to "validate" the higher-order dimensions as factors that are or can be researched and used to differentiate between occupations.

Although all of the second-order dimensions are assessed by multiple questions, most of the work context item-level constructs are measured by a single item or scale. For instance, Communication is a second-order dimension under Interpersonal Relationships, and there are five items assessing Communication. However, each of these five items measures a different type or aspect of Communication. Also, due to the type of information being collected, some of the Physical Work Conditions constructs involve multiple ratings (e.g., level, frequency, etc.), but these also are arguably different aspects of the conditions being assessed.

Given the large amount of material that falls under the domain of work context, multiple items for all constructs would require an extremely large set of questions. Substantially increasing the length of the survey was impractical, and it was judged that additional items would not provide incremental utility. Accordingly, due to the relative objectivity of most of the constructs and the existing research evidence, multiple items for each construct have not been developed.

Research suggests that many of the work context variables proposed can be rated quite reliably with single-item scales. A number of the item-level constructs are similar to PAQ job elements, OAI work elements, or Dictionary of Occupational Titles (DOT; U.S. Dept. of Labor, 1991) ratings, and single item scales from these instruments produced acceptable to high reliabilities. As reviewed by McPhail et al. (1995), the dimensions of the PAQ which correspond to the work context dimensions have very high inter rater and rate-rerate reliabilities (.85 to .95), and the job elements within these dimensions are assessed with single-item scales (McCormick,

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Mecham, Jeanneret, 1989). Reliability estimates for OAI items with similar content to work context taxonomy items are moderate to high (.62 to .93) and certainly within acceptable standards (Boese & Cunningham, 1975). Further, the results of an analysis of ratings from the DOT indicate that many work context constructs can be rated very reliably (.63 to .94) without the need of multiple items for each construct (Geyer, Hice, Hawk, Boese, & Brannon, 1989).

The contextual taxonomy includes factors believed to differentiate between occupations and to provide meaningful and useful information about any specific occupation. In cases where it was concluded that particular contextual characteristics did not differentiate meaningfully between occupations for any of a variety of reasons (e.g., overlap with other characteristics, difficulty in operationalization, inappropriate level of detail, etc.), the variable was combined with other factors or removed from the taxonomy. In developing the taxonomy, overlap with other domains was limited. Variables that we determined would be more appropriately measured elsewhere were excluded from the taxonomy. However, given the broad range of constructs in the work context domain, it is inevitable that some overlap occurs. This overlap is particularly obvious with respect to the Organizational Context domain. The differentiation between the work context and Organizational Context factors involves the focus of the items. The work context items focus on the effects of these constructs on the worker, the occupation, or specific tasks, whereas the Organizational Context items are intended to examine the effects on a broader scale. Where construct overlap occurs, we believe there is sufficient distinction between the items to warrant inclusion in their respective surveys.

The literature presented below indicates that the various aspects of work context recommended for inclusion in the O*NET are distinct, yet often related, facets of work on which occupations may be expected to differ meaningfully, both intra- and interorganizationally, and which are likely to have substantive impact on important outcome variables. Each level of the three-tiered taxonomy is discussed below. The majority of items assessed are similar to items or constructs which are currently assessed by various job analysis instruments. A matrix showing the overlap of our items with constructs evaluated in frequently used job analysis instruments is presented in Figure 7-2.

Sample and Measures

As described above, based on review of the relevant literature and job analysis instruments, work context was divided into three first-order dimensions: (a) Interpersonal Relationships, (b) Physical Work Conditions, and (c) Structural Job Characteristics. These dimensions were further divided into second-order dimensions from which specific item-level constructs were generated (see Figure 7-3). An outline of the taxonomic structure, including item level constructs, definitions, and measurement scale types is presented in Figure 7-4.

Interpersonal Relationships

Interpersonal Relationships describe(s) the context of the job in terms of human interaction processes. Evans, Johansson, and Carrere (1994) discussed the psychosocial environment as the social climate of the workplace, the settings produced by the activities of the organization, and the people in those settings. This definition seems to include the types of social relationships and roles the job holder must assume as part of the job, including communication and accountability for others' performance. The Interpersonal Relationships dimension is divided into four second-order factors: (a) Communication, (b) Role Relationships, (c) Responsibility for Others, and (d) Conflictual Contact.

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Physical Work Conditions

The actual physical conditions in which an employee is asked to perform a job are arguably the most obvious aspects of a taxonomy of work context. There are few, if any, job analysis instruments which do not consider the tangible aspects of the work environment. Physical Work Conditions are considered to be the relationships or interactions between the worker and the physical job environment. Evans et al. (1994) defined physical characteristics of work as the inanimate facets of the work environment. For the proposed taxonomy, Physical Work Conditions include (a) the Work Setting, (b) the Environmental Conditions of the work setting that may pose a hazard to the worker, and (c) Job Demands, including body positions and work attire that are part of the work environment. Aspects of these factors are measured by the frequency with which a job exposes the worker to various Work Settings, certain Environmental Conditions and job hazards, as well as the possibility and impact of injuries. The specific facets of Physical Work Conditions included in the taxonomy were obtained mainly through review of the human factors literature, as well as an examination of several job analysis instruments.

Structural Job Characteristics

Facets of Structural Job Characteristics have been referred to as work context factors in the job analysis literature (Bemis, Belenky, & Soder, 1983; McCormick, 1979) and are assessed by several job analysis instruments (e.g., GWI; JDS; PAQ; PMPQ). Included in this category are assessments of the extent to which the tasks are critical to the organization and whether the work is routine or varied in nature, as well as descriptions of work hours, scheduling, the pace of work, and whether the job creates competition. Research has shown that incumbents' reports of these types of job characteristics correlate significantly with several outcomes, such as job satisfaction, work frustrations, anxiety on the job, turnover intentions, and number of physician visits (Spector

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& Jex, 1991). The characteristics examined include frustrating circumstances, degree of automation, responsibility level, and decision latitude. These specific facets of the Structural Job Characteristics dimension were obtained both through a review of job analysis instruments and relevant literature, as well as by rationally identifying the aspects of job structure on which occupations may differ.

Summary

As discussed above, the contextual factors of work are clearly important features on which occupations may differ. In conjunction with organizational variables and Generalized Work Activities, contextual factors affect many important work outcomes (see Figure 7-5). Contextual factors have been linked to such outcome variables as job performance, satisfaction, compensation, group formation, group cohesion, organizational effectiveness, and physical and psychological health. However, attempts to assess these factors have been unstructured and have lacked a systematic approach. Although many job analysis instruments tap various aspects of the psychosocial work environment, they do not capture or assess individually the broad range of work context factors. The proposed taxonomy builds on research literature and existing job analysis instruments to organize relevant work context factors into a coherent structure for job analytic purposes. The assessment of these contextual factors is supported by numerous job analysis studies and will provide valuable information for a variety of human resource management functions.

Sample

As described in the Methods chapter, two samples of raters were obtained: job incumbents and occupational analysts. For some occupations, supervisors were included in the job incumbent sample, and their responses are included in this report. Ratings by job incumbents and supervisors will be referred to collectively as the incumbent sample and will serve as the primary focus of the analyses.

Incumbents from 81 occupations completed the work context survey. The data collection resulted in 37 occupations for which at least four incumbents provided ratings on the work context survey. Only data from these occupations were included in the analyses, yielding a total of 728 incumbent responses. A list of the 37 occupations and the number of respondents within each is provided in Figure 7-6. As noted in previous chapters, the occupations in this sample span a wide range of occupations and were sampled from many different organizations.

In addition to the job incumbent sample, ratings from six occupational analysts were collected. Experienced analysts from the North Carolina Occupational Analysis Field Center rated selected portions of the work context survey for the occupations included in their analyses. The analysts reviewed commonly performed tasks from the DOT for each of the occupations, then rated the occupations on the work context variables. Although six analysts rated all 81 occupations, only those 37 occupations for which there were at least four incumbent respondents were used in the data analyses. A review of the DOT job tasks without actually observing the job being performed did not provide sufficient information regarding several of the work context variables, and these variables were not rated by the analysts. For instance, the formality of communication, communication methods, and Privacy of Communication (Descriptor #5) are difficult to evaluate based simply on a list of job tasks, and would require observation before accurate assessments could be performed. In addition, as noted in Chapter 2, analysts rated items having to do with frequency on a five-point (0 to 4) scale, while incumbents made frequency ratings on scales of varying length.

Descriptive Statistics

The mean, standard deviation, standard error of measurement, and interrater agreement coefficient for each variable are provided in Table 7-1. Unlike the descriptors in many of the other domains, the work context variables are not measured on common rating scales. Thus a comparison of means across all items is not appropriate.

A review of the mean values for each descriptor indicates that the most commonly used communication method across the occupations was Face-to-Face Interactions with other individuals (Descriptor #2a), followed closely by use of a Telephone (Descriptor #2f). The communication methods with the lowest ratings were Video Conferencing (Descriptor #2d) and Public Speaking (Descriptor #2c). Even with the innovations in computer technology, the use of Electronic Mail (Descriptor #2h) and Interactive Computer (Descriptor #2g) communication was rated relatively low for the occupations in this sample. In general, communication on the job was viewed as more subjective than objective in nature.

Across all occupations in the sample, the types of job interaction rated most important were Working With or Contributing To a Team (Descriptor #6e) and Providing a Service to Others (Descriptor #6c). These ratings reflect the fact that these types of interactions can be found in a wide range of occupations, ranging from janitors to managers. The two types of Job Interactions (Descriptor #6) rated least important were Persuading and Influencing Others (Descriptor #6b) and Taking a Position Opposed to Others (Descriptor #6d). This may reflect the types of occupations included in this sample. Of the 37 occupations, relatively few explicitly involve selling or influencing others.

The type of Work Setting (Descriptor #12) in which workers from this sample spent the most time was Indoors (Descriptor #12a) in a climate controlled environment. The Physical Proximity (Descriptor #14) among workers is somewhat close, and Environmental Conditions (Descriptor #15) was the highest rated environmental condition. Making Repetitive Motions (Descriptor #22), Standing (Descriptor #22b), Sitting (Descriptor #22a), and Handling Tools and

Objects (Descriptor #22g) were the most frequently occurring Body Positioning (Descriptor #22) activities for workers in this sample. Exposure to various job hazards received relatively low ratings, with Exposure to Hazardous Situations (Descriptor #21a) (those likely to involve cuts, bites, or minor burns) receiving the highest mean rating of the group.

The general findings regarding the means and standard deviations reflect what is commonly known about how and where work is performed. A majority of jobs are performed indoors, with relatively few associated hazards. Individual communication, either Face-to-Face (Descriptor #2a) or via Telephone (Descriptor #2f), remains the most frequently used technique to convey information. One finding which may reflect somewhat recent changes in the way work is structured is the high mean rating for working with and contributing to a team (Work/ Contribute to Team, Descriptor #6e). Employees at all levels of organizations find it relatively important to participate on teams in order to perform work activities.

Reliability

As reported in Table 7-1, based on a harmonic mean of 9.44 respondents per occupation, most variables had an acceptable level of interrater agreement. The median interrater agreement coefficient was .83, with a range from .20 to .97. Given the relatively small number of raters per occupation, the agreement coefficients are acceptable for most items. Only five items had an agreement coefficient less than .50 and another nine items had reliabilities above .50, but less than .70. However, a somewhat large number of raters is desired when evaluating the agreement of descriptors. Table 7-2 provides estimates of single-rater reliability and reliability which would have been obtained if the initial sampling plan of 30 raters per occupation was obtained. Obviously, the single-rater estimates were lower than those found using either the harmonic mean number of raters or the estimate found for 30 raters. The estimates for 30 raters provide extremely high levels of reliability (.44 to .99).

When comparing these results to the median reliabilities reported for work context variables obtained using other procedures, we find the present results to be very satisfactory. Specifically, the median reliability for PAQ dimensions that reflect the work context range from .86 to .99 ($\underline{n}$ = 19,961 analyzed pairs) (McCormick et al., 1989). Reliability estimates based on use of the OAI to analyze work context range from .62 to .93 (Boese & Cunningham, 1975), and ratings of DOT work context items by four trained analysts range from .63 to .94 (Geyer et al., 1989).

Responses to items regarding Work Setting (Descriptor #12), Work Attire (Descriptor #23), Body Positioning (Descriptor #22), Environmental Conditions (Descriptor #15), and job hazards resulted in the most consistently high levels of agreement. Overall, the level of agreement found for the work context variables is adequate for research purposes, and only a few items have reliability coefficients below .70. The agreement coefficients based on the average raters per occupation showed acceptable agreement, and it would be expected that samples of this size, and certainly samples as large as 30 judges, would provide satisfactory levels of reliability.

The lower agreement coefficients for some descriptors could be due to a number of causes. It is possible that the wording of the item was ambiguous, or that job incumbents are unable to reliably provide information regarding certain variables. The descriptor with the lowest agreement estimate is the use of video conferencing as a communication method (Video Conference, Descriptor #2d). The infrequent use of this method may account for the low level of agreement. It is also possible that some incumbents did not understand the term Video Conferencing (Descriptor #2d). Janitors rated the item almost as high as did executives. It is

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likely that some incumbents interpreted the question to include videotaped addresses by mangers and executives. Further review of those items with questionable interrater reliability coefficients is certainly warranted and would be completed for a revised work context survey.

Unlike the other domains in the content model, all work context variables are not assessed on a common rating scale. Some items are rated on a level scale where a not relevant response may be appropriate. However, several items involve topics which do not lend themselves to a not relevant rating. For instance, the item concerning Physical Proximity (Descriptor #14) to coworkers cannot have a not relevant response. The use of a not relevant response has been thought to increase the level of interrater agreement; thus it is of interest to examine the impact of the not relevant response on interrater agreement in the current sample. For those items where a not relevant response was available, two additional interrater agreement coefficients were calculated. One estimate was based on a relevant/not relevant dichotomy and the other based only on relevant responses. These interrater agreement estimates are consistent with and largely similar to those found using the full scale scoring. Both the dichotomously coded responses and the relevant-only responses resulted in slightly lower agreement coefficients than the full scale coding. Due to the small number of items with not relevant options and the similarity of these results to the findings using the full-scale responses, no table was created to present these results.

Analyses of Variance

As another means of assessing the level of interrater agreement, an analysis of variance was completed to examine the descriptors, occupations, and interactions as sources of variance treating the descriptors as repeated measures variables. Significant differences were found for the descriptors across occupations. Occupations and the descriptors by occupation interaction also yielded significant effects. These results indicate that some variables were very useful in differentiating between occupations. We note that most of the 90 work context descriptors are rated on seven- or eight-point scales, but about 20 descriptors are rated on four- or five-point scales. These differences in scale length will operate to produce between-descriptor variance that is artifactual. However, such differences would have no impact on the most salient source of variance in Table 7-4--descriptors by occupations. Interrater agreement coefficients were obtained based on these sources of variation. As reported in Table 7-5, the full sample interrater agreement is high, as is the estimate for a sample of 30 raters per occupation.

Unlike the variables in other domains, the work context variables do not lend themselves to aggregation at higher level factors. The nature of the constructs assessed and the use of different rating scales makes it inappropriate to attempt to formulate higher-order scale scores. Thus, analyses reported in other chapters were not appropriate for this chapter.

In general, the results of the various interrater agreement analyses lead to the conclusion that the work context descriptors can be assessed with sufficient levels of agreement by job incumbents. As always, a large sample of respondents per occupation is recommended. There was an average of approximately 20 incumbents per occupation in the current sample (harmonic mean = 9.44), and it appears that a sample of that size, and certainly a sample of 30 raters per occupation would result in adequate interrater agreement.

Descriptor Relationships

The variables in the other domain chapters were assessed using multiple scales (e.g., importance, level, job entry requirements). Not all of the work context variables lend themselves to measurement by such scales, and an analysis of the relationship between scale types is not feasible for these variables.

The intercorrelations between the work context variables at the occupation level are presented in Tables 7-9a, 7-9b, and 7-9c. The intercorrelations in the three tables are computed within each of the three higher-order work context dimensions (Interpersonal Relationships, Physical Work Conditions, and Structural Job Characteristics) and not across dimensions. Tables 7-10a, 7-10b, and 7-10c present the same intercorrelations at the individual respondent level using four randomly selected raters per occupation. The primary focus of this study is at the occupation level, and the individual level data are presented for comparison purposes, but are not discussed in detail.

The occupation level intercorrelations within the Interpersonal Relationship dimension yield meaningful patterns of relationships. For instance, responsibility for others' work (Responsible Others' Work, Descriptor #8) is strongly related to the occupation interaction of Supervising and Developing Others (Descriptor #6a) (r = .66) and to Coordinating and Leading Others (Descriptor #6g) (r = .61). Dealing With the Public (Descriptor #6f) is strongly related to Social Interaction (Descriptor #4) (r = .60), Persuading and Influencing Others (Descriptor #6b) (r = .66), Public Speaking (Descriptor #2c) (r = .57), and interacting with Unpleasant Individuals (Descriptor #10) (r = .53), but weakly related to Communication Privacy (Descriptor #5) (r = -.04) and Communication Formality (Descriptor #1) (r = .05).

Intercorrelations within the Physical Work Conditions dimension also display rational patterns of relationships. Work Setting: Indoors, Controlled (Descriptor #12a) has a strong negative correlation with descriptors measuring uncomfortable working conditions (r = -.47 to r = -.79) and has a positive relationship with Business or Office Attire (Descriptor #23a) (r = .47). Privacy of Work Area (Descriptor #13) was positively related to the Sitting (Descriptor #22a) body position (r = .49), but negatively related to all other Body Positioning (Descriptor #22) (r =

-.23 to r = -.71). Sitting (Descriptor #22a) is often associated with an office job, which would likely provide more privacy than jobs requiring Walking (Descriptor #22d), Standing (Descriptor #22b), or Handling Tools (Descriptor #22g). Exposure to Diseases and Infections (Descriptor #17a) is positively related to wearing a Special Uniform (Descriptor #23b) (r = .72) and Physical Proximity (Descriptor #14) (r = .56), which may reflect duties found in nursing and public safety jobs.

Rational patterns of intercorrelations are also found within the Structural Job Characteristics dimension. Machine Driven Pace (Descriptor #39) is positively correlated with Repetitive Activities (Descriptor #34) (r = .59) and working under Time Pressure or Deadlines (Descriptor #37) (r = .66), but negatively correlated with Unstructured Tasks (Descriptor #35) (r = -.63). Level of Automation (Descriptor #29) on the job is positively related to the necessity of being Accurate and Exact (Descriptor #31) (r = .55) and Attention to Details (Descriptor #32) (r = .55). Dealing with Frustrating Circumstances (Descriptor #28) is negatively related to Clarity of Tasks or Performance goals (Descriptor #30) (r = -.37) and positively related to Accountability for Results (Descriptor #26) (r = .70) and Decision Latitude (Descriptor #27) (r = .77).

The number of variables within the work context domain does not allow for presentation of correlations of variables across the higher-order dimensions. However, there are relationships worth noting. For instance, the importance of Supervising Others (Descriptor #6a) is significantly correlated with Consequence of Error (Descriptor #24) (r = .42), Impact (Descriptor #25) (r = .52), Frequency (Descriptor #25b) (r = .33), and Latitude of Decisions (Descriptor #27) (r = .37), and Accountability of Results (Descriptor #26) (r = .42). Further, Supervising Others (Descriptor #6a) was significantly related to the extent that work is Unstructured (Descriptor #35) (r = .36). Formality of Communication (Descriptor #1) is related to Consequence of Error (Descriptor #24)

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(r = .34), Impact of Decisions (Descriptor #25) (r = .44) and Frequency of Decisions (Descriptor #25b) (r = .34). The importance of dealing with Physically Aggressive (Descriptor #11) individuals is also correlated with Consequence of Error (Descriptor #24) (r = .33) and Impact of Decisions (Descriptor #25) (r = .36).

Responsibility for the Health and Safety of Others (Descriptor #7) is significantly correlated with Exposure to Diseases and Infections (Descriptor #17a) (r = .39), High Places (Descriptor #18a) (r = .35), Hazardous Conditions (Descriptor #19a) (r = .41), Hazardous Equipment (Descriptor #20a) (r = . 49), and Hazardous Situations (Descriptor #21a) (r = .67). Responsibility for Health and Safety (Descriptor #7) is also correlated with wearing a Special Uniform (Descriptor #23b) (r = .42) and Common Safety Attire (Descriptor #23d) (r = .58). Importance of being Constantly Aware (Descriptor #33) of events is correlated with several Environmental Conditions (Descriptor #15), such as Extreme Temperature (Descriptor #15b) (r = .33), Poor Lighting (Descriptor #15c) (r = .55), Contaminants (Descriptor #15d) (r = .39), and Exposure to Diseases and Infections (Descriptor #17a) (r = .41). The extent to which the work pace is machine driven is correlated with Exposure to Hazardous Equipment (Descriptor #20a) (r = .43) and Hazardous Conditions (Descriptor #19a) (r = .54).

Factor Structure

After finding rational patterns of intercorrelations between variables, a principal components factor analysis with varimax rotation was conducted to further explore the relationships between items. The results of this analysis (reported in Table 7-11) yielded a seven-factor solution for the structure of the work context variables.

The first factor is labeled environmental conditions. Items associated with Work Setting (Descriptor #12) and Environmental Conditions (Descriptor #15) produced strong loadings on this factor. For example, Poor Lighting (Descriptor #15c) (r = .91), Extreme Temperatures (Descriptor #15b) (r = .91), and working indoors (r = -.79), Work Setting: Indoors, Controlled (Descriptor 12a) had very high loadings on the environmental conditions factor, as did working in an Open Vehicle (Descriptor #2e) (r = .87) and Outdoors (Descriptor #12c) under exposed conditions (r = .86).

The second factor is labeled physical activity and manual work which consists mostly of Body Positioning (Descriptor #22) variables. For instance, Standing (Descriptor #22b) (r = .93), Sitting (Descriptor #22a) (r = -.93), and Handling Tools or Objects (Descriptor #22g) (r = .50) all have strong loadings on this factor. Also, the use of Voice Mail (Descriptor #2e) (r = -.64) and Electronic Mail (Descriptor #2h) (r = -.56) loaded negatively on this factor. The pattern of positive and negative loadings on this factor are consistent with aspects of manual labor and physical tasks versus those work activities that do not require extensive physical effort.

Managerial and interpersonal relations is the third factor extracted from the analysis. Variables with strong loadings on this factor include Persuading and Influencing Others (Descriptor #6b) (r = .76), Coordinating and Leading Activities (Descriptor #6g) (r = .71), Supervising and Developing Others (Descriptor #6a) (r = .68), and Decision Latitude (Descriptor #27) (r = .67). The variables within this factor are common to supervisory or management positions or relating to others on an individual basis.

The fourth factor is labeled structured and machine operations. This factor is characterized by variables associated with performing automated or strictly defined tasks. For example, performing Repetitive Activities (Descriptor #34) (r = .80), Level of Automation (Descriptor #29) (r = .72), Unstructured Tasks and Goals (Descriptor #35) (r = -.70), and Machine Driven Pace (Descriptor #39) (r = .89) have strong loadings on this factor.

The fifth factor extracted from the analyses includes variables found in business or office environments. Wearing Business Clothes (Descriptor #23a) (r = .61) and Communicating via the Telephone (Descriptor #2f) (r = .59), with Letters and Memos (Descriptor #2j) (r = .58), with Handwritten Notes (Descriptor #2i) (r = .56), and in Formal Communication (Descriptor #`) (r = .59) produced positive loadings on this factor. Wearing Safety Equipment (Descriptor #23e) (r = -.55) and Maintenance Clothing (Descriptor #23c) (r = -.58) yielded negative loadings.

The sixth factor, health and safety conditions, is defined by variables that can be associated with tasks found in health care and public safety jobs. For instance, Exposure to Diseases (Descriptor #17a) (r = .81), Wearing a Special Uniform (Descriptor #23b) (r = .67), and being responsible for the Health and Safety of Others (Descriptor #7) (r = .50) produced strong loadings on this factor.

The final factor extracted from the analysis is labeled interacting with the public. Obviously, Dealing With the Public (Descriptor #6f) (r = .81), Public Speaking (Descriptor #2c) (r = .71), and Social Interaction (Descriptor #4) (r = .55) were strongly loaded on this factor. Apparently, encountering Unpleasant Individuals (Descriptor #10) (r = .53) also is associated with public interactions. Interestingly, Exposure to Radiation (Descriptor #16a) has a loading on this factor. The correlation was negative (r = -.45), which is logical given that employees working near Radiation (Descriptor #16) are unlikely to also work with the public.

Overall, the variable loadings can be interpreted as meaningful work context factors. We also attempted to confirm our original three-dimension taxonomy by limiting the principal components analysis to the extraction of three factors. The results are surprisingly similar to our initial taxonomy given our very small sample size and restricted set of occupations.

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The factor analysis matrix of coefficients is reported in Table 7-11b. The first factor is the physical work conditions dimension from the original taxonomy, and only two extraneous items load on this factor that are not readily explained (Deadline and Time Pressure [Descriptor #37] and Level of Competition [Descriptor #36]). The second factor is the original interpersonal relationships dimension. This factor is also extremely clear and has only one extraneous item, namely that of Unstructured Tasks and Goals (Descriptor #35). The final component is matched with the structural job characteristics dimension from the initial taxonomy. This is the most confounded component in that it includes all of the physical body positions (e.g., Sitting [(Descriptor #22a)], Standing [(Descriptor #22b)]) having their expected positive or negative signs, and interpersonal items associated with using computers, writing reports, and providing service. It is interesting to speculate that all of these activities, especially the use of a computer, add more structure to a job as opposed to facilitating interpersonal relationships. Perhaps this confirmatory analysis is more accurate in describing the structure of work context than is our original taxonomy.

Occupation Differences

In an attempt to further investigate how well the variables differentiate between occupations, the mean item ratings from six occupations were examined. The six occupations were selected to represent distinct and diverse jobs in the overall economy and included General Managers and Top Executives, Computer Programmers, Registered Nurses, Police Patrol Officers, Janitors and Cleaners, and Maintenance Repairers and General Utility Workers. The mean ratings of the variables for each of the six occupations are presented in Table 7-12.

An examination of the patterns of mean ratings reveals meaningful differences between the occupations. For instance, Computer Programmers produced the lowest level of Social

Interaction (Descriptor #4) (M = 3.76, SD = 1.22) and the highest level of Making Repetitive Motions (Descriptor #22i) (M = 2.89, SD = 2.09). Managers and Top Executives had the highest levels of Supervising and Developing Others (Descriptor #6a) (M = 4.22, SD = .71), Accountability for Results (Descriptor #26) (M = 6.13, SD = .96), and wearing Business or Office Clothing (Descriptor #23) (M = 4.18, SD = 1.39). The two occupations that most directly involve decisions affecting the Health and Safety of Others (Descriptor #7), Registered Nurses and Police Patrol Officers, yielded the highest levels of Consequence of Error (Descriptor #24) (M = 5.79, SD = 1.69 and M = 5.48, SD = 1.90) and Impact of Decisions (Descriptor #25) (M = 5.20, SD = 1.42 and M = 6.12, SD = 1.51). Police Patrol Officers also were most frequently Interacting with the Public (Descriptor #6f) (M = 4.80, SD = .41) and handling Physical Aggression (Descriptor #11) (M = 2.80, SD = .76).

Teamwork was reasonably important to all six occupations, but had greater variability among the Janitor and Maintenance Repairer Categories. Communicating Face-to-Face With Other Individuals (Descriptor #2a) was the most common communication method across all six occupations. Computer Programmers and Janitors consistently used all communication methods less frequently than did the other occupations. However, Computer Programming is apparently the only occupation from this group of six using Electronic Mail (Descriptor #2h) (M = 4.67, SD = 1.50) to any significant degree. Not surprisingly, Police Patrol Officers, Janitors and Cleaners, and Maintenance Repairers work more frequently under unpleasant Environmental Conditions (Descriptor #15) (e.g., Noise [Descriptor #15a], Extreme Temperatures [Descriptor #15b]) than do workers in the other occupations, and they were less likely to work in an Indoor Temperature-Controlled area (Descriptor #12a).

Discriminant Analyses

In order to assess how well the work context variables differentiate between occupations, a discriminant analysis was conducted using the ratings provided by the incumbents in the 37 occupations. The analysis yielded six interpretable functions, and the results are presented in Table 7-13. The results indicate that the work context variables are capable of differentiating one occupation from another. The variances accounted for by the descriptors, as assessed with η^2, range from .06 to .61. The squared function coefficients range from .02 to .50. It appears that those items involving Environmental Conditions (Descriptor #15) and physical activities (i.e., working outdoors, working in a vehicle, Sitting [Descriptor #22a], and Standing [Descriptor #22b]) are more useful in differentiating occupations, at least for this limited data set.

The variable loadings on the discriminant functions provided evidence about the structure of the items that differentiate occupations. The six functions involve environmental conditions, physical activity, health care, interacting with the public, managerial and interpersonal relations, and hazardous work conditions. Using these six functions, 58% of incumbents were correctly reclassified into their occupations. Using all 23 functions, not just the six shown in Table 7-13, 79% of incumbents were correctly reclassified. The six functions shown in Table 7-13 are similar to the factors as extracted by the principal components factor analysis previously presented in Table 7-11a.

Convergence with Analysts' Ratings

Table 7-14 provides the mean ratings from both the incumbent and analyst samples. As stated earlier, analysts made ratings based on a reading of tasks from the DOT for each of the occupations in the sample. Many work context variables cannot be accurately assessed from this information, and thus Table 7-14 only includes data for those variables which analysts were capable of rating. Also presented in the table are t and F tests comparing the analyst and incumbent ratings, as well as the correlation coefficient and d^2 index. Analysts utilized a modified frequency scale for some items, thus comparisons between incumbent and analyst frequency ratings are not reported for those items.

Analysts' and incumbents' ratings have a moderate level of agreement, with the median correlation between the incumbent and analyst mean ratings being .58. Further, there were significant differences in the mean ratings provided by the two samples. Of the 33 items with comparable scales, 24 were rated significantly higher by incumbents. Given the nature of the work context items, this may not be surprising. The physical and structural components of an occupation are much more salient or apparent to incumbents than they are likely to be for analysts reading a list of tasks.

On the other hand, the analyst data tended to be just slightly more reliable. The median reliability coefficient for analysts is .86 while it is .83 for incumbent ratings. Although the median reliabilities are not substantially different, the analysts have fewer items with significantly low reliabilities.

In an additional attempt to compare ratings from analysts and incumbents, a principal components factor analysis with varimax rotation was conducted on the analysts' data. The resulting factor structure (reported in Table 7-16) is very similar to that found for the incumbent data. Although the analysts rated only a subset of the work context items, these data , like that for the incumbents, yielded a seven-factor solution for the structure of the variables. The factors from the analyst data: (a) managerial relations, (b) environmental conditions, (c) health and

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safety conditions, (d) interacting with the public, (e) physical activity, (f) body movement, and (g) structured/machine operations, are very similar to the seven factors found with the incumbent data presented in Table 7-11a. Generally, work context items load on the same factors within each data set. The only substantive difference between the two data sets is that the incumbent data yielded a factor related to a business/office environment, while the analyst data yielded a body movement factor. Many of the variables that loaded on the business/office environment factor in the incumbent data were not rated by analysts; thus is it not surprising that this factor is not present. The variables in the body positioning factor in the analyst data load in the physical activity and manual work factor in the incumbent data.

Additional Analyses

A review of the data analyses led to additional questions and hypotheses which were not planned beforehand. Our taxonomic model was developed from research spanning many diverse fields. Information about work context is widely collected, but there is a lack of a coherent or cohesive theory. Thus, additional exploratory analyses are warranted. Reported below are a few analyses conducted to further investigate similarities and differences between occupations based on the work context variables.

Cluster Analysis

After showing that work context variables are capable of differentiating between occupations, it was of interest to examine how well the variables group occupations. A hierarchical cluster analysis was conducted on the 37 occupations in this sample based on the mean incumbent ratings of the work context variables. This cluster analysis identifies homogeneous groups of cases or variables and is appropriately used for medium-sized files (less than 200 cases or variables). For the current analysis, the unweighted pair-group method using arithmetic averages was used to combine clusters. It defines the distance between two clusters as the average of the distances between all pairs of cases in which one member of the pair is from each of the clusters. The squared Euclidean distance, the sum of the squared differences over all of the variables, was the distance measure in this analysis.

As presented in cluster analysis dendogram (reported in Figure 7-7), the results of the analysis yield readily identifiable and meaningful groupings of occupations. Five job clusters consisting of at least three occupations were identified, as were five clusters consisting of only two occupations each. Two occupations did not cluster with any other occupation.

The first group consists of eight, primarily clerk and secretarial, occupations. Two occupations, Tellers and Computer Programmers, are not an obvious match for this group of clerical jobs, but the requirements and tasks are somewhat similar in terms of equipment, attention to detail, need for accuracy, and physical job demands. The second job group consists of Education Administrators, First Line Supervisors, General Managers and Top Executives, and non-retail Salespersons. These jobs require a significant amount of communication and social contact. The next group of jobs all involve teaching (Preschool and Elementary School Teachers, and Teachers' Aides and Assistants). This is an obvious grouping of jobs, and each job occurs in the same type of environment and has very similar work activities. The fourth job group consists of Registered Nurses, Medical Assistants, and Nursing Aides. Again, this is an obvious grouping of jobs that require similar activities and are conducted in the same type of environment. The fifth group consists of seven jobs that are somewhat diverse. Three jobs, Waiters and Waitresses, Cooks, and Food Preparation Workers occur within similar environments, but Retail Salespersons, Stock Clerks, Cashiers, and Janitors perform work in a different context. However,

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each of these jobs involve Providing a Service to Others (Descriptor #6c) and involve similar physical demands, such as being on one's feet much of the time, Standing (Descriptor #22b).

The cluster analysis also yielded five job clusters consisting of two jobs each. The two jobs within the cluster are obviously related, but the clusters are not closely linked to other job groupings. Mechanical and Chemical Engineers form a small job cluster. Similarly, Medical and Clinical Laboratory Technologists and Technicians form a distinct job group, as do Police and Detective Supervisors and Police Patrol Officers. Maintenance Repairers and Packaging and Filling Machine Operators cluster together, and Truck Drivers and Bus Drivers also form a distinct cluster. Finally, two jobs, Machinists and Earth Drillers, do not cluster with any other jobs based on the work context variables.

The results of the cluster analysis are interesting given the nature of the work context variables. Based solely on the physical environment, interpersonal relations, and the structural characteristics of the occupation, meaningful groupings of jobs can be created. The jobs within the clusters are similar in terms of the work context variables, but further examination of the jobs within the clusters provides additional evidence of the importance of the work context variables. Without examining actual job duties, Generalized Work Activities, or requisite skills and education, the work context variables yielded rational groupings of occupations which would seem to perform similar activities and require similar skills.

Exempt vs. Non-Exempt Jobs

It was expected that exempt jobs would differ from non-exempt jobs in terms of many of the work context variables. Although exempt status can differ between organizations even for the same job title, we rationally grouped the occupations as exempt or non-exempt. Nine occupations were classified as exempt, and 28 were classified as non-exempt. Based on this grouping, t-tests were conducted on variables hypothesized to vary based on the duties and requirements generally found with exempt jobs (reported in Table 7-17a). In order to provide an adequate sample size and to eliminate the effect of unequal sample sizes within the occupations, the responses of four individuals randomly selected from each occupation were included in this analysis.

As expected, exempt jobs involved significantly more Supervising and Developing Others (Descriptor #6a), Coordinating or Leading Activities (Descriptor #6g), and Persuading and Influencing Others (Descriptor #6b) than did non-exempt jobs. Surprisingly, being Responsible for the Work of Others (Descriptor #8) was not rated significantly higher by exempt workers, but the difference is in the expected direction. It was hypothesized that non-exempt positions would involve significantly more work in various Environmental Conditions (Descriptor #15). Non-exempt jobs require the worker to work Outdoors (Descriptors #12c, #12d), in Vehicles (Descriptors #12e, #12f), exposed to Extreme Temperatures (Descriptor #15b), Poor Lighting (Descriptor #15c) and Contaminants (Descriptor #15d), and in a Cramped Work Space (Descriptor #15e) significantly more frequently than do exempt jobs. Additionally, non-exempt incumbents are exposed to job hazards (Radiation [Descriptor #16a], Diseases [Descriptor #17a], High Places (Descriptor #18a), Hazardous Conditions (Descriptor #19a), Hazardous Equipment (Descriptor #20a), and Hazardous Situations (Descriptor #21a)) significantly more frequently than workers in exempt jobs.

It was expected that Body Positioning (Descriptor #22) would differ between exempt and non-exempt jobs. Workers in exempt jobs spent significantly more time Sitting (Descriptor #22a) than did those in non-exempt jobs, and non-exempt jobs require significantly more Bending and Twisting of the Body (Descriptor #22h), use of hands to manipulate Tools (Descriptor #22g), and Making Repetitive Motions (Descriptor #22i). Although the differences are not significant, non-exempt jobs involve more frequent Kneeling or Stooping (Descriptor #22e) and Keeping or Regaining Balance (Descriptor #22f) than do exempt jobs.

It was also hypothesized that the non-exempt jobs would involve a higher Level of Automation (Descriptor #29), more Unstructured work (Descriptor #35), and be more dependent on a Machine Driven Work Pace (Descriptor #39). These hypotheses were not supported. This may be due to the type of occupations included in this sample. There are only a few non-exempt jobs in the sample that require a significant amount of work with machinery or in a production setting. Most of the non-exempt jobs are performed in an office or retail environment and would not be dependent on any type of manufacturing or production machinery that gives considerable structure to work.

Working as Part of a Team

Given the use of work teams across a wide range of occupations, we explored differences in jobs based on the importance of working as part of a team. High and low teamwork groups were created based on the mean ratings for the occupations. Those occupations rated at least a half a standard deviation above the mean in terms of the importance of working as a team member were compared with occupations rated at least a half a standard deviation below the mean. Eleven occupations fall into the high teamwork group, and 13 occupations are in the low teamwork group. Specifically, t-tests were conducted on the interpersonal relationship and structural occupational characteristic variables we hypothesized to be related to teamwork (reported in Table 7-17b). As before, responses of four individuals from each occupation were randomly selected for use in this analysis.

Not surprisingly, occupations where working as part of a team is important are found to require significantly more Face-to-Face Communications With Individuals (Descriptor #2a) and

Groups and to require more Public Speaking (Descriptor #2c) than do jobs in which teams are not an important component. Also, high teamwork jobs involve communication of information which is more Subjective (Descriptor #3) than do low teamwork jobs. It was hypothesized that the occupations where teamwork is important would require less communication by methods other than Face-to-Face talking (Descriptors #2a, #2b). If team members work in the same area, the need to use a Telephone (Descriptor #2f), Voice Mail (Descriptor #2e), Letters and Memos (Descriptor #2j), Handwritten Notes (Descriptor #2i), or Electronic Mail (Descriptor #2h) should be less. Indeed, jobs low in teamwork used these communication methods more frequently than did jobs high in teamwork, but the differences were not significant.

As expected, the various types of role relationships are more important to jobs in which working as part of a team is highly important. Supervising and Developing Others (Descriptor #6a), Persuading Others (Descriptor #6b), Providing a Service (Descriptor #6c), Taking a Position Opposed (Descriptor #6d) to coworkers, and Leading or Coordinating Activities (Descriptor #6g) were all rated as significantly more important to high teamwork jobs than to low teamwork jobs. Also, high teamwork employees are somewhat more Responsible for the Work of Others (Descriptor #8) and must handle Conflict Situations (Descriptor #9) more frequently than do workers in low teamwork jobs, but the differences are not significant.

Decisions made by groups are likely to affect a larger number of people (at least as many people as there are in the group) than do decisions made by individuals. As expected, Impact of Decisions (Descriptor #25) and Consequence of Error (Descriptor #24) are rated significantly higher for high teamwork jobs. Frequency of Decisions (Descriptor #25b) was also higher, but not significantly, for high teamwork jobs. Additionally, it was expected that occupations high in teamwork would require more Working With Distractions (Descriptor #38) and involve less

Unstructured Tasks (Descriptor #35) and goals than would jobs low in teamwork. Again, these differences were not significant, but were in the expected direction.

Conclusions

Before discussing the conclusions derived from this part of the study, it is important to note the limitations associated with the current research. The analyses presented above are based on a sample of 37 occupations, with as few as four raters within a particular occupation. Although a wide range of occupations were sampled, this is certainly a small sample when compared to the entire world of work, and caution is warranted when attempting to generalize these findings to other occupations. Further, given the small number of raters within some occupations, it is not possible to say definitively that these data necessarily reflect work context factors found in these occupations across the economy.

It is possible that substantive changes could occur in the relationships and structure of the results with a larger sample. Also, the focus of these analyses was to provide evidence for the internal structure of the variables. It will be important for future research to focus on the relationships of these variables with other measures outside the work context domain. Nonetheless, the current findings provide evidence for the measurement of these variables and have valuable implications for further research and practice.

Overall, the work context variables can be reliably assessed by job incumbents and analysts. However, the nature of some work context variables may make it difficult, if not impossible, to accurately make ratings based solely on task lists. Actual job performance or at least visual observation of the job being performed would be required to accurately respond to many descriptors. The moderate levels of agreement for the mean ratings between incumbents and occupational analysts may be due to how salient and pervasive the work context variables are to job incumbents. It is often difficult to get an accurate assessment of these variables simply by reading task lists. In terms of describing occupations, incumbent data are more likely to provide appropriate work context information.

One concern is the somewhat marginal results for interrater agreement with as many as eight descriptors. Further review of these items is needed in order to evaluate their utility in the taxonomy. Using the average number of raters across occupations, there were five items with interrater agreement coefficients below .50. When the agreement is estimated for 30 raters, obviously these coefficients increase, but a few items continue to have insufficient interrater agreement. Revision, or removal, of the items may be warranted if raters are unable to provide reliable results.

The patterns of results across occupations provide evidence that the variables can differentiate between occupations. The comparison of variables across the six example occupations provided evidence showing occupations differed in rational, measurable ways. Further, the discriminant analysis provided evidence that groupings of work context variables can be used to effectively differentiate between occupations.

We are also very encouraged about the capability of the work context descriptors alone to provide meaningful information about the similarities and differences among occupations, as well as how those occupations are positioned in the workforce. Thus, the very positive results we obtained from our studies of job clusters, exempt versus non-exempt status, and teamwork clearly emphasize the role that work context Variables will have in future research and applications with the O*NET content model. Given the effects of work context variables on workers and work performance, analyzing only work tasks, behaviors, and outcomes is not adequate. work context also must be examined and integrated with other job analysis information

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in order to provide complete information about occupations. Measuring work context more systematically will contribute to a better understanding of work and will provide valuable information essential for a comprehensive Occupational Information System.

An interesting outcome of the analyses is the prospect of reevaluating the structure of the taxonomy based on the results of the factor and discriminant analyses. The item loadings on the factors and functions were highly consistent with the grouping in the original taxonomy, but there were several items which loaded with descriptors from other higher-order factors. For instance, the factor associated with managerial activities is made up of variables from both the interpersonal and structural components of the taxonomy. Findings such as this are not all that surprising given the nature of the items, but future research might investigate the need to reconfigure the taxonomy.

There has been tremendous fragmentation and lack of standardization in previous attempts to assess aspects of the context in which work occurs. This is likely due to the extremely broad range of constructs that may be considered under the rubric of work context. Our taxonomy builds on previous work to present a set of meaningful work context variables which accurately differentiates between occupations and provides a framework for further study of the structure, reliability, and validity of work context measures.

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Figure 7-1
Work Context and Work Processes

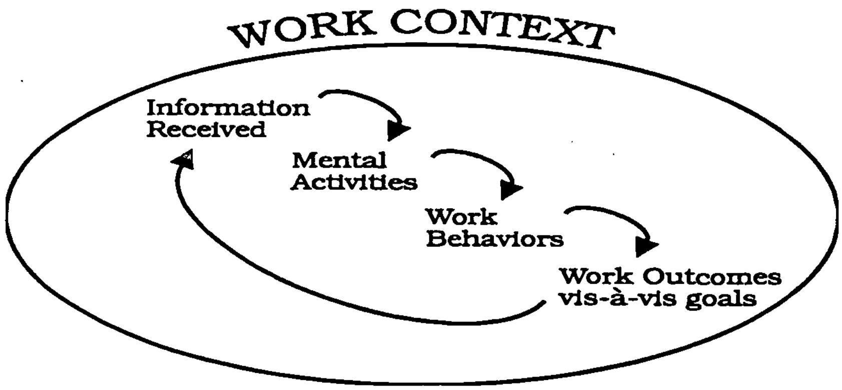

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Figure 7-2
Work Context Items - Job Analysis Instruments Matrix

Work Context Dimensions	Job Analysis Instrument[a]								
	ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Interpersonal: Communication									
1. Formality of Communication						√	√		
2. Communication Methods	√		√	√		√	√	√	√
3. Objectivity vs. Subjectivity of Information Communicated				√		√			
4. Job Required Social Interaction		√	√	√	√	√	√		
5. Privacy of Communications									
Work Context: Interpersonal: Role Relationships									
6. Job Interactions			√						
a. Supervise, coach, train, or develop other employees?	√	√		√		√	√	√	√
b. Persuade someone to a course of action (informally) or influence others to buy something (to sell)?		√		√		√	√		
c. Provide a service to others (e.g., customers)?		√		√		√	√		√
d. Take a position opposed to coworkers or others?				√		√			√
e. Work with or contribute to a work group or team to perform this job?	√			√		√			√
f. Deal with public customers (e.g., retail sales) or the public in general (e.g., police work)?	√	√		√		√	√		√
g. Coordinate or lead others in accomplishing work activities (not supervision)?	√	√		√		√	√	√	√
Work Context: Interpersonal: Responsibility for Others									
7. Responsibility for Others' Health and Safety	√			√		√	√		
8. Responsibility for Work Outcomes and Results	√		√		√		√	√	√
9. How frequently do the job requirements place the worker in conflict situations?				√		√	√		

Figure 7-2 (continued)

Work Context Items - Job Analysis Instruments Matrix

Work Context Dimensions	Job Analysis Instrument[a]								
	ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Interpersonal: Conflictual Contact									
10. How frequently does the worker have to deal with unpleasant, angry, or discourteous individuals as part of the job requirements?				√		√	√		
11. How frequently does this job require the worker to deal with physical aggression of violent individuals?									
Work Context: Physical Work Conditions: Work Setting									
12. How frequently does this job require the worker to work:									
a. indoors, environmentally controlled?				√		√	√		
b. indoors, not environmentally controlled (e.g., un-airconditioned warehouse)?				√		√	√		
c. outdoors, exposed to all weather conditions?		√		√		√	√		
d. outdoors, under cover (e.g., open shed)?									
e. open vehicle or operating equipment (e.g., tractor)?		√							
f. enclosed vehicle or operating equipment		√							
13. Privacy of Work Area									
14. Physical Proximity									
Work Context: Physical Work Conditions: Environmental Conditions									
15. Environmental Conditions			√						
a. sounds and noise levels that are distracting and uncomfortable?		√		√		√	√		
b. very hot (above 90° F) or very cold (under 32° F) temperatures?		√		√		√	√		
c. extremely bright or inadequate lighting conditions?						√	√		
d. contaminants (pollutants, gases, dust, odors, etc.)?		√		√		√	√		
e. cramped work space that requires getting into awkward positions?						√			
f. whole body vibration (e.g., operating a jackhammer or earth-moving equipment)?		√		√		√	√		

Figure 7-2 (continued)
Work Context Items - Job Analysis Instruments Matrix

Work Context Dimensions		Job Analysis Instrument[a]								
		ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Physical Work Conditions: Job Hazards				√				√		
16.	Exposure to Radiation		√		√		√			
17.	Exposure to Diseases/Infections (e.g., patient care, some laboratory work, sanitation control, etc.)									
18.	Exposure to High Places (such as heights above 8 feet on ladders, poles, scaffolding, catwalks, etc.)		√		√		√			
19.	Exposure to Hazardous Conditions (such as high voltage electricity, combustibles, explosives, chemicals; do not include hazardous equipment or situations - see questions 20 and 21).		√		√		√			
20.	Exposure to Hazardous Equipment, such as saws, machinery/mechanical parts (include exposure to vehicular traffic, but not driving a vehicle).		√				√			
21.	Exposure to Hazardous Situations involving likely cuts, bites, stings, or minor burns						√			
Work Context: Physical Work Conditions: Body Positioning										
22.	Body Positioning			√						
	a. Sitting?		√		√		√	√		
	b. Standing?		√		√		√	√		
	c. Climbing ladders, scaffolds, poles, etc.?		√				√	√		
	d. Walking or running?		√		√		√	√		
	e. Kneeling, crouching, stooping, or crawling?		√		√		√	√		
	f. Keeping or regaining balance?		√		√		√	√		
	g. using hands to finger, handle, control, or feel objects, tools or controls?		√		√		√	√		
	h. bending or twisting the body?		√		√					
	i. making repetitive motions?		√					√		

Figure 7-2 (continued)

Work Context Items - Job Analysis Instruments Matrix

Work Context Dimensions	Job Analysis Instrument[a]								
	ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Physical Work Conditions: Work Attire			√						
23. Work Attire				√					
a. business clothes, such as ties and dresses that are often worn in offices?						√	√		
b. a special uniform, such as that of a commercial pilot, nurse, police officer, or military personnel?						√	√		
c. work clothing such as that worn by production or maintenance workers?						√	√		
d. common protective or safety attire, such as safety shoes, glasses, gloves, hearing protection, hard-hat, or personal flotation device?		√				√	√		
e. specialized protective or safety attire, such as a breathing apparatus, safety harness, full protection suit, or radiation protection?		√					√		
Work Context: Structural Job Characteristics: Criticality of Position			√						
24. Consequences of Error				√		√	√	√	
25. Impact of Decisions	√						√		
26. Responsibility/Accountability				√	√	√	√	√	
27. Decision Latitude				√	√	√	√		√
Work Context: Structural Job Characteristics: Routine vs. Challenging Work									
28. Frustrating Circumstances						√	√		
29. Degree of Automation									
30. Task Clarity					√	√			
31. How important is being very exact or highly accurate in performing this job?		√					√		
32. How important is it to be sure that all the details of this job are performed and everything is done completely?							√		

Figure 7-2 (continued)
Work Context Items - Job Analysis Instruments Matrix

Work Context Dimensions		Job Analysis Instrument[a]								
		ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
33.	How important is being constantly aware of either frequently changing events (e.g., security guard watching for shoplifters) or infrequent events (e.g., radar operator watching for tornadoes) to performing this job?				√			√		
34.	How important is repeating the same physical (e.g., key entry) or mental (e.g., checking entries in a ledger) activities over and over, without stopping, to performing this job?		√		√	√	√	√		
35.	Structured vs. Unstructured Work						√	√		
Work Context: Structural Job Characteristics: Level of Competition										
36.	Level of Competition									
Work Context: Structural Job Characteristics: Pace and Scheduling										
37.	Deadlines and Time Pressure				√		√	√		
38.	How important is working under frequent distractions or interruptions to performing this job?						√	√		
39.	How important is it to this job that the pace is determined by the speed of equipment or machinery? (This does not refer to keeping busy at all times on this job.)						√	√		

[a]ACT: Work Activities Survey (Form A and Form B)
(American College Testing)
DOL: Department of Labor
The Revised Handbook for Analyzing Jobs
FES: Factor Evaluation System
(Office of Personnel Management)
GWI: The General Work Inventory
(Copyright, J.W. Cunningham and Rodger D. Ballentine)
JDS: ob Diagnostic Survey
(Copyright, Hackman & Oldhan)
OAI: Occupation Analysis Inventory
(Copyright, J.W. Cunningham)
JEI: Job Element Inventory
(Cornelius & Hakel)
PAQ: Position Analysis Questionnaire
(McCormick, Jeanneret, & Mecham; Copyright, Purdue University/Consulting Psychologists Press)
PMPQ: Professional and Managerial Position Questionnaire
(Mitchell and McCormick; (Copyright, Purdue University/Consulting Psychologists Press)
SCANS: Secretary's Commission on Achieving Necessary Skills
(Department of Labor)

Figure 7-3
Work Context Taxonomy: Higher Order Factors

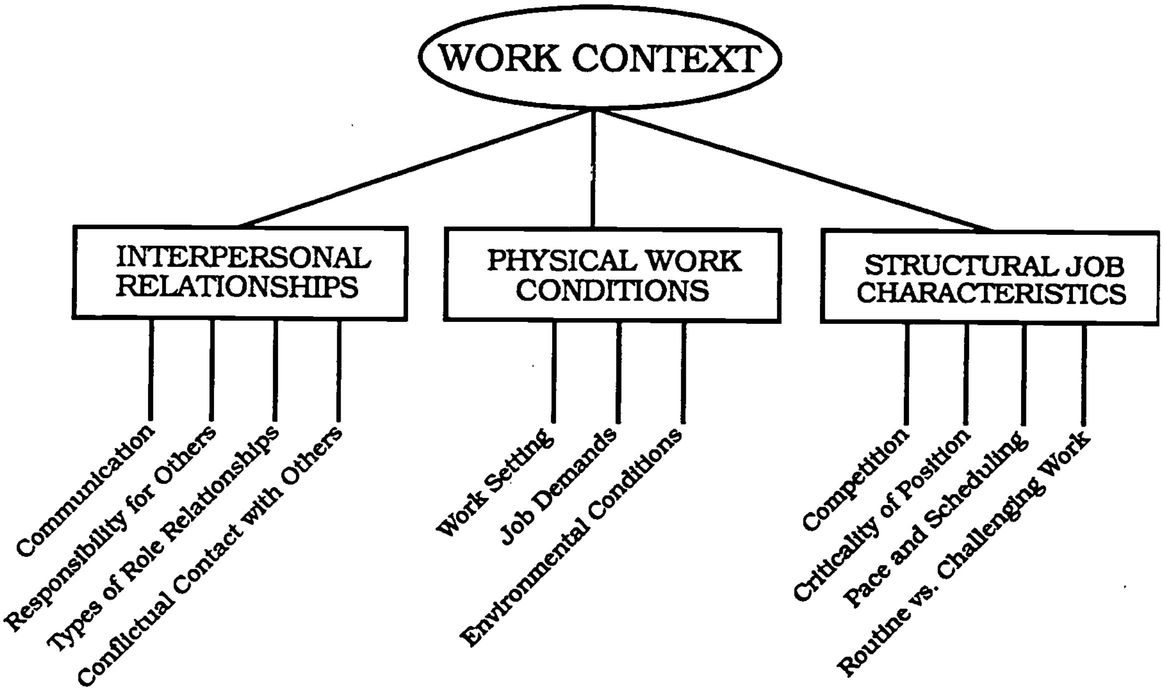

Figure 7-4
Work Context Taxonomic Structure

Higher Order Job Dimension	Second Order	Item-Level Constructs	Technical Definition	Scale
Interpersonal Relationships	Communication	Formality of Communication	The extent to which communication is informal and personal (such as words spoken face to face, touching, eye contact) or formal and impersonal (such as telephone, letters, reports, memoranda, electronic mail, or facsimile).	Level
		Communication Method	The extent to which the job requires a variety of communication methods, including face-to-face, public speaking, video conferencing, voice mail, telephone, interactive computer communication, electronic mail, handwritten notes or messages, letters or memos, and written reports.	Frequency
		Objectivity of Information Communicated	The extent to which the job requires the communication of emotionally/psychologically valued subjective information, feelings, thoughts, and ideas versus the communication of objective and verifiable data-based information.	Level
		Frequency of Job-Required Social Interaction	Extent to which the worker is required to have interpersonal contact with others, including customers, trainees, supervisors, phone callers, etc.	Frequency
		Privacy of Communication	The extent an individual's work materials and communications (face-to-face, phone, fax, e-mail, etc.) can be monitored by others.	Level
	Types of Role Relationships	Supervisory Roles	Importance of interactions requiring the worker to assume a role of trainer, coach, leader, supervisor, manager, etc., with respect to other workers.	Importance
		Sales Roles	Importance of interpersonal contacts requiring the worker to engage in persuasion or influence.	Importance
		Service Roles	Importance of interpersonal interactions requiring the worker to provide others with needed services or to assist others to accomplish an objective, including customer service and advisor-client/patient relationships.	Importance
		Adversarial Roles	Importance of interpersonal contacts requiring the worker to state, defend, or advocate some goal or objective in opposition to others'. Job activities may involve negotiation to a compromise, but the emphasis is on the taking of a position opposed to that taken by others of equal or similar power.	Importance
		Team Participant Roles	Importance of job activities requiring the worker to contribute to group accomplishment of goals or objectives, to work closely with others, to be supportive and cooperative, and to place group accomplishment ahead of individual aspirations.	Importance

Figure 7-4 (continued)
Work Context Taxonomic Structure

Higher Order Job Dimension	Second Order	Item-Level Constructs	Technical Definition	Scale
Interpersonal Relationships (Cont.)	Responsibility for Others	Responsibility for the Safety of Others	Extent to which the job requires the worker to be particularly careful not to cause harm or injury to others, including the responsibility to establish policies and programs to protect others.	Level
		Responsibility for Work Outcomes and Results	Extent to which the job requires the worker to assume responsibility for the results of the work of others, including being responsible for the errors or failures of others.	Level
	Conflictual Contact with Others	Interpersonal Conflict	Extent to which the job structure itself creates a role for the worker that inevitably places him/her in conflict with others (e.g., police officer making an arrest, utility worker collecting overdue bills, labor relations manager dealing with grievances).	Frequency
		Strained Interpersonal Relations	Extent to which the worker must from time to time deal with others who are discourteous, angry, hostile, or otherwise unpleasant even when the job structure does not make such encounters inevitable (e.g., food servers, customer service representatives, postal counter workers).	Frequency
Physical Work Conditions	Work Setting	Types of Work Settings	Extent to which the work is performed in a variety of settings, including indoors (environmentally or not environmentally controlled), outdoors (exposed to weather conditions or under cover), in a vehicle or operating equipment (open or enclosed).	Frequency
		Privacy of Work Area	The extent to which the work area is private.	Level
		Physical Proximity	The extent to which the job requires the worker to perform job tasks in close physical proximity to other people.	Level
	Environmental Conditions	Exposure to Extreme Environmental Conditions	Extent to which the work is performed under extreme temperatures, noise levels, lighting, air contaminants, or in a confined space.	Frequency
		Exposure to Job Hazards	Extent to which the work is performed under hazardous conditions (e.g., radiation, disease/infection, high places, equipment).	Frequency
		Exposure to Job Hazards	Extent to which the work is performed under hazardous conditions (e.g., radiation, disease/infection, high places, equipment).	Frequency
		Possibility of Injury from Job Hazards	The likelihood the worker will be injured while working under hazardous conditions.	Likelihood of Occurrence
		Impact of Injury	The likely extent, duration, and seriousness of injuries possible to be received on the job.	Seriousness of Injury

Figure 7-4 (continued)
Work Context Taxonomic Structure

Higher Order Job Dimension	Second Order	Item-Level Constructs	Technical Definition	Scale
Physical Work Conditions (Cont.)	Job Demands	Body Positioning	Extent to which the worker sits, stands, walks, climbs, etc.	Time Spent
		Work Attire	Extent to which the worker must wear various types of clothing and equipment	Frequency
Structural Job Characteristics	Criticality of Position	Consequence of Error	Breadth and severity of outcomes resulting from errors made by the worker	Level
		Impact of Decisions	Breadth and impact of results of the decisions required of a worker	Level
		Responsibility/Accountability	Extent to which the worker's performance is judged based on the ultimate outcome of work activities, and/or results of errors and mistakes.	Level
		Decision Latitude	Level of responsibility assigned to the job to be exercised by the worker, including the level of decision making which must be approved by others before action can proceed.	Level
	Routine versus Challenging Work	Frustrating Circumstances	Extent to which the worker's goal-oriented behavior is blocked by impediments over which the worker has little or no control	Importance
		Degree of Automation	Degree to which significant job functions are automated and require little input from the worker beyond monitoring.	Level
		Task Clarity	Extent to which tasks or objectives are not clearly defined or communicated	Level
		Required Precision	Extent to which the job requires the worker to maintain a high level of accuracy and precision including both manual and mental precision	Importance
		Required Attention to Detail	Extent to which a job requires a high level of thoroughness to ensure that nothing is left undone or that steps are not taken out of order, including attending to the details of a set of procedures, checking the completion of a series of tasks, auditing the correctness and documentation of activities or financial results.	Importance

Figure 7-4 (continued)
Work Context Taxonomic Structure

Higher Order Job Dimension	Second Order	Item-Level Constructs	Technical Definition	Scale
Structural Job Characteristics (Cont.)	Routine versus Challenging Work (Cont.)	Required Maintenance of Vigilance	Extent to which the job requires the worker to maintain attention or alertness, either for events or circumstances which do not occur often or for those which are subject to continual change.	Importance
		Monotony/Repetitive Activities	Extent to which the worker is required to perform the same physical and/or mental activities repeatedly, in a relatively short period of time, usually less than one hour.	Importance
		Structured vs. Unstructured Work	The degree to which job activities are at the discretion of the worker rather than being predetermined and requiring following directions and carrying out orders.	Level
		Level of Competition	Extent job requires the worker to compete or be aware of competitive pressures.	Level
	Pace and Scheduling	Frequency and Stringency of Deadlines	Extent that the job imposes frequent strict deadlines.	Importance
		Distractions and Interruptions	Extent to which the worker cannot expect to start and complete a task without interruptions, including the extent to which the worker has control over the interruptions.	Importance
		Machine Driven Work Pace	Extent to which the work pace is machine driven or controlled by the speed of process, such as assembly lines, leaving the worker little control over it.	Importance

Figure 7-5
Impact of Work Context Variables

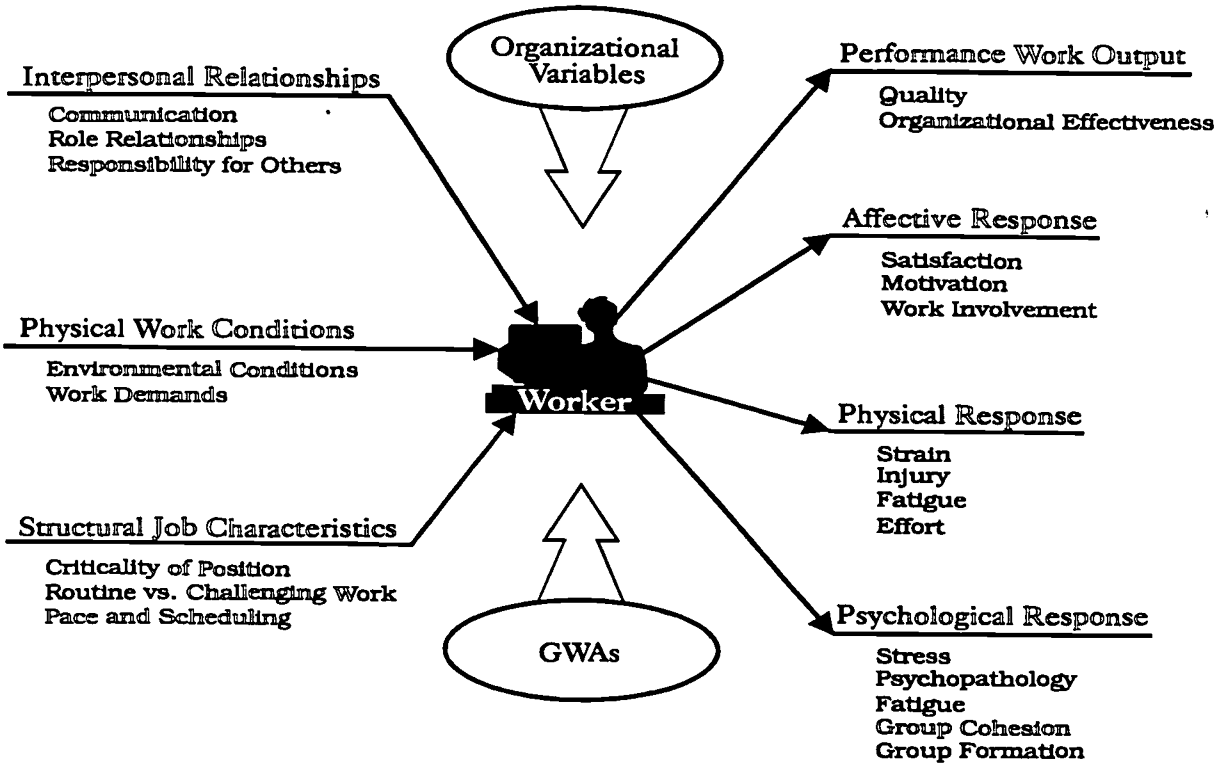

Figure 7-6
Occupations Included in Data Analysis

Occupation Code	Occupation Title	Incumbent Sample Size
15005	Education Administrators	9
19005	General Managers & Top Executives	55
22114	Chemical Engineers	5
22135	Mechanical Engineers	5
25105	Computer Programmers	9
31303	Teachers, Preschool	4
31305	Teachers, Elementary School	13
32502	Registered Nurses	30
32902	Medical & Clinical Laboratory Technologists	5
32905	Medical & Clinical Laboratory Technicians	6
49008	Salespersons, Except Scientific & Retail	7
49011	Salespersons, Retail	21
49021	Stock Clerks, Sales Floor	15
49023	Cashiers	28
51002	First Line Supervisors, Clerical & Administrative	57
53102	Tellers	4
53121	Loan & Credit Clerks	5
53311	Insurance Claims Clerks	10
53905	Teachers' Aides & Assistants, Clerical	4
55108	Secretaries, Except Legal & Medical	78
55305	Receptionists & Information Clerks	7
55338	Bookkeeping, Accounting & Auditing Clerks	38
55347	General Office Clerks	78
61005	Police & Detective Supervisors	11
63014	Police Patrol Officers	25
65008	Waiters & Waitresses	22
65026	Cooks, Restaurant	6
65038	Food Preparation Workers	25
66005	Medical Assistants	6
66008	Nursing Aides, Orderlies & Attendants	17
67005	Janitors & Cleaners	30
85132	Maintenance Repairers, General Utility	37
87902	Earth Drillers, Except Oil & Gas	8
89108	Machinists	4
92974	Packaging & Filling Machine Operations	12
97102	Truck Drivers, Heavy or Tractor Trailer	16
97111	Bus Drivers, Schools	16

Figure 7-7
Cluster Analysis Dendogram of Job Groupings

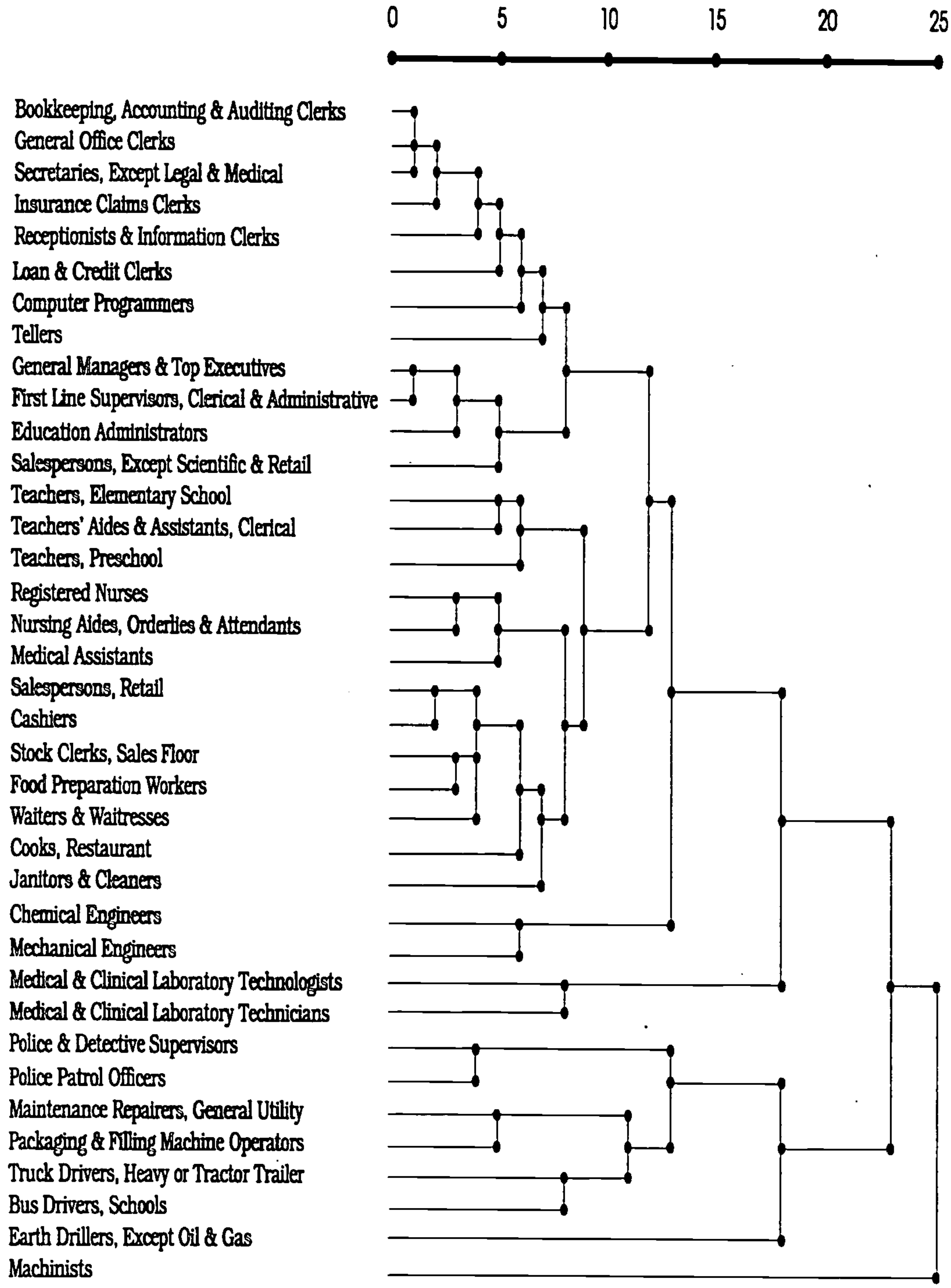

Table 7-1

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor	Rating Scale	M	SD	SEM[a]	r_k[b]
1. Communication Formality	1 = Very informal	3.94	0.86	0.49	0.68
	7 = Very formal				
2. Communication Methods					
2a. Face-to-Face Individuals		5.38	0.70	0.52	0.44
2b. Face-to-Face Groups	0 = Never or less than once a month	1.98	0.87	0.41	0.77
2c. Public Speaking	1 = Once or more per month, but less than weekly	0.97	1.00	0.46	0.79
2d. Video Conference	2 = Once or more per week, but less than daily	0.22	0.30	0.27	0.20
2e. Voice Mail	3 = Daily (once or twice a day)	1.52	1.49	0.48	0.89
2f. Telephone	4 = Several times per day	4.08	1.49	0.42	0.92
2g. Interactive Computer	5 = Hourly	1.49	1.16	0.60	0.73
2h. Electronic Mail	6 = More than hourly	1.28	1.38	0.45	0.89
2i. Handwritten Notes	7 = Continually	3.09	0.93	0.42	0.80
2j. Letters and Memos		2.26	0.77	0.38	0.75
2k. Written Reports		1.76	0.95	0.46	0.77
3. Communication Subjectivity	1 = Very objective	3.33	0.56	0.43	0.41
	7 = Very subjective				
4. Social Interaction	1 = Very little contact	5.72	0.91	0.44	0.76
	7 = Very extensive contact				
5. Privacy of Communication	1 = Little privacy	3.66	0.70	0.36	0.73
	7 = Substantial privacy				
6. Job Interactions					
6a. Supervise/Develop Others	0 = Does not apply	3.03	0.76	0.32	0.83
6b. Persuade or Influence	5 = Extremely Important	1.83	1.15	0.40	0.88
6c. Provide Service to Others		3.53	1.09	0.51	0.78

Table 7-1 (continued)
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor	Rating Scale	M	SD	SEM[a]	r_k[b]
6d. Take Opposing Position		1.75	0.80	0.39	0.77
6e. Work/Contribute To Team		3.80	0.55	0.35	0.59
6f. Deal With Public		2.84	1.12	0.46	0.83
6g. Coordinate/Lead Activity		2.99	0.75	0.41	0.70
7. Health/Safety of Others	0 = None (No responsibility) 7 = Very substantial responsibility	3.95	1.84	0.47	0.94
8. Responsible Others' Work	0 = None (No responsibility) 7 = Very substantial responsibility	3.45	1.21	0.50	0.83
9. Conflict Situations	0 = Never (or does not apply) 4 = Always	1.81	0.45	0.23	0.75
10. Unpleasant Individuals	0 = Never (or does not apply) 4 = Always	2.06	0.38	0.22	0.65
11. Physical Aggression	0 = Never (or does not apply) 4 = Always	0.94	0.64	0.19	0.91
12. Work Settings	0 = Never (or does not apply)				
12a. Indoors, Controlled	1 = Once per year or less	5.71	1.35	0.54	0.84
12b. Indoors, Uncontrolled	2 = More than once per year, but less than monthly	1.48	1.33	0.60	0.80
12c. Outdoors, Exposed	3 = More than once per month, but less than weekly	1.94	2.05	0.42	0.96
12d. Outdoors, Covered	4 = More than once per week, but less than daily	0.91	1.21	0.35	0.92
12e. Open Vehicle/Equip.	5 = Daily (1 or 2 times/day)	0.51	1.10	0.31	0.92
12f. Enclosed Vehicle/Equip.	6 = Several times per day	1.48	2.03	0.38	0.97
	7 = Hourly or more often (including continually)				

Table 7-1 (continued)
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor	Rating Scale	M	SD	SEM[a]	r_k[b]
13. Privacy of Work Area	1 = Little privacy	2.97	1.18	0.44	0.86
	7 = Substantial privacy				
14. Physical Proximity	1 = Not close	4.48	0.85	0.44	0.73
	7 = Very close				
15. Environmental Conditions	0 = Never (or does not apply)				
15a. Distracting Noise	1 = Once per year or less	3.39	1.22	0.70	0.67
15b. Extreme Temperature	2 = More than once per year, but less than monthly	2.05	1.71	0.49	0.92
15c. Poor Lighting	3 = More than once per month, but less than weekly	1.35	1.25	0.48	0.85
15d. Contaminants	4 = More than once per week, but less than daily	2.52	1.73	0.62	0.87
15e. Cramped Work Space	5 = Daily (1 or 2 times/day)	1.38	0.98	0.44	0.80
15f. Whole Body Vibration	6 = Several times per day	0.46	1.18	0.30	0.94
	7 = Hourly or more often (including continually)				
16. Radiation					
16a. Exposure	0 = Never (or does not apply)	0.44	0.72	0.37	0.73
	7 = Hourly or more often (including continually)				
16b. Likelihood of Injury	0 = No possibility	0.43	0.47	0.30	0.59
	7 = Very high possibility				
16c. Extent of Injury	0 = No treatment required	0.43	0.47	0.30	0.59
	7 = Injury resulting in permanent total impairment/death				
17. Diseases/Infections					
17a. Exposure	0 = Never (or does not apply)	2.10	1.86	0.55	0.91
	7 = Hourly or more often (including continually)				

Table 7-1 (continued)
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor		Rating Scale	M	SD	SEM[a]	r_k[b]
17b.	Likelihood of Injury	0 = No possibility 7 = Very high possibility	1.64	1.32	0.42	0.90
17c.	Extent of Injury	0 = No treatment required 7 = Injury resulting in permanent total impairment/death	1.15	1.11	0.36	0.90
18. High Places						
18a.	Exposure	0 = Never (or does not apply) 7 = Hourly or more often (including continually)	0.77	1.00	0.26	0.93
18b.	Likelihood of Injury	0 = No possibility 7 = Very high possibility	0.68	0.82	0.24	0.91
18c.	Extent of Injury	0 = No treatment required 7 = Injury resulting in permanent total impairment/death	0.68	0.77	0.25	0.89
19. Hazardous Conditions						
19a.	Exposure	0 = Never (or does not apply) 7 = Hourly or more often (including continually)	1.29	1.28	0.44	0.88
19b.	Likelihood of Injury	0 = No possibility 7 = Very high possibility	1.11	1.02	0.36	0.88
19c.	Extent of Injury	0 = No treatment required 7 = Injury resulting in permanent total impairment/death	0.86	0.89	0.31	0.88

Table 7-1 (continued)

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor		Rating Scale	M	SD	SEM[a]	r_k[b]
20. Hazardous Equipment						
20a.	Exposure	0 = Never (or does not apply) 7 = Hourly or more often (including continually)	1.69	1.90	0.44	0.95
20b.	Likelihood of Injury	0 = No possibility 7 = Very high possibility	1.28	1.43	0.33	0.95
20c.	Extent of Injury	0 = No treatment required 7 = Injury resulting in permanent total impairment/death	0.99	1.08	0.28	0.93
21. Hazardous Situations						
21a.	Exposure	0 = Never (or does not apply) 7 = Hourly or more often (including continually)	2.25	1.57	0.48	0.91
21b.	Likelihood of Injury	0 = No possibility 7 = Very high possibility	1.93	1.34	0.41	0.91
21c.	Extent of Injury	0 = No treatment required 7 = Injury resulting in permanent total impairment/death	1.01	0.69	0.26	0.86
22. Body Positioning						
22a.	Sitting		2.59	1.28	0.23	0.97
22b.	Standing		2.96	1.21	0.23	0.96
22c.	Climbing Ladders, etc.	0 = Never (or does not apply)	0.39	0.52	0.14	0.93
22d.	Walking or Running	1 = Under 10% of the time	2.28	1.05	0.28	0.93
22e.	Kneeling or Crouching	2 = Between 1/10 and 1/3 of the time	1.04	0.70	0.26	0.87

Table 7-1 (continued)
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor	Rating Scale	M	SD	SEM[a]	r_k[b]
22f. Keeping/Regaining Balance	3 = Between 1/3 and 2/3 of the time	0.76	0.62	0.30	0.77
22g. Handling Tools, Objects	4 = Over 2/3 of the time	2.57	1.00	0.49	0.76
22h. Bending/Twisting Body	5 = Almost continually	1.70	0.99	0.31	0.90
22i. Making Repetitive Motions		2.70	0.91	0.42	0.78
23. Work Attire	0 = Never (or does not apply)				
23a. Business/Office Clothes	1 = Once per year or less	2.20	1.66	0.37	0.95
23b. Special Uniform	2 = More than once per year, but less than monthly	1.21	1.47	0.41	0.92
23c. Maintenance Clothes	3 = More than once per month, but less than weekly	1.15	1.44	0.35	0.94
23d. Common Safety Attire	4 = More than once a week, but not daily	2.78	2.48	0.53	0.95
23e. Special Safety Attire	5 = Daily	0.67	0.96	0.32	0.89
24. Consequence of Error	1 = Mildly serious 7 = Extremely serious	3.54	1.32	0.45	0.88
25. Impact of Decisions					
25a. Level of Decisions	1 = Very minor results 7 = Extreme results	4.28	0.90	0.37	0.83
25b. Frequency of Decisions	0 = Never (or does not apply) 7 = Hourly or more often (including continually)	3.57	1.32	0.56	0.82
26. Accountable for Results	1 = Very limited 7 = Very substantial	4.86	1.03	0.49	0.78
27. Decision Latitude	1 = Very little freedom 7 = Extensive freedom	4.26	0.74	0.34	0.79

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Table 7-1 (continued)

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor	Rating Scale	M	SD	SEM[a]	r_k[b]
28. Frustrating Circumstances	1 = Low extent 7 = High extent	3.41	0.96	0.54	0.68
29. Level of Automation	1 = Low automation 7 = High automation	3.13	0.90	0.48	0.72
30. Task/Performance Clarity	1 = Low clarity 7 = High clarity	5.64	0.53	0.43	0.34
31. Accuracy/Exactness	0 = Does not apply 7 = Extremely important	4.10	0.43	0.23	0.72
32. Details and Completeness	0 = Does not apply 7 = Extremely important	4.22	0.37	0.23	0.60
33. Constant Awareness	0 = Does not apply 7 = Extremely important	2.47	0.85	0.44	0.73
34. Repetitive Activities	0 = Does not apply 7 = Extremely important	2.52	0.82	0.43	0.72
35. Unstructured Tasks/Goals	1 = Very structured 7 = Very unstructured	4.37	0.78	0.40	0.74
36. Level of Competition	1 = Low competition 7 = High competition	3.32	0.74	0.48	0.57

Table 7-1 (continued)

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

Descriptor	Rating Scale	M	SD	SEM[a]	r_k[b]
37. Deadlines/Time Pressure	0 = Never (or does not apply) 7 = Hourly or more often (including continually)	4.32	0.84	0.50	0.65
38. Work With Distractions	0 = Does not apply 5 = Extremely important	3.29	0.64	0.40	0.61
39. Machine Driven Pace	0 = Does not apply 5 = Extremely important	1.75	0.98	0.46	0.78

Note. Statistics are based on 37 occupations with Work Context Questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.68; median = 12.5; harmonic mean = 9.44).

[a]This estimate of the standard error of measurement was calculated as $SEM = SD * \sqrt{(1 - r_k)}$

[b]This estimate of reliability was obtained by calculating the intraclass correlation for the mean of k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean number of ratings provided per occupation.

Table 7-2
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Work Context

	Descriptor	Variable r_1 [a]	r_{30} [b]
1.	Communication Formality	.18	.87
2.	Communication Methods		
	2a. Face-to-Face Individuals	.08	.72
	2b. Face-to-Face Groups	.26	.92
	2c. Public Speaking	.28	.92
	2d. Video Conference	.03	.44
	2e. Voice Mail	.47	.96
	2f . Telephone	.55	.97
	2g. Interactive Computer	.22	.90
	2h. Electronic Mail	.47	.96
	2i. Handwritten Notes	.29	.93
	2j. Letters and Memos	.24	.91
	2k. Written Reports	.26	.91
3.	Communication Subjectivity	.07	.69
4.	Social Interaction	.26	.91
5.	Privacy of Communication	.22	.90
6.	Job Interactions		
	6a. Supervise/Develop Others	.33	.94
	6b. Persuade or Influence	.43	.96
	6c. Provide Service to Others	.28	.92
	6d. Take Opposing Position	.26	.91
	6e. Work/Contribute to Team	.13	.82
	6f. Deal With Public	.34	.94
	6g. Coordinate/Lead Activity	.20	.88
7.	Health/Safety of Others	.61	.98
8.	Responsible Others' Work	.34	.94
9.	Conflict Situations	.24	.90
10.	Unpleasant Individuals	.16	.86
11.	Physical Aggression	.53	.97
12.	Work Settings		
	12a. Indoors, Controlled	.36	.94
	12b. Indoors, Uncontrolled	.29	.93
	12c. Outdoors, Exposed	.71	.99
	12d. Outdoors, Covered	.53	.97
	12e. Open Vehicle/Equip.	.56	.97
	12f. Enclosed Vehicle/Equip.	.75	.99
13.	Privacy of Work Area	.39	.95
14.	Physical Proximity	.22	.90
15.	Environmental Conditions		

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Table 7-2 (continued)
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Work Context

Descriptor		Variable r_1	r_{30}
	15a. Distracting Noise	.18	.87
	15b. Extreme Temperature	.54	.97
	15c. Poor Lighting	.37	.95
	15d. Contaminants	.42	.96
	15e. Cramped Work Space	.29	.93
	15f. Whole Body Vibration	.61	.98
16.	Radiation		
	16a. Exposure	.23	.90
	16b. Likelihood of Injury	.13	.82
	16c. Extent of Injury	.09	.76
17.	Diseases/Infections		
	17a. Exposure	.52	.97
	17b. Likelihood of Injury	.49	.97
	17c. Extent of Injury	.48	.96
18.	High Places		
	18a. Exposure	.59	.98
	18b. Likelihood of Injury	.53	.97
	18c. Extent of Injury	.47	.96
19.	Hazardous Conditions		
	19a. Exposure	.44	.96
	19b. Likelihood of Injury	.43	.96
	19c. Extent of Injury	.43	.96
20.	Hazardous Equipment		
	20a. Exposure	.66	.98
	20b. Likelihood of Injury	.66	.98
	20c. Extent of Injury	.59	.98
21.	Hazardous Situations		
	21a. Exposure	.51	.97
	21b. Likelihood of Injury	.51	.97
	21c. Extent of Injury	.38	.95
22.	Body Positioning		
	22a. Sitting	.75	.99
	22b. Standing	.74	.99
	22c. Climbing Ladders, etc.	.58	.98
	22d. Walking or Running	.58	.98
	22e. Kneeling or Crouching	.41	.95
	22f. Keeping/Regaining Balance	.26	.91
	22g. Handling Tools, Objects	.25	.91
	22h. Bending/Twisting Body	.49	.97

Table 7-2 (continued)
Reliability of Rated Differences Between OccupationsConsidering Varying Numbers of Raters: Work Context

	Descriptor	Numbers of Raters on Each Variable r_1	r_{30}
	22i. Making Repetitive Motions	.28	.92
23.	Work Attire		
	23a. Business/Office Clothes	.67	.98
	23b. Special Uniform	.56	.97
	23c. Maintenance Clothes	.63	.98
	23d. Common Safety Attire	.69	.99
	23e. Special Safety Attire	.45	.96
24.	Consequence of Error	.45	.96
25.	Impact of Decisions		
	25a. Level of Decisions	.34	.94
	25b. Frequency of Decisions	.33	.94
26.	Accountable for Results	.27	.92
27.	Decision Latitude	.28	.92
28.	Frustrating Circumstances	.19	.87
29.	Level of Automation	.21	.89
30.	Task/Performance Clarity	.05	.62
31.	Accuracy/Exactness	.22	.89
32.	Details and Completeness	.14	.83
33.	Constant Awareness	.23	.90
34.	Repetitive Activities	.22	.89
35.	Unstructured Tasks/Goals	.23	.90
36.	Level of Competition	.13	.81
37.	Deadlines/Time Pressure	.16	.85
38.	Work With Distractions	.14	.83
39.	Machine Driven Pace	.27	.92

Note. Statistics are based on 37 occupations with Work Context Questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.68; median = 12.5; harmonic mean = 9.44).
[a]Single rater estimates of reliability were obtained by calculating the intraclass correlation for single-judge ratings across occupations: ICC(1,1) = [BMS-WMS]/BMS + (k-1)WMS] (Shrout & Fleiss, 1979).
[b]Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

Table 7-4
Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation: Work Context

Source of Variation	SS	df	MS	F
Occupations	9367.69	36	260.21	12.18*
S(Occupations)	14763.67	691	21.37	
Descriptor	60466.24	89	679.40	301.04*
Descriptor x Occupations	53764.99	3204	16.78	7.44*
Descriptor x S(Occupations)	138793.68	61499	2.26	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.
*$p < .05$

Table 7-5
Interrater Agreement Coefficients: Work Context

Number of Raters on Each Variable	r_k	r_1	r_{30}
Descriptor	.87	.40	.95

Note. Statistics are based on 37 occupations with Work Context Questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.68, median = 12.5, harmonic mean = 9.44). Full sample interrater agreement coefficients (r_k) were obtained by considering "Descriptor x Occupations" terms from Table 7-4 as true variance. Error variance was defined as the "Descriptor x S(Occupations) term. Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation.

Table7-9a

Intercorrelations of Descriptors (Occupation Level Data): Work Context--Interpersonal Relationships

Descriptor	1.	2a.	2b.	2c.	2d.	2e.	2f.	2g.	2h.	2i.	2j.	2k.	3.
1. Communication Formality	--												
2. Communication Methods													
2a. Face-to-Face Individuals	29	--											
2b. Face-to-Face Groups	53	36	--										
2c. Public Speaking	23	46	46	--									
2d. Video Conference	20	05	32	55	--								
2e. Voice Mail	37	-13	35	09	18	--							
2f. Telephone	29	09	18	12	22	67	--						
2g. Interactive Computer	27	06	04	13	28	47	52	--					
2h. Electronic Mail	29	-23	25	02	04	78	45	46	--				
2i. Handwritten Notes	34	05	04	12	10	52	82	40	35	--			
2j. Letters and Memos	55	01	15	17	22	56	67	42	40	77	--		
2k. Written Reports	50	17	33	19	30	26	30	14	18	30	06	--	
3. Communication Subjectivity	20	02	38	33	45	05	05	06	-10	08	29	05	--
4. Social Interaction	16	57	29	51	22	42	42	17	-12	49	30	20	22
5. Privacy of Communication	31	21	42	06	06	30	27	13	35	05	24	05	15
6. Job Interactions													
6a. Supervise/Develop Others	10	23	43	09	10	31	19	06	21	09	09	36	22
6b. Persuade or Influence	06	30	56	47	31	47	34	04	30	07	03	17	17
6c. Provide Service to Others	06	33	19	29	13	28	47	38	20	22	03	27	-19
6d. Take Opposing Position	15	17	58	13	25	41	18	-11	30	40	04	12	28
6e. Work/Contribute To Team	33	53	55	34	12	08	01	01	03	-16	05	22	28
6f. Deal With Public	05	33	23	57	35	18	45	07	06	37	19	33	20
6g. Coordinate/Lead Activity	38	23	62	31	35	35	20	05	17	07	08	42	30
7. Health/Safety of Others	02	07	21	03	13	-44	-44	-40	-53	-29	-42	24	31
8. Responsible Others' Work	03	20	46	14	27	03	07	06	-13	-17	-23	21	24
9. Conflict Situations	31	31	49	29	19	25	16	-15	07	14	05	47	19
10. Unpleasant Individuals	20	21	11	35	27	14	27	08	02	37	09	52	08
11. Physical Aggression	25	22	23	08	16	-10	03	-16	-23	08	-15	58	21

Table 7-9a (continued)

Intercorrelations of Descriptors (Occupation Level Data): Work Context-- Interpersonal Relationships

Descriptor	4.	5.	6a.	6b.	6c.	6d.	6e.	6f.	6g.	7.	8.	9.	10.	11.
4. Social Interaction	--													
5. Privacy of Communication	03	--												
6. Job Interactions														
6a. Supervise/Develop Others	27	27	--											
6b. Persuade or Influence	19	35	49	--										
6c. Provide Service to	35	07	47	56	--									
6d. Take Opposing Position	-01	45	59	70	25	--								
6e. Work/Contribute To Team	23	29	41	25	18	21	--							
6f. Deal With Public	60	-04	23	56	55	19	15	--						
6g. Coordinate/Lead Activity	24	26	72	62	30	59	36	36	--					
7. Health/Safety of Others	07	-05	32	-06	-18	17	14	-08	35	--				
8. Responsible Others' Work	13	36	66	43	31	57	23	22	61	53	--			
9. Conflict Situations	34	07	28	42	12	35	25	43	32	26	34	--		
10. Unpleasant Individuals	53	-23	13	20	27	-09	04	53	13	21	00	71	--	
11. Physical Aggression	27	-03	22	01	-08	06	15	24	20	61	25	67	71	--

Note. N = 37. All correlations calculated based on the mean of ratings assigned on a given occupation and descriptor. Decimals are omitted.

Table 7-9b

Intercorrelations of Descriptors (Occupation Level Data): Work Context--Physical Work Conditions

Descriptor	12.	12b.	12c.	12d.	12e.	12f.	13.	14.	15a.	15b.	15c.	15d.	15e.	15f	16a.	16b.	16c.
12. Work Settings																	
12a. Indoors, Controlled	--																
12b. Indoors, Uncontrolled	-07	--															
12c. Outdoors, Exposed	-81	30	--														
12d. Outdoors, Covered	-55	52	77	--													
12e. Open Vehicle/Equip.	-77	19	71	46	--												
12f. Enclosed Vehicle/Equip.	-70	25	87	73	54	--											
13. Privacy of Work Area	16	-01	-16	-06	-24	05	--										
14. Physical Proximity	-25	-18	16	-06	28	08	-22	--									
15. Environmental Conditions																	
15a. Distracting Noise	-47	44	56	40	64	48	21	06	--								
15b. Extreme Temperature	-77	45	82	74	75	72	-34	12	70	--							
15c. Poor Lighting	-79	27	84	73	75	80	-25	26	58	89	--						
15d. Contaminants	-43	51	48	41	59	38	-32	18	63	62	50	--					
15e. Cramped Work Space	-57	44	68	64	72	56	-33	36	53	79	79	71	--				
15f. Whole Body Vibration	-79	09	72	54	82	61	-19	26	55	74	76	53	69	--			
16. Radiation																	
16a. Exposure	05	34	04	07	20	02	10	04	13	10	16	26	33	12	--		
16b. Likelihood of Injury	-26	33	41	39	44	30	-08	16	28	37	47	29	47	29	68	--	
16c. Extent of Injury	-48	15	61	49	60	49	-14	13	24	52	62	27	59	42	40	79	--
17. Diseases/Infections																	
17a. Exposure	01	-23	03	-07	-14	-01	-20	56	-31	-13	-04	15	16	-17	02	07	10
17b. Likelihood of Injury	-04	-10	14	06	-06	08	-17	55	-23	-01	10	18	25	-13	01	19	26
17c. Extent of Injury	-04	-10	08	04	-04	06	-21	49	-30	-03	07	17	24	-12	02	11	18
18. High Places																	
18a. Exposure	-54	41	60	55	83	44	-26	14	54	72	63	49	73	61	28	50	64
18b. Likelihood of Injury	-48	42	64	58	72	48	-23	20	43	68	64	46	74	51	34	62	75
18c. Extent of Injury	-52	44	68	62	78	54	-17	10	52	71	63	52	71	55	24	55	69

Table 7-9b (continued)

Intercorrelations of Descriptors (Occupation Level Data): Work Context--Physical Work Conditions

Descriptor	17a.	17b.	17c.	18a.	18b.	18c.	19a.	19b.	19c.	20a.	20b.	20c.	21a.	21b.	21c.		
19. Hazardous Conditions																	
19a. Exposure	-45	37	45	43	64	37	-36	29	42	61	56	78	77	60	41	41	40.
19b. Likelihood of Injury	-51	36	59	56	67	50	-36	29	42	70	68	73	83	63	63	52	56
19c. Extent of Injury	-64	24	68	54	80	57	-31	39	46	73	74	69	85	71	31	56	67
20. Hazardous Equipment																	
20a. Exposure	-52	59	61	57	72	53	-31	06	70	79	68	76	73	63	25	40	44
20b. Likelihood of Injury	-48	55	58	55	58	53	-32	07	55	70	67	68	68	52	17	40	47
20c. Extent of Injury	-53	54	62	60	61	56	-35	13	48	73	73	63	70	55	18	42	50
21. Hazardous Situations																	
21a. Exposure	-41	50	49	39	53	32	-45	26	59	68	54	65	68	44	10	30	39
21b. Likelihood of Injury	-43	45	48	39	49	33	-45	30	46	61	54	60	62	38	-03	25	38
21c. Extent of Injury	-42	47	51	46	46	39	-38	26	43	62	59	63	66	41	10	37	46
22. Body Positioning																	
22a. Sitting	10	-19	-15	-10	-23	14	49	-44	-11	-24	-08	-23	-33	-15	06	-18	-22
22b. Standing	-06	18	12	04	19	20	-53	43	10	18	04	26	30	13	00	17	20
22c. Climbing Ladders, etc.	-42	48	51	44	72	31	-23	12	53	65	54	52	76	59	37	45	53
22d. Walking or Running	-22	14	26	20	24	-04	-36	40	04	22	12	28	32	17	-07	19	29
22e. Kneeling or Crouching	-23	08	29	13	30	00	-41	40	07	23	11	25	44	26	02	15	33
22f. Keeping/Regaining Balance	-46	08	45	29	58	18	-34	51	27	47	40	36	60	53	17	45	57
22g. Handling Tools, Objects	-40	07	26	24	40	13	-71	21	31	47	41	49	54	43	00	21	29
22h. Bending/Twisting Body	-32	20	36	32	36	09	-54	36	21	42	31	35	51	35	-03	31	40
22i. Making Repetitive Motions	-22	-16	-09	-09	14	-22	-54	18	08	14	12	17	20	21	00	04	08
23. Work Attire																	
23a. Business/Office Clothes	47	-27	-34	-31	-37	-14	54	-25	-23	-51	-32	-54	-52	-36	04	00	-16
23b. Special Uniform	-23	03	23	27	03	27	-26	44	-13	20	29	25	36	-03	-06	16	27

Table 7-9b (continued)

Intercorrelations of Descriptors (Occupation Level Data): Work Context--Physical Work Conditions

Descriptor	17a.	17b.	17c.	18a.	18b.	18c.	19a.	19b.	19c.	20a.	20b.	20c.	21a.	21b.	21c.		
23c. Maintenance Clothes	-43	50	43	47	53	24	-52	-06	56	64	43	69	55	48	-01	17	25
23d. Common Safety Attire	-39	61	41	42	50	35	-22	25	43	54	42	82	70	43	31	31	30
23e. Special Safety Attire	-55	34	61	56	81	48	-20	20	51	67	61	65	71	56	29	44	62

Table 7-9b (continued)
Intercorrelations of Descriptors (Occupation Level Data): Work Context--Physical Work Conditions

Descriptor	17a.	17b.	17c.	18a.	18b.	18c.	19a.	19b.	19c.	20a.	20b.	20c.	21a.	21b.	21c.
17. Diseases/Infections															
17a. Exposure	--														
17b. Likelihood of Injury	94	--													
17c. Extent of Injury	90	93	--												
18. High Places															
18a. Exposure	-20	-09	-07	--											
18b. Likelihood of Injury	-05	11	07	92	--										
18c. Extent of Injury	-13	03	03	94	94	--									
19. Hazardous Conditions															
19a. Exposure	22	27	40	56	54	56	--								
19b. Likelihood of Injury	21	31	38	63	67	67	95	--							
19c. Extent of Injury	20	32	37	72	74	76	89	95	--						
20. Hazardous Equipment															
20a. Exposure	-18	-04	00	69	61	70	77	80	77	--					
20b. Likelihood of Injury	-04	16	19	54	55	62	75	80	75	93	--				
20c. Extent of Injury	01	21	26	59	60	65	74	80	77	88	97	--			
21. Hazardous Situations															
21a. Exposure	05	18	16	50	50	49	65	70	66	82	83	76	--		
21b. Likelihood of Injury	16	32	31	42	44	45	62	68	64	76	84	80	95	--	
21c. Extent of Injury	23	40	39	40	45	46	68	73	69	77	88	87	91	95	--
22. Body Positioning															
22a. Sitting	-21	-23	-14	-34	-38	-27	-20	-25	-26	-25	-20	-18	-57	-54	-42
22b. Standing	26	27	17	26	33	20	22	24	24	24	21	19	56	55	44
22c. Climbing Ladders, etc.	-25	-17	-15	88	83	80	56	60	65	68	51	51	57	43	42
22d. Walking or Running	28	27	18	32	38	27	13	20	25	16	10	10	43	42	35
22e. Kneeling or Crouching	32	28	16	43	47	34	15	20	28	13	04	08	33	27	22
22f. Keeping/Regaining Balance	19	20	11	61	63	52	39	47	57	37	26	28	53	46	43

Table 7-9b (continued)

Intercorrelations of Descriptors (Occupation Level Data): Work Context--Physical Work Conditions

Descriptor	17a.	17b.	17c.	18a.	18b.	18c.	19a.	19b.	19c.	20a.	20b.	20c.	21a.	21b.	21c.
22g. Handling Tools, Objects	10	09	12	39	36	30	54	56	53	49	48	46	61	58	52
22h. Bending/Twisting Body	18	20	16	46	51	39	24	36	37	30	25	27	52	49	44
22i. Making Repetitive Motions	09	04	04	09	05	-04	26	21	20	13	14	15	27	27	21
23. Work Attire															
23a. Business/Office Clothes	-26	-24	-29	-31	-22	-24	-56	-53	-47	-54	-50	-47	-69	-68	-61
23b. Special Uniform	72	77	73	03	14	09	29	35	36	13	29	36	27	40	44
23c. Maintenance Clothes	-17	-11	-09	58	51	54	60	61	52	73	66	61	70	66	58
23d. Common Safety Attire	25	31	39	48	44	50	82	74	71	78	76	75	72	71	76
23e. Special Safety Attire	12	20	20	79	71	79	66	68	75	69	56	60	50	48	52

Table 7-9b (continued)

Intercorrelations of Descriptors (Occupation Level Data): Work Context--Physical Work Condition

Descriptor	22a.	22b.	22c.	22d.	22e.	22f.	22g.	22h.	22i.	23a.	23b.	23c.	23d.	23e.
22. Body Positioning														
22a. Sitting	--													
22b. Standing	-97	--												
22c. Climbing Ladders, etc.	-42	36	--											
22d. Walking or Running	-83	80	40	--										
22e. Kneeling or Crouching	-73	72	49	76	--									
22f. Keeping/Regaining Balance	-76	72	65	79	81	--								
22g. Handling Tools, Objects	-51	52	43	42	39	53	--							
22h. Bending/Twisting Body	-82	79	49	79	84	86	62	--						
22i. Making Repetitive Motions	-35	40	10	22	28	32	78	41	--					
23. Work Attire														
23a. Business/Office Clothes	50	-51	-34	-48	-43	-47	-62	-50	-40	--				
23b. Special Uniform	-19	20	-15	20	23	18	30	26	25	-41	--			
23c. Maintenance Clothes	-42	43	61	37	31	42	69	52	34	-68	03	--		
23d. Common Safety Attire	-29	30	50	27	26	36	42	30	15	-63	41	56	--	
23e. Special Safety Attire	-25	21	60	29	36	54	27	38	05	43	27	47	64	--

Note. N = 37. All correlations calculated based on the mean of ratings assigned on a given occupation and descriptor. Decimals are omitted.

Table 7-9c

Intercorrelations of Descriptors (Occupation Level Data): Work Context- Structural Job Characteristics

Descriptor	24	25a.	25b.	26	27	28	29	30	31	32	33	34	35	36	37	38	39
24. Consequence of Error	--																
25. Impact of Decisions																	
25a. Level of Decisions	74	--															
25b. Frequency of Decisions	55	85	--														
26. Accountable for Results	67	75	71	--													
27. Decision Latitude	59	65	57	73	--												
28. Frustrating Circumstances	52	54	52	70	77	--											
29. Level of Automation	30	33	25	32	23	24	--										
30. Task/Performance Clarity	02	-08	-18	-16	-36	-37	05	--									
31. Accuracy/Exactness	34	33	27	26	19	06	55	27	--								
32. Details and Completeness	35	35	37	34	10	07	55	25	90	--							
33. Constant Awareness	54	48	63	43	39	22	16	02	36	45	--						
34. Repetitive Activities	13	02	16	-01	-15	-25	44	40	54	57	37	--					
35. Unstructured Tasks/Goals	-08	09	-06	-03	17	11	-46	-21	-38	-42	-27	-68	--				
36. Level of Competition	17	08	16	41	36	30	-05	-29	00	08	32	-12	09	--			
37. Deadlines/Time Pressure	42	11	12	46	23	21	17	13	36	30	26	25	-32	39	--		
38. Work With Distractions	33	39	47	52	45	53	35	22	41	47	27	08	00	10	29	--	
39. Machine Driven Pace	27	02	07	28	07	17	49	15	45	50	25	59	-63	27	66	26	--

Note. N = 37. All correlations calculated based on the mean of ratings assigned on a given job and descriptor. Decimals are omitted.

Table 7-10a

Intercorrelations of Descriptors (Individual Level Data): Work Context-- Interpersonal Relationships

Descriptor	1.	2a.	2b.	2c.	2d.	2e.	2f.	2g.	2h.	2i.	2j.	2k.	3.
1. Communication Formality	--												
2. Communication Methods													
2a. Face-to-Face Individuals	05	--											
2b. Face-to-Face Groups	06	21	--										
2c. Public Speaking	01	10	36	--									
2d. Video Conference	-15	10	36	23	--								
2e. Voice Mail	26	01	24	-03	11	--							
2f. Telephone	27	23	15	05	15	45	--						
2g. Interactive Computer	29	-01	-02	09	11	27	31	--					
2h. Electronic Mail	30	03	11	01	00	70	38	37	--				
2I. Handwritten Notes	25	21	06	02	11	33	55	27	30	--			
2j. Letters and Memos	31	04	10	04	30	41	47	35	33	53	--		
2k. Written Reports	32	-01	20	02	24	07	13	17	16	18	34	--	
3. Communication Subjectivity	07	15	19	23	15	11	-05	01	10	00	04	03	--
4. Social Interaction	10	41	07	18	-05	-03	22	-08	-05	21	06	-02	16
5. Privacy of Communication	12	10	23	15	08	25	21	05	30	12	21	06	01
6. Job Interactions													
6a. Supervise/Develop Others	19	05	12	07	02	11	03	10	15	01	-05	09	15
6b. Persuade or Influence	07	02	33	29	06	30	16	-05	19	03	12	12	08
6c. Provide Service to Others	10	08	13	11	08	11	33	17	15	15	09	15	00
6d. Take Opposing Position	15	09	24	13	10	29	17	14	27	02	17	24	24
6e. Work/Contribute To Team	24	11	22	18	-02	02	07	06	06	04	04	09	27
6f. Deal With Public	24	12	12	27	11	06	26	16	06	13	16	25	18
6g. Coordinate/Lead Activity	23	19	20	26	08	16	14	13	14	12	19	17	11
7. Health/Safety of Others	02	10	11	02	14	-31	-31	-06	-25	-12	-10	23	23
8. Responsible Others' Work	13	13	08	00	10	07	05	07	04	05	08	12	10
9. Conflict Situations	27	09	14	05	06	16	10	11	08	15	07	24	23
10. Unpleasant Individuals	22	04	00	08	07	12	13	13	07	22	15	22	08
11. Physical Aggression	14	08	17	03	17	-07	-12	-05	-12	08	-03	32	11

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Table 7-10a (continued)

Intercorrelations of Descriptors (Individual Level Data): Work Context--Interpersonal Relationships

Descriptor	4.	5.	6a.	6b.	6c.	6d.	6e.	6f.	6g.	7.	8.	9.	10.	11.
5. Privacy of Communication	02	--												
6. Job Interactions														
6a. Supervise/Develop Others	23	-04	--											
6b. Persuade or Influence	05	10	26	--										
6c. Provide Service to Others	20	05	22	39	--									
6d. Take Opposing Position	02	10	35	45	27	--								
6e. Work/Contribute To Team	22	06	30	31	22	40	--							
6f. Deal With Public	21	03	18	36	45	29	26	--						
6g. Coordinate/Lead Activity	21	06	44	46	31	48	37	38	--					
7. Health/Safety of Others	15	-05	21	-05	03	14	16	01	22	--				
8. Responsible Others' Work	16	-02	52	22	13	30	15	13	35	39	--			
9. Conflict Situations	16	-04	24	16	19	26	38	30	22	25	24	--		
10. Unpleasant Individuals	18	-03	13	12	18	08	21	29	14	18	09	59	--	
11. Physical Aggression	04	-11	07	-01	01	19	23	12	16	37	08	49	43	--

Note. N = 148 (4 incumbents selected at random from each of 37 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation and descriptor. Decimals are omitted.

Table 7-10b

Intercorrelations of Descriptors (Individual Level Data): Work Context--Physical Work Conditions

Descriptor	12a.	12b.	12c.	12d.	12e.	12f.	13.	14.	15a.	15b.	15c.	15d.	15e.	15f.	16a.	16b.	16c.
12. Work Settings																	
12a. Indoors, Controlled	--																
12b. Indoors, Uncontrolled	08	--															
12c. Outdoors, Exposed	-47	19	--														
12d. Outdoors, Covered	-10	31	50	--													
12e. Open Vehicle/Equip.	-27	17	44	39	--												
12f. Enclosed Vehicle/Equip.	-40	15	61	38	33	--											
13. Privacy of Work Area	-05	01	-02	05	-02	25	--										
14. Physical Proximity	07	00	11	16	15	04	-18	--									
15. Environmental Conditions																	
15a. Distracting Noise	-02	33	22	19	23	17	-12	22	--								
15b. Extreme Temperature	-34	31	54	30	37	41	-12	17	41	--							
15c. Poor Lighting	-40	11	51	32	42	51	00	20	29	57	--						
15d. Contaminants	-07	25	18	21	31	25	-04	17	38	41	40	--					
15e. Cramped Work Space	-11	23	35	33	35	26	-21	31	46	46	42	49	--				
15f. Whole Body Vibration	-49	-01	41	25	69	34	-04	21	27	47	40	35	34	--			
16. Radiation																	
16a. Exposure	01	31	10	16	38	08	06	12	15	14	21	18	24	30	--		
16b. Likelihood of Injury	01	20	24	15	30	09	00	07	09	20	16	12	22	27	60	--	
16c. Extent of Injury	-04	17	22	15	32	09	03	01	06	24	22	01	27	31	46	61	--
17. Diseases/Infections																	
17a. Exposure	10	-01	12	05	04	03	-27	33	11	08	16	17	25	01	01	08	09
17b. Likelihood of Injury	08	06	16	13	10	13	-24	32	11	13	19	23	37	09	09	15	11
17c. Extent of Injury	06	-02	09	11	10	10	-18	27	04	09	12	18	31	08	04	09	12
18. High Places																	
18a. Exposure	-18	23	29	28	49	31	-08	13	40	48	28	37	39	51	20	14	19
18b. Likelihood of Injury	-19	27	41	27	42	29	-13	08	29	48	29	29	56	47	32	30	38
18c. Extent of Injury	-11	30	29	25	31	21	-11	13	32	30	19	21	46	30	28	26	36

Table 7-10b (continued)

Intercorrelations of Descriptors (Individual Level Data): Work Context - Physical Work Conditions

Descriptor	12a.	12b.	12c.	12d.	12e.	12f.	13.	14.	15a.	15b.	15c.	15d.	15e.	15f.	16a.	16b.	16c.
19. Hazardous Conditions																	
19a. Exposure	-11	21	30	18	41	27	-09	23	22	28	29	50	42	43	24	14	11
19b. Likelihood of Injury	-13	27	38	30	42	39	-13	29	25	33	37	44	49	45	24	18	21
19c. Extent of Injury	-21	22	44	25	47	44	-04	21	23	36	32	35	46	52	26	21	29

Table 7-10b (continued)

Intercorrelations of Descriptors (Individual Level Data): Work Context-- Physical Work Conditions

Descriptor	12a.	12b.	12c.	12d.	12e.	12f.	13.	14.	15a.	15b.	15c.	15d.	15e.	15f.	16a.	16b.	16c.
20. Hazardous Equipment																	
20a. Exposure	-22	29	41	37	46	41	-05	16	42	49	40	49	41	48	27	13	11
20b. Likelihood of Injury	-17	31	42	34	35	42	-05	12	35	45	38	50	41	37	23	13	10
20c. Extent of Injury	-16	28	39	36	27	36	-05	14	29	41	38	36	41	33	27	16	17
21. Hazardous Situations																	
21a. Exposure	-10	25	38	32	33	18	-24	23	38	50	30	45	42	38	15	22	18
21b. Likelihood of Injury	-03	26	29	25	30	20	-24	21	38	52	25	51	48	28	13	22	15
21c. Extent of Injury	-02	26	21	35	13	16	-20	17	33	34	20	32	41	20	09	11	16
22. Body Positioning																	
22a. Sitting	03	-22	-17	-19	-21	10	45	-20	-18	-18	-01	-15	-17	-17	04	-05	01
22b. Standing	05	08	09	08	11	-19	-34	26	18	15	-01	21	19	15	-06	03	00
22c. Climbing Ladders, etc.	-24	10	26	12	48	19	-09	08	20	37	30	34	33	56	26	23	16
22d. Walking or Running	-03	18	20	16	13	-10	-32	23	11	17	04	24	16	14	04	13	14
22e. Kneeling or Crouching	-06	08	16	06	20	-06	-22	20	20	22	19	25	27	28	05	10	17
22f. Keeping/Regaining Balance	-16	10	20	12	31	05	-14	09	16	32	40	28	25	36	11	16	21
22g. Handling Tools, Objects	-05	01	14	06	12	01	-20	10	10	20	19	21	20	17	-05	01	03
22h. Bending/Twisting Body	-09	05	24	19	18	01	-29	20	31	38	28	32	40	29	03	21	19
22i. Making Repetitive Motions	07	-06	00	-08	02	-18	-21	13	05	07	06	19	22	08	02	08	03
23. Work Attire																	
23a. Business/Office Clothes	22	-12	-26	-12	-20	-02	37	-07	-11	-25	-20	-14	-20	-15	12	06	02
23b. Special Uniform	-08	06	19	18	-02	22	-15	19	04	10	22	12	19	04	-04	03	07
23c. Maintenance Clothes	-09	25	25	24	42	10	-23	09	27	38	25	42	35	38	09	12	10
23d. Common Safety Attire	-13	39	31	29	32	29	-13	03	27	44	29	55	38	32	19	09	12
23e. Special Safety Attire	-26	15	31	22	45	30	-08	12	15	35	29	33	37	42	14	11	14

Table 7-10b (continued)
Intercorrelations of Descriptors (Individual Level Data): Work Context--Physical Work Conditions

Descriptors	17a.	17b.	17c.	18a.	18b.	18c.	19a.	19b.	19c.	20a.	20b.	20c.	21a.	21b.	21c.
17. Diseases/Infections															
17a. Exposure	--														
17b. Likelihood of Injury	81	--													
17c. Extent of Injury	71	82	--												
18. High Places															
18a. Exposure	-06	02	-02	--											
18b. Likelihood of Injury	13	24	11	69	--										
18c. Extent of Injury	05	20	17	63	70	--									
19. Hazardous Conditions															
19a. Exposure	29	44	39	35	39	32	--								
19b. Likelihood of Injury	37	58	49	34	44	43	82	--							
19c. Extent of Injury	30	47	48	37	48	49	71	79	--						
20. Hazardous Equipment															
20a. Exposure	00	19	13	52	48	37	52	51	48	--					
20b. Likelihood of Injury	12	34	28	32	38	33	55	62	58	86	--				
20c. Extent of Injury	12	36	36	33	41	45	44	57	60	71	83	--			
21. Hazardous Situations															
21a. Exposure	18	31	17	43	44	30	35	41	38	60	59	51	--		
21b. Likelihood of Injury	25	40	30	37	43	29	37	43	43	57	64	54	85	--	
21c. Extent of Injury	27	42	39	24	35	35	29	43	43	50	60	63	65	76	--
22. Body Positioning															
22a. Sitting	-15	-08	-05	-20	-11	-07	-10	-11	-07	-19	-10	-11	-33	-28	-18
22b. Standing	13	07	04	17	11	01	12	06	06	16	09	07	36	34	20
22c. Climbing Ladders, etc.	-01	02	00	53	43	30	33	27	31	43	32	28	28	21	14
22d. Walking or Running	23	12	12	21	20	18	09	12	07	10	06	09	27	23	18
22e. Kneeling or Crouching	23	18	07	30	24	22	21	21	19	13	07	03	23	18	15
22f. Keeping/Regaining Balance	14	16	10	34	27	18	18	24	22	19	15	10	25	23	14

Table 7-10b (continued)

Intercorrelations of Descriptors (Individual Level Data): Work Context--Physical Work Conditions

Descriptors	17a.	17b.	17c.	18a.	18b.	18c.	19a.	19b.	19c.	20a.	20b.	20c.	21a.	21b.	21c.
22g. Handling Tools, Objects	13	16	12	24	18	17	20	22	26	20	21	18	35	34	24
22h. Bending/Twisting Body	36	32	16	32	35	26	13	24	22	19	18	17	40	44	35
22i. Making Repetitive Motions	18	18	17	09	10	03	06	08	08	-02	07	06	10	16	12
23. Work Attire															
23a. Business/Office Clothes	-24	-23	-20	-13	-14	-10	-28	-25	-27	-29	-29	-22	-31	-34	-23
23b. Special Uniform	41	43	46	07	10	16	17	27	30	21	24	32	14	21	32
23c. Maintenance Clothes	-03	05	-01	51	42	34	35	30	28	54	42	39	48	45	27
23d. Common Safety Attire	13	24	24	32	34	29	47	42	41	62	57	49	50	53	43
23e. Special Safety Attire	02	05	00	54	55	40	29	30	27	41	28	25	31	28	17

Table 7-10b (continued)

Intercorrelations of Descriptors (Individual Level Data): Work Context--Physical Work Conditions

Descriptor	22a.	22b.	22c.	22d.	22e.	22f.	22g.	22h.	22i.	23a.	23b.	23c.	23d.	23e.
22. Body Positioning														
22a. Sitting	--													
22b. Standing	-75	--												
22c. Climbing Ladders, etc.	-19	19	--											
22d. Walking or Running	-50	55	28	--										
22e. Kneeling or Crouching	-35	44	43	48	--									
22f. Keeping/Regaining Balance	-22	30	39	38	59	--								
22g. Handling Tools, Objects	-22	29	17	23	34	24	--							
22h. Bending/Twisting Body	-36	43	35	43	67	56	42	--						
22i. Making Repetitive Motions	00	23	13	22	32	29	49	39	--					
23. Work Attire														
23a. Business/Office Clothes	37	-32	-13	-24	-27	-22	-26	-27	-19	--				
23b. Special Uniform	-10	11	00	15	17	17	27	31	19	-27	--			
23c. Maintenance Clothes	-38	34	47	27	26	20	32	28	17	-34	-02	--		
23d. Common Safety Attire	-29	22	31	24	18	18	21	21	02	-39	28	46	--	
23e. Special Safety Attire	-11	04	49	14	27	28	15	26	00	-16	02	41	38	--

Note. N = 148 (4 incumbents selected at random from each of 37 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation and descriptor. Decimals are omitted.

Table 7-10c

Intercorrelations of Descriptors (Individual Level Data): Work Context--Structural Occupation Characteristics

Descriptor	24.	25a.	25b.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.
24. Consequence of Error	--																
25. Impact of Decisions																	
25a. Level of Decisions	39	--															
25b. Frequency of Decisions	21	59	--														
26. Accountable for Results	35	53	50	--													
27. Decision Latitude	07	24	26	41	--												
28. Frustrating Circumstances	27	33	32	35	16	--											
29. Level of Automation	15	12	04	23	11	36	--										
30. Task/Performance Clarity	01	19	04	10	12	-09	06	--									
31. Accuracy/Exactness	31	19	13	29	06	04	25	31	--								
32. Details and Completeness	29	19	24	30	06	12	22	24	81	--							
33. Constant Awareness	32	20	22	27	09	23	11	-05	24	26	--						
34. Repetitive Activities	15	08	04	12	-04	14	26	10	26	31	39	--					
35. Unstructured Tasks/Goals	-03	18	01	10	15	14	-09	13	-04	-03	03	-10	--				
36. Level of Competition	13	16	13	24	06	19	06	-06	08	03	23	09	20	--			
37. Deadlines/Time Pressure	16	12	18	26	11	24	10	16	14	21	23	27	-04	26	--		
38. Work With Distractions	17	20	23	20	00	35	05	01	05	16	09	13	12	02	33	--	
39. Machine Driven Pace	17	07	10	22	12	25	49	08	27	25	20	46	-10	24	47	26	--

Note. N = 148 (4 incumbents selected at random from each of 37 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation and descriptor. Decimals are omitted.

Table 7-11a
Principal Components Analysis Pattern Matrix: Work Context

Descriptor	F1	F2	F3	F4	F5	F6	F7	Communality
		Factors						
1. Communication Formality	-.02	-.23	.28	-.10	.51	.45	-.15	.63
2. Communication Methods								
2a. Face-to-Face Individuals	-.03	.33	.33	.22	.35	.18	.19	.46
2b. Face-to-Face Groups	.15	.01	.73	-.14	.27	.16	.09	.68
2c. Public Speaking	-.05	.13	.30	-.01	.15	.01	.71	.63
2d. Video Conference	-.09	.10	.26	-.15	-.03	.13	.53	.41
2e. Voice Mail	.02	-.64	.46	-.14	.37	-.19	.04	.81
2f. Telephone	-.11	-.41	.20	.07	.59	-.02	.24	.63
2g. Interactive Computer	-.27	-.28	.10	.35	.29	.06	.10	.38
2h. Electronic Mail	-.18	-.56	.35	-.06	.27	-.20	-.09	.59
2i. Handwritten Notes	-.07	-.47	-.11	-.16	.56	.12	.28	.67
2j. Letters and Memos	-.23	-.42	-.02	-.22	.58	-.08	.13	.64
2k. Written Reports	.35	-.20	.24	.14	.18	.67	.16	.74
3. Communication Subjectivity	-.04	.29	.20	-.57	.17	.07	.20	.53
4. Social Interaction	-.05	.16	.06	.00	.52	.22	.55	.65
5. Privacy of Communication	.21	.22	.66	-.03	-.19	.20	.13	.62
6. Job Interactions								
6a. Supervise/Develop Others	.09	.12	.68	-.09	.04	.20	.07	.55
6b. Persuade or Influence	.03	-.11	.76	-.08	.06	-.17	.46	.84
6c. Provide Service to Others	.05	.01	.41	.51	.25	-.01	.43	.67
6d. Take Opposing Position	.05	-.12	.78	-.27	-.11	-.07	.04	.72
6e. Work/Contribute To Team	-.05	.42	.46	.18	.20	.20	.00	.50
6f. Deal With Public	.07	-.04	.20	.09	.26	.08	.81	.79
6g. Coordinate/Lead Activity	.13	.12	.71	-.22	.09	.18	.22	.67
7. Health/Safety of Others	.43	.45	.10	-.33	-.36	.50	.02	.88
8. Responsible Others' Work	.21	.22	.66	-.03	-.19	.20	.13	.62
9. Conflict Situations	.51	-.16	.33	-.21	.23	.30	.30	.67
10. Unpleasant Individuals	.34	-.07	-.08	-.15	.31	.45	.53	.73
11. Physical Aggression	.43	.13	.04	-.27	.05	.70	.13	.79
12. Work Settings								
12a. Indoors, Controlled	-.79	-.09	.06	.00	.02	-.21	-.09	.69
12b. Indoors, Uncontrolled	.36	-.02	.30	-.22	-.48	-.17	-.10	.54
12c. Outdoors, Exposed	.86	.06	.01	-.21	-.04	.27	.20	.91
12d. Outdoors, Covered	.72	-.07	.13	-.11	-.22	.09	.26	.67
12e. Open Vehicle/Equip.	.87	.22	.17	.08	.10	.00	-.16	.88
12f. Enclosed Vehicle/Equip.	.77	-.27	.09	-.11	-.08	.26	.37	.90
13. Privacy of Work Area	-.23	-.53	.49	-.28	.25	.04	-.02	.72
14. Physical Proximity	.12	.52	.06	.20	.14	.53	.03	.63
15. Environmental Conditions								
15a. Distracting Noise	.72	.00	-.08	-.02	-.21	-.12	-.09	.59

Table 7-11a (continued)
Principal Components Analysis Pattern Matrix: Work Context

Descriptor	F1	F2	F3	F4	F5	F6	F7	Communality
15b. Extreme Temperature	.91	.10	-.01	-.05	-.26	.01	.10	.91
15c. Poor Lighting	.91	-.02	-.02	.10	-.08	.18	.18	.91
15d. Contaminants	.59	.16	.10	.17	-.52	.12	-.23	.74
15e. Cramped Work Space	.79	.26	.16	.16	-.25	.15	-.05	.83
15f. Whole Body Vibration	.84	.15	.01	.16	.05	.03	-.06	.75
16a. Radiation--Exposure	.22	-.03	.35	.25	.07	-.01	-.45	.44.
17a Diseases/Infections-- Exposure	-.21	.30	-.01	.17	-.12	.81	.02	.84
18a. High Places-- Exposure	.80	.27	.25	-.04	.05	-.22	-.10	.84
19a. Hazardous Conditions-- Exposure	.62	.14	.20	.38	-.35	.20	-.35	.87
20a. Hazardous Equipment-- Exposure	.77	.09	.15	.03	-.42	-.05	-.19	.84
21a. Hazardous Situations-- Exposure	.55	.41	.03	-.05	-.53	.08	-.08	.77
22. Body Positioning								
22a. Sitting	-.09	-.93	-.08	.09	.15	.07	-.11	.93
22b. Standing	.04	.93	.04	-.03	-.21	-.01	.05	.92
22c. Climbing Ladders, etc.	.71	.35	.25	-.09	-.06	-.32	-.27	.87
22d. Walking or Running	.14	.83	.01	-.24	-.11	.06	.02	.78
22e. Kneeling or Crouching	.19	.83	.00	-.20	.01	.07	.02	.76
22f. Keeping/Regain Balance	.47	.79	.13	-.06	.07	.05	-.02	.88
22g. Handling Tools, Objects	.40	.50	-.27	.47	-.38	-.17	.06	.88
22h. Bending/Twisting Body	.34	.82	-.09	-.08	-.12	-.03	.21	.87
22i. Making Repet. Motions	.07	.45	-.37	.60	-.16	-.17	-.04	.76
23. Work Attire								
23a. Business/Office Clothes	-.32	-.47	.13	.02	.61	-.16	.17	.77
23b Special Uniform	.06	.19	.10	.25	-.33	.62	.37	.75
23c. Maintenance Clothes	.55	.30	-.12	.00	-.58	-.27	-.12	.84
23d. Common Safety Attire	.48	.19	.32	.14	-.55	.26	-.28	.83
23e. Special Safety Attire	.72	.21	.28	.00	-.06	.17	-.18	.72
24. Consequence of Error	.36	-.24	.42	.31	-.15	.55	-.17	.81
25. Level of Decisions								
25a. Impact of Decisions	.18	-.32	.56	.25	.15	.54	.08	.82
25b. Frequency of Decisions	.26	-.30	.40	.35	.24	.38	.32	.75
26. Accountable for Results	.20	-.31	.62	.36	-.22	.27	.24	.83
27. Decision Latitude	.31	-.46	.67	.16	-.12	.05	.03	.79
28. Frustrating Circumstances	.40	-.48	.55	.12	-.19	-.01	-.11	.75
29. Level of Automation	-.22	-.25	.20	.72	.02	.03	-.27	.74
30. Task/Performance Clarity	-.12	.20	-.47	.27	.09	.27	-.05	.44

Table 7-11a (continued)
Principal Components Analysis Pattern Matrix: Work Context

	Factors							
Descriptor	F1	F2	F3	F4	F5	F6	F7	Communality
31. Accuracy/Exactness	-.18	-.25	-.02	.68	-.03	.33	-.05	.67
32. Details and Completeness	-.14	-.13	.01	.76	.02	.32	.08	.73
33. Constant Awareness	.43	.11	.17	.41	.00	.47	.27	.69
34. Repetitive Activities	.10	.13	-.40	.80	.13	.10	-.02	.85
35. Unstructured Tasks/Goals	-.05	-.12	.37	-.70	.30	.08	.02	.75
36. Level of Competition	.25	.17	.52	.16	-.25	-.18	.24	.54
37. Deadlines/Time Pressure	.25	-.17	-.02	.37	-.59	.20	.11	.63
38. Work With Distractions	.10	-.54	.14	.41	.09	.09	.14	.53
39. Machine Driven Pace	.32	-.09	-.14	.69	-.36	-.11	-.11	.76
Percent of Variance	23	16	10	8	6	4	3	
Eigenvalue	18.37	12.55	8.05	6.65	4.84	3.25	2.68	

Note. N = 37. The Correlation Matrix was based on means calculated at the occupation level. These loadings are based on an orthoganal varimax rotation. F1 = Environmental Conditions, F2 = Physical Activity and Manual Work, F3 = Managerial/Interpersonal Relations, F4 = Structured/Machine Operations, F5 = Business/Office Environment, F6 = Health and Safety Conditions, F7 = Interacting with Public.

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Table 7-11b
Confirmatory Factor Analysis Pattern Matrix: Work Context

Descriptor	F1	F2	F3	Communality
	Factors			
1. Communication Formality	-.12	.49	.29	.34
2. Communication Methods				
2a. Face-to-Face Individuals	.09	.31	-.01	.10
2b. Face-to-Face Groups	.18	.73	.10	.58
2c. Public Speaking	.00	.49	-.06	.24
2d. Video Conference	.01	.42	-.10	.19
2e. Voice Mail	-.26	.57	.48	.62
2f. Telephone	-.35	.45	.41	.50
2g. Interactive Computer	-.29	.07	.46	.30
2h. Electronic Mail	-.37	.34	.43	.44
2i. Handwritten Notes	-.41	.39	.29	.40
2j. Letters and Memos	-.57	.37	.19	.50
2k. Written Reports	.39	.41	.43	.50
3. Communication Subjectivity	-.07	.51	-.50	.52
4 .Social Interaction	-.12	.45	-.05	.22
5. Privacy of Communication	-.22	.40	.17	.24
6. Job Interactions				
6a. Supervise/Develop Others	.26	.57	.03	.40
6b. Persuade or Influence	.08	.71	.15	.53
6c. Provide Service to Others	.13	.28	.38	.24
6d. Take Opposing Position	.14	.62	.07	.41
6e. Work/Contribute To Team	.17	.28	-.07	.12
6f. Deal With Public	.03	.50	.14	.27
6g. Coordinate/Lead Activity	.25	.72	-.04	.59
7. Health/Safety of Others	.66	.17	-.43	.65
8. Responsible Others' Work	.47	.46	-.02	.43
9. Conflict Situations	.38	.64	.14	.58
10. Unpleasant Individuals	.21	.45	.05	.25
11. Physical Aggression	.48	.38	-.10	.39
12. Work Settings				
12a. Indoors, Controlled	-.72	-.09	.02	.52
12b. Indoors, Uncontrolled	.43	.09	-.11	.21
12c. Outdoors, Exposed	.76	.29	-.10	.67
12d. Outdoors, Covered	.67	.24	.03	.51
12e. Open Vehicle/Equip.	.79	.12	-.05	.65
12f. Enclosed Vehicle/Equip.	.64	.37	.21	.60
13. Privacy of Work Area	-.36	.60	.35	.61
14. Physical Proximity	.35	.07	-.15	.15
15. Environmental Conditions				
15a. Distracting Noise	.62	-.11	-.04	.39

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Table 7-11b (continued)
Confirmatory Factor Analysis Pattern Matrix: Work Context

Descriptor	F1	F2	F3	Communality
	Factors			
15b. Extreme Temperature	.85	.03	-.10	.74
15c. Poor Lighting	.83	.10	.11	.70
15d. Contaminants	.79	-.23	.01	.68
15e. Cramped Work Space	.91	.00	-.03	.82
15f. Whole Body Vibration	.75	.00	.02	.56
16a. Radiation--Exposure	.27	.00	.26	.14
17a. Diseases/Infection--Exposure	.16	-.02	.01	.03
18a. High Places--Exposure	.71	.17	-.19	.57
19a. Hazardous Conditions--Exposure	.83	-.22	.19	.78
20a. Hazardous Equipment--Exposure	.83	-.09	-.04	.70
21a. Hazardous Situations--Exposure	.76	-.17	-.33	.72
22. Body Positioning				
22a. Sitting	-.36	.04	.76	.71
22b. Standing	.35	-.14	-.73	.67
22c. Climbing Ladders, etc.	.66	.06	-.31	.54
22d. Walking or Running	.34	.01	-.76	.69
22e. Kneeling or Crouching	.35	.04	-.72	.65
22f. Keeping/Regaining Balance	.60	.10	-.58	.71
22g. Handling Tools, Objects	.59	-.58	-.20	.73
22h. Bending/Twisting Body	.50	-.07	-.70	.74
22i. Making Repetitive Motions	.24	-.69	-.09	.54
23. Work Attire				
23a. Business/Office Clothes	-.60	.36	.39	.65
23b. Special Uniform	.42	.05	.12	.19
23c. Maintenance Clothes	.65	-.38	-.33	.68
23d. Common Safety Attire	.78	-.08	.04	.62
23e. Special Safety Attire	.77	.18	-.05	.63
24. Consequence of Error	.56	.19	.56	.66
25. Impact of Decisions				
25a. Level of Decisions	.30	.50	.61	.71
25b. Frequency of Decisions	.29	.45	.60	.64
26. Accountable for Results	.41	.36	.60	.66
27. Decision Latitude	.35	.43	.58	.65
28. Frustrating Circumstances	.40	.29	.53	.53
29. Level of Automation	-.06	-.27	.66	.51
30. Task/Performance Clarity	-.06	-.41	-.03	.17

Table 7-11b (continued)
Confirmatory Factor Analysis Pattern Matrix: Work Context

Descriptor	F1	F2	F3	Communality
	Factors			
31. Accuracy/Exactness	.00	-.28	.65	.50
32. Details and Completeness	.07	-.25	.60	.43
33. Constant Awareness	.60	.13	.28	.46
34. Repetitive Activities	.17	-.59	.32	.48
35. Unstructured Tasks/Goals	-.22	.73	-.22	.63
36. Level of Competition	.43	.23	.01	.24
37. Deadlines/Time Pressure	.48	-.29	.35	.44
38. Work With Distractions	.03	.08	.70	.50
39. Machine Driven Pace	.45	-.57	.42	.70
Percent of Variance	23	16	10	
Eigenvalue	18.37	12.55	8.05	

Note. N = 37. The Correlation Matrix was based on means calculated at the occupation level. These loadings are based on an orthoganal varimax rotation., F1 = Physical Work Conditions, F2 = Interpersonal Relationships, F3 = Structural Occupation Characteristics.

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Table 7-12

Descriptor Means and Standard Deviations on Six Example Occupations: Work Context

Descriptor	General Managers & Top Executives (n = 55)		Computer Programmers (n = 9)		Registered Nurses (n = 30)		Police Patrol Officers (n = 25)		Janitors & Cleaners[a] (n = 30)		Maintenance Repairers, General Utility (n = 37)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Communication Formality	4.29	1.54	3.67	2.00	3.64	1.64	5.24	1.81	3.14	1.80	3.78	1.87
2. Communication Methods												
2a. Face-to-Face Individuals	5.36	1.70	5.00	1.66	5.63	1.65	5.80	1.47	4.27	2.07	4.62	1.96
2b. Face-to-Face Groups	2.31	1.20	2.75	1.64	2.73	1.01	2.48	1.56	1.03	1.25	1.68	1.33
2c. Public Speaking	0.85	1.53	0.63	0.70	0.70	1.09	2.08	2.36	0.33	0.80	0.43	0.96
2d. Video Conference	0.22	0.53	0.22	0.44	0.20	0.61	0.56	1.45	0.27	0.52	0.27	0.51
2e. Voice Mail	3.05	2.25	2.22	1.39	0.90	1.58	2.24	2.24	0.27	1.14	0.76	1.61
2f. Telephone	5.53	1.54	2.33	1.58	5.00	1.39	4.56	1.58	2.17	1.84	3.19	2.09
2g. Interactive Computer	1.43	1.74	0.78	1.56	1.47	2.34	2.00	2.40	0.23	0.77	0.65	0.98
2h. Electronic Mail	1.91	1.98	4.67	1.50	1.30	1.68	1.64	1.91	0.31	0.83	0.51	0.96
2i. Handwritten Notes	3.80	1.69	1.78	0.97	3.73	1.55	3.32	1.93	2.03	1.69	2.62	1.48
2j. Letters and Memos	2.91	1.68	1.33	1.32	1.93	1.62	1.92	1.12	2.20	1.83	1.73	1.24
2k. Written Reports	1.96	1.71	1.33	0.87	2.63	2.36	5.04	1.74	1.03	1.59	1.92	1.50
3. Communication Subjectivity	3.36	1.13	2.89	1.17	3.30	1.49	3.24	1.64	3.87	1.98	3.41	1.54
4. Social Interaction	6.00	1.26	3.67	1.22	6.53	0.90	6.52	0.82	3.97	2.20	5.16	1.94
5. Privacy of Communication	5.22	1.29	3.78	1.20	3.86	1.48	3.08	1.89	3.62	2.11	3.22	1.46
6. Job Interactions												
6a. Supervise/Develop Others	4.22	0.71	2.44	1.33	3.77	1.28	3.44	1.36	2.73	1.48	2.46	1.56
6b. Persuade or Influence	3.43	1.26	2.78	1.48	1.83	1.80	1.92	1.96	1.13	1.59	1.16	1.32
6c. Provide Service to Others	4.09	1.09	3.33	1.58	4.13	1.53	4.08	1.35	2.83	1.93	2.50	1.86
6d. Take Opposing Position	2.67	1.44	2.78	1.48	1.97	1.54	2.08	1.85	1.33	1.60	1.57	1.41
6e. Work/Contribute To Team	3.91	0.97	3.89	0.93	4.37	0.76	3.60	1.26	3.30	1.37	3.30	1.37

Table 7-12 (continued)
Descriptor Means and Standard Deviations on Six Example Occupations: Work Context

Descriptor	General Managers & Top Executives (n = 55) M	SD	Computer Programmers (n = 9) M	SD	Registered Nurses (n = 30) M	SD	Police Patrol Officers (n = 25) M	SD	Janitors & Cleaners[a] (n = 30) M	SD	Maintenance Repairers, General Utility (n = 37) M	SD
6f. Deal With Public	3.19	1.68	2.33	1.58	3.70	1.68	4.80	0.41	1.93	1.82	1.33	1.67
6g. Coordinate/Lead Activity	3.81	0.94	2.33	1.58	3.27	1.60	3.28	1.40	2.57	1.33	2.86	1.58
7. Health/Safety of Others	4.18	2.04	0.22	0.44	5.60	1.79	5.96	1.46	5.00	2.03	5.19	1.94
8. Responsible Others' Work	5.53	1.61	3.11	2.67	4.40	2.21	3.68	2.21	3.40	2.37	3.68	2.43
9. Conflict Situations	2.31	0.66	1.78	0.97	2.37	0.61	2.88	0.53	1.57	1.10	1.83	0.96
10. Unpleasant Individuals	2.18	0.75	1.56	0.88	2.40	0.72	3.16	0.62	2.07	1.11	1.97	0.90
11. Physical Aggression	0.95	0.85	0.00	0.00	1.83	0.91	2.80	0.76	1.10	1.12	0.78	0.85
12. Work Settings												
12a. Indoors, Controlled	6.42	1.67	6.22	2.33	6.57	1.33	3.84	2.44	5.10	2.76	5.06	1.94
12b. Indoors, Uncontrolled	1.58	2.23	0.11	0.33	1.07	2.32	1.52	1.94	2.17	2.69	3.81	2.49
12c. Outdoors, Exposed	1.40	1.90	0.00	0.00	1.13	2.13	6.52	0.87	2.50	2.32	4.41	1.94
12d. Outdoors, Covered	0.71	1.40	0.00	0.00	0.73	1.60	3.24	2.71	1.07	1.87	2.89	2.00
12e. Open Vehicle/Equip.	0.09	0.35	0.00	0.00	0.17	0.91	2.08	3.04	0.53	1.14	2.43	2.06
12f. Enclosed Vehicle/Equip	1.82	2.23	0.00	0.00	1.30	2.20	6.40	0.91	0.37	0.89	3.22	1.99
13. Privacy of Work Area	5.38	2.05	3.89	1.27	3.87	2.29	2.88	2.17	1.96	1.73	2.22	1.78
14. Physical Proximity	3.98	1.52	3.00	1.22	5.83	1.21	4.48	1.92	3.80	2.17	5.05	1.58
15. Environmental Conditions												
15a. Distracting Noise	2.58	2.12	1.33	1.66	4.07	2.38	3.80	2.24	2.40	2.55	4.97	2.11
15b. Extreme Temperature	0.96	1.47	0.00	0.00	0.90	1.45	5.08	1.68	3.13	2.40	4.19	2.03
15c. Poor Lighting	0.45	1.00	0.33	1.00	1.10	2.12	4.68	2.72	0.76	1.55	3.11	2.20
15d. Contaminants	1.65	2.30	0.11	0.33	4.03	2.46	3.96	2.24	5.27	1.98	4.11	1.73
15e. Cramped Work Space	0.51	0.94	0.22	0.44	2.00	2.33	2.88	2.44	1.97	2.08	3.58	1.86

Table 7-12 (continued)

Descriptor Means and Standard Deviations on Six Example Occupations: Work Context

Descriptor	General Managers & Top Executives (n = 55)		Computer Programmers (n = 9)		Registered Nurses (n = 30)		Police Patrol Officers (n = 25)		Janitors & Cleaners[a] (n = 30)		Maintenance Repairers, General Utility (n = 37)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
15f. Whole Body Vibration	0.00	0.00	0.00	0.00	0.00	0.00	1.28	2.46	0.43	1.19	1.53	1.61
16. Radiation												
16a. Exposure	0.38	1.43	1.44	2.65	0.73	1.26	0.92	2.1	0.47	1.25	1.65	2.36
16b. Likelihood of Injury	0.22	0.50	0.33	0.50	0.33	0.61	1.16	2.08	0.57	1.48	0.89	1.51
16c. Extent of Injury	0.07	0.26	0.44	1.33	0.00	0.00	1.12	1.96	0.40	1.10	0.57	1.37
17. Diseases/Infections												
17a. Exposure	1.69	2.24	0.00	0.00	5.63	1.71	4.64	1.70	4.30	2.14	2.11	2.38
17b. Likelihood of Injury	1.31	1.71	0.00	0.00	4.07	1.68	4.52	1.56	3.30	1.93	1.54	1.79
17c. Extent of Injury	1.04	1.44	0.00	0.00	2.80	1.54	3.00	1.63	2.37	1.85	1.16	1.52
18 High Places												
18a. Exposure	0.53	1.05	0.00	0.00	0.03	0.18	2.08	1.78	1.70	1.64	3.57	1.52
18b. Likelihood of Injury	0.53	1.07	0.00	0.00	0.10	0.31	2.28	1.99	2.03	1.99	2.73	1.35
18c. Extent of Injury	0.71	1.42	0.00	0.00	0.07	0.25	2.24	1.92	1.67	1.69	2.41	1.38
19. Hazardous Conditions												
19a. Exposure	1.11	1.91	0.33	0.71	1.57	2.22	2.48	1.90	2.67	2.45	3.27	2.10
19b. Likelihood of Injury	0.89	1.34	0.22	0.67	1.03	1.40	2.80	2.31	2.33	2.23	2.73	1.63
19c. Extent of Injury	0.73	1.19	0.11	0.33	0.93	1.28	2.52	1.92	1.57	1.61	1.95	1.65
20. Hazardous Equipment												
20a. Exposure	0.84	1.34	0.00	0.00	0.83	1.82	4.76	1.71	1.37	1.88	4.65	1.83
20b. Likelihood of Injury	0.62	0.91	0.00	0.00	0.53	1.17	4.68	1.80	1.20	1.73	2.81	1.41
20c. Extent of Injury	0.60	1.05	0.00	0.00	0.33	0.71	3.84	1.28	0.97	1.52	2.14	1.49
21. Hazardous Situations												
21a. Exposure	1.16	1.78	0.22	0.67	3.07	2.18	4.16	1.65	2.25	1.94	3.97	1.83

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Table 7-12 (continued)

Descriptor Means and Standard Deviations on Six Example Occupations: Work Context

Descriptor	General Managers & Top Executives (n = 55)		Computer Programmers (n = 9)		Registered Nurses (n = 30)		Police Patrol Officers (n = 25)		Janitors & Cleaners[a] (n = 30)		Maintenance Repairers, General Utility (n = 37)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
21b. Likelihood of Injury	1.05	1.51	0.22	0.67	2.70	1.73	4.24	1.42	2.17	1.91	3.05	1.47
21c. Extent of Injury	0.69	0.98	0.11	0.33	1.53	1.33	2.68	1.49	1.20	1.30	1.35	1.01
22. Body Positioning												
22a. Sitting	3.47	0.96	4.44	0.73	2.37	0.89	3.17	0.90	0.97	0.96	1.43	0.90
22b. Standing	2.05	0.95	1.67	0.71	3.13	1.04	2.52	0.77	4.50	0.82	3.84	1.07
22c. Climbing Ladders, etc.	0.24	0.43	0.00	0.00	0.00	0.00	0.40	0.58	0.97	0.85	1.92	1.09
22d. Walking or Running	1.58	0.90	0.78	0.67	3.10	1.09	2.16	0.99	4.27	1.14	3.00	1.11
22e. Kneeling or Crouching	0.51	0.74	0.33	0.50	1.13	1.07	1.00	0.71	2.40	1.71	2.14	1.18
22f. Keeping/Regaining Balance	0.48	1.07	0.11	0.33	1.20	1.32	0.96	0.98	1.67	1.92	1.57	1.39
22g. Handling Tools, Objects	1.07	1.57	2.22	2.22	2.33	1.63	2.40	1.50	3.57	1.45	3.46	1.30
22h. Bending/Twisting Body	0.75	1.04	0.33	0.50	2.00	1.49	1.92	1.41	3.63	1.52	2.70	1.43
22I. Making Repetitive Motions	1.36	1.38	2.89	2.09	1.93	1.31	2.56	1.42	3.20	1.58	2.65	1.34
23. Work Attire												
23a. Business/Office Clothes	4.18	1.39	1.67	1.80	1.90	2.17	2.36	1.38	0.24	0.68	0.41	1.17
23b. Special Uniform	0.49	1.35	0.00	0.00	3.07	2.30	4.72	0.98	1.33	2.25	0.41	1.38
23c. Maintenance Clothes	0.15	0.56	0.56	1.67	0.13	0.57	0.52	1.23	3.93	2.03	4.50	1.44
23d. Common Safety Attire	1.51	2.00	0.00	0.00	4.73	2.42	5.32	2.67	4.31	2.39	4.92	2.30
23e. Special Safety Attire	0.51	1.27	0.22	0.67	1.33	2.06	3.48	3.28	1.52	2.25	2.49	2.14
24. Consequence of Error	4.24	1.86	3.33	1.12	5.79	1.69	5.48	1.90	2.30	1.73	4.11	1.95
25. Decision-Making												
25a. Impact of Decisions	5.80	0.97	3.89	1.27	5.20	1.42	6.12	1.51	3.37	1.96	3.78	1.64
25b. Frequency of Decisions	5.04	1.40	3.11	1.76	5.07	1.51	5.76	1.94	2.53	2.54	2.14	1.93
26. Accountable for Results	6.13	0.96	5.33	1.41	5.73	1.46	5.92	1.58	4.24	2.08	4.76	1.75

Table 7-12 (continued)
Descriptor Means and Standard Deviations on Six Example Occupations: Work Context

Descriptor	General Managers & Top Executives (n = 55)		Computer Programmers (n = 9)		Registered Nurses (n = 30)		Police Patrol Officers (n = 25)		Janitors & Cleaners[a] (n = 30)		Maintenance Repairers, General Utility (n = 37)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
27. Decision Latitude	5.55	0.94	4.22	1.39	4.77	0.94	5.28	1.06	3.67	1.65	4.19	1.51
28. Frustrating Circumstances	4.15	1.52	4.56	1.88	3.93	1.48	3.96	2.09	3.03	1.97	4.38	1.66
29. Level of Automation	3.47	1.72	2.78	1.39	2.77	1.43	2.48	1.76	3.14	1.68	2.81	1.73
30. Task/Performance Clarity	5.38	1.06	4.56	1.42	5.63	1.00	5.60	1.15	5.28	1.82	5.27	1.45
31. Accuracy/Exactness	4.07	0.81	3.88	0.93	4.53	0.57	4.36	0.81	2.93	1.44	3.89	0.99
32. Details and Completeness	4.15	0.65	4.43	0.68	4.50	0.57	4.36	0.76	3.47	1.14	4.05	0.91
33. Constant Awareness	2.67	1.48	1.11	1.27	3.53	1.59	4.48	0.65	2.07	1.74	2.41	1.57
34. Repetitive Activities	1.60	1.51	1.78	1.86	2.27	1.68	2.72	1.62	2.17	1.97	2.00	1.37
35. Unstructured Tasks/Goals	5.67	1.37	4.67	1.94	4.93	1.28	4.88	1.39	4.67	1.69	4.30	1.79
36. Level of Competition	3.98	1.89	3.44	1.51	3.40	1.54	3.16	1.72	3.07	1.74	3.24	1.95
37. Deadlines/Time Pressure	3.93	1.49	3.11	0.78	4.86	1.68	4.64	1.29	3.60	2.39	4.16	1.62
38. Work With Distractions	3.56	1.23	3.44	1.51	3.90	0.76	3.56	1.50	2.43	1.65	2.89	1.20
39. Machine Driven Pace	0.82	1.19	1.44	2.01	0.72	1.11	1.36	1.63	1.53	1.61	1.54	1.52

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 7-13

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions: Work Context

Descriptor	F1	F2	F3	F4	F5	F6	ΣF^2	η^2
1. Communication Formality	-.04	.14	.01	.04	.06	.11	.05	.14
2a. Face-to-Face Individuals	-.02	.01	.08	-.06	.05	.06	.02	.09
2b. Face-to-Face Groups	.05	.08	.12	.09	.22	.08	.09	.19
2c. Public Speaking	.06	-.02	.15	-.20	.19	-.02	.10	.20
2d. Video Conference	.02	.02	.05	-.02	.05	.01	.01	.06
2e. Voice Mail	-.20	.20	-.07	.06	.24	.20	.19	.33
2g. Interactive Computer	-.13	.07	.02	-.05	-.06	.11	.05	.16
2f. Telephone	-.26	.22	-.02	.00	.06	.29	.20	.39
2k. Written Reports	.05	.21	.08	-.02	-.04	.17	.08	.18
2h. Electronic Mail	-.21	.14	-.05	.07	.17	.17	.13	.33
2i. Handwritten Notes	-.15	.15	-.02	-.01	-.02	.12	.07	.21
2j. Letters and Memos	-.16	.07	-.07	.01	.00	.08	.06	.17
3. Communication Subjectivity	.05	-.04	.04	.06	.09	.01	.03	.08
4. Social Interaction	-.02	.05	.16	-.14	.07	.12	.07	.18
5. Privacy of Communication	-.11	.04	.04	.21	.14	.05	.08	.16
6a. Supervise/Develop Others	.06	.03	.18	.16	.27	.03	.16	.23
6b. Persuade or Influence	.02	.03	.17	-.02	.51	-.01	.31	.30
6c. Provide Service to Others	.02	.03	.16	-.12	.17	.05	.14	.19
6d. Take Opposing Position	.04	.06	.08	.14	.28	.01	.12	.18
6e. Work/Contribute To Team	.04	-.01	.11	.05	.10	.02	.04	.11
6f. Deal With Public	.02	.09	.17	-.24	.17	.08	.14	.24
6g. Coordinate/Lead Activity	.05	.03	.10	.06	.26	.04	.09	.15
7. Health/Safety of Others	.36	.03	.20	.20	.03	-.13	.26	.45
8. Responsible Others' Work	.09	.03	.12	.19	.27	-.05	.14	.23
9. Conflict Situations	.08	.16	.10	.01	.18	.04	.08	.17
10. Unpleasant Individuals	.08	.10	.13	-.10	.03	.05	.06	.13
11. Physical Aggression	.21	.22	.26	.07	-.06	.15	.23	.38
12a. Indoors, Controlled	-.22	-.11	.09	.08	.05	.07	.09	.25
12b. Indoors, Uncontrolled	.15	-.03	-.08	.15	.13	-.03	.07	.20
12c Outdoors, Exposed	.46	.24	-.09	-.13	.12	.01	.39	.55
12d. Outdoors, Covered	.29	.11	-.09	-.05	.12	-.06	.12	.38
12e. Open Vehicle/Equip.	.30	.09	-.21	.01	.04	.33	.25	.40
12f. Enclosed Vehicle/Equip	.39	.48	-.08	-.15	.21	-.09	.50	.60
13. Privacy of Work Area	-.15	.17	.05	.19	.25	-.04	.17	.27
14. Physical Proximity	.10	-.01	.13	.02	-.07	.09	.04	.16
15a. Distracting Noise	.11	.05	-.11	-.01	-.03	-.01	.03	.14
15b. Extreme Temperature	.34	.10	-.17	-.07	.00	-.02	.16	.39
15c. Poor Lighting	.22	.15	-.09	-.14	-.01	.08	.10	.26
15d. Contaminants	.23	.03	-.06	.18	-.16	.01	.12	.29
15e. Cramped Work Space	.21	.02	-.06	.01	-.02	.12	.06	.20

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Table 7-13 (continued)
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions: Work Context

Descriptor	F1	F2	F3	F4	F5	F6	ΣF^2	η^2
15f. Whole Body Vibration	.31	.15	-.27	-.05	.02	-.07	.20	.45
16a. Radiation	.07	.02	-.04	.14	.03	.16	.06	.16
17a. Diseases/Infections	.15	.02	.36	.15	-.28	.08	.27	.37
18a. High Places	.31	-.05	-.22	.08	.17	.39	.34	.43
19a. Hazardous Conditions	.25	.05	-.09	.20	-.04	.07	.14	.30
20a Hazardous Equipment	.40	.12	-.23	.10	.05	.13	.33	.50
21a. Hazardous Situations	.32	-.02	.02	.05	-.02	.03	.13	.36
22a. Sitting	-.40	.49	-.22	-.01	-.09	-.10	.47	.61
22b. Standing	.37	-.48	.23	-.01	.05	.05	.44	.59
22c. Climbing Ladders, etc.	.27	-.12	-.27	.14	.18	.29	.30	.42
22d. Walking or Running	.25	-.28	.15	.11	-.06	.10	.21	.42
22e. Kneeling or Crouching	.19	-.21	.03	.05	-.07	.15	.11	.28
22f. Keeping/Regaining Balance	.18	-.11	.04	.05	.00	.11	.06	.18
22g. Handling Tools, Objects	.14	-.10	-.08	-.10	-.16	-.01	.09	.18
22h. Bending/Twisting Body	.25	-.23	.07	-.03	-.06	.05	.13	.34
22i. Making Repetitive Motions	.03	-.12	-.08	-.18	-.24	-.01	.14	.19
23a Business/Office Clothes	-.41	.17	-.02	-.11	.23	.24	.35	.51
23b. Special Uniform	.22	.09	.36	-.11	-.19	.05	.28	.41
23c. Maintenance Clothes	.33	-.20	-.28	.12	-.03	-.10	.26	.47
23d Common Safety Attire	.42	.08	.03	.40	-.12	.03	.44	.53
23e. Special Safety Attire	.26	.06	-.02	.11	-.02	.30	.17	.32
24. Consequence of Error	.16	.24	.10	.20	.06	-.04	.17	.31
25a. Level of Decisions	.05	.20	.16	.09	.22	.00	.13	.23
25b. Frequency of Decisions	.06	.17	.19	-.05	.20	-.04	.12	.23
26. Accountable for Results	.08	.13	.11	.08	.22	-.13	.12	.19
27. Decision Latitude	.00	.18	.05	.11	.28	.05	.13	.20
28. Frustrating Circumstances	.03	.12	-.05	.11	.18	.00	.06	.14
29. Level of Automation	-.12	.02	-.06	.05	-.07	.01	.07	.16
30. Task/Performance Clarity	-.02	-.01	.01	-.07	-.11	-.08	.02	.07
31. Accuracy/Exactness	-.08	.11	.02	-.08	-.09	.00	.08	.16
32. Details and Completeness	-.04	.07	.03	-.09	-.08	-.04	.06	.12
33. Constant Awareness	.12	.10	.13	-.07	.04	.03	.05	.16
34. Repetitive Activities	-.02	.01	-.05	-.20	-.21	-.01	.11	.16
35. Unstructured Tasks/Goals	-.05	.06	.06	.15	.19	.11	.13	.17
36. Level of Competition	.06	.00	.04	.03	.20	-.05	.06	.11
37. Deadlines/Time Pressure	.06	.08	-.02	.02	-.11	-.17	.06	.13
38. Work With Distractions	-.07	.12	.00	-.03	.02	-.03	.02	.12
39. Machine Driven Pace	.01	.04	-.19	-.08	-.20	-.17	.15	.19
R_c	90	86	83	77	73	69		
Percent of Variance	21	14	11	7	6	5		

Table 7-13 (continued)
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions: Work Context

Descriptor	F1	F2	F3	F4	F5	F6	ΣF^2	η^2
Eigenvalue	4.27	2.86	2.16	1.44	1.11	.92		

Note. Statistics are based on 37 occupations with Work Context questionnaire, responses from at least 4 incumbents (mean number of incumbents - 19.68, median - 12.5, harmonic mean - 9.44)
F1 = Environmental Conditions, F2 = Physical Activity, F3 = Health Care, F4 = Interacting with Public, F5 = Managerial/Interpersonal Relations, F6 = Hazardous Work Conditions.
ΓF^2 = Sum of squared rotated standardized discriminant function coefficients across 6 functions.
η^2 = Variance in Work Context Level Scale ratings accounted for by occupations.
The statistics "R_c," "Percent of Variance," and "Eigenvalue," were calculated based on the unrotated discriminant functions.

Table 7-14

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
3. Communication Subjectivity	3.33	0.56	0.41	2.75	1.04	0.90	3.02*	3.45*	0.30	0.34
4. Social Interaction	5.72	0.91	0.76	4.56	1.53	0.96	3.98*	2.83*	0.56	1.35
6. Job Interactions										
6a. Supervise/Develop Others	3.03	0.76	0.83	1.19	1.45	0.95	6.82*	3.64*	0.45	3.39
6b. Persuade or Influence	1.83	1.15	0.88	1.49	1.22	0.93	1.25	1.13	0.71	0.12
6c. Provide Service to Others	3.53	1.09	0.78	2.91	1.29	0.89	2.27*	1.40	0.32	0.38
6d. Take Opposing Position	1.75	0.80	0.77	0.86	0.57	0.83	5.48*	1.97	0.57	0.79
6f. Deal With Public	2.84	1.12	0.83	2.64	1.50	0.94	0.66	1.79	0.71	0.04
6g. Coordinate/Lead Activity	2.99	0.75	0.70	1.50	1.12	0.90	6.75*	2.23*	0.56	2.22
7. Health/Safety of Others	3.95	1.84	0.94	2.33	1.74	0.92	3.90*	1.12	0.75	2.62
8. Responsible Others' Work	3.45	1.21	0.83	1.68	1.49	0.92	5.60*	1.52	0.41	3.13
9. Conflict Situations	1.81	0.45	0.75	1.31	0.57	0.84	4.18*	1.60	0.52	0.25
10. Unpleasant Individuals	2.06	0.38	0.65	1.37	0.58	0.88	6.00*	2.33*	0.60	0.48
11. Physical Aggression	0.94	0.64	0.91	0.44	0.54	0.90	3.66*	1.40	0.80	0.25
12. Work Settings										
12a. Indoors, Controlled[a]	5.71	1.35	0.84	3.39	0.69	0.91			0.75	
12c. Outdoors, Exposed[a]	1.94	2.05	0.96	1.18	0.85	0.92			0.89	
15. Environmental Conditions										
15a. Distracting Noise[a]	3.39	1.22	0.67	1.16	0.74	0.89			0.74	
15b. Extreme Temperature[a]	2.05	1.71	0.92	0.84	0.63	0.89			0.78	
15c. Poor Lighting[a]	1.35	1.25	0.85	0.89	0.43	0.77			0.71	
15d. Contaminants[a]	2.52	1.73	0.87	1.15	0.64	0.78			0.78	
15e. Cramped Work Space[a]	1.38	0.98	0.80	0.51	0.44	0.81			0.70	
15f. Whole Body Vibration[a]	0.46	1.18	0.94	0.18	0.41	0.88			0.91	
16. Radiation										
16a. Exposure[a]	0.44	0.72	0.73	0.23	0.36	0.79			0.08	
16b. Likelihood of Injury	0.43	0.47	0.59	0.20	0.31	0.77	2.42*	2.30*	0.02	0.05

Table 7-14 (continued)

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
16c. Extent of Injury	0.23	0.29	0.50	0.13	0.22	0.59	1.72	1.74	0.05	0.01
17. Diseases/Infections										
17a. Exposure[a]	2.10	1.86	0.91	0.62	0.99	0.96			0.77	
17b. Likelihood of Injury	1.64	1.32	0.90	0.64	1.01	0.95	3.67*	1.71	0.72	1.00
17c. Extent of Injury	1.15	1.11	0.90	0.56	0.92	0.96	2.49*	1.46	0.71	0.35
18. High Places										
18a. Exposure[a]	0.77	1.00	0.93	0.26	0.35	0.73			0.69	
18b. Likelihood of Injury	0.68	0.82	0.91	0.32	0.52	0.80	2.22*	2.49*	0.78	0.13
18c. Extent of Injury	0.68	0.77	0.89	0.28	0.47	0.79	2.67*	2.68*	0.75	0.16
19. Hazardous Conditions										
19a. Exposure[a]	1.29	1.29	0.88	0.60	0.61	0.84			0.67	
19b. Likelihood of Injury	1.11	1.02	0.88	0.69	0.76	0.85	2.00*	1.80	0.61	0.18
19c. Extent of Injury	0.86	0.89	0.88	0.62	0.75	0.86	1.27	1.41	0.59	0.06
20. Hazardous Equipment										
20a. Exposure[a]	1.69	1.90	0.95	0.84	0.91	0.92			0.91	
20b. Likelihood of Injury	1.28	1.43	0.95	0.95	1.00	0.90	1.13	2.04	0.82	0.11
20c. Extent of Injury	0.99	1.08	0.93	0.81	0.92	0.93	0.76	1.38	0.82	0.03
21. Hazardous Situations										
21a. Exposure[a]	2.25	1.57	0.91	1.08	0.60	0.84			0.76	
21b. Likelihood of Injury	1.93	1.34	0.91	1.24	0.75	0.82	2.71*	3.19*	0.74	0.48
21c. Extent of Injury	1.01	0.69	0.86	0.76	0.42	0.75	1.89	2.70*	0.60	0.06
22. Body Positioning										
22a. Sitting[b]	2.59	1.28	0.97	2.43	0.72	0.94			0.91	
22b. Standing[b]	2.96	1.21	0.96	2.41	0.60	0.92			0.90	
22c. Climbing Ladders, etc.[b]	0.39	0.52	0.93	0.35	0.43	0.79			0.76	
22d. Walking or Running[b]	2.28	1.05	0.93	1.85	0.42	0.85			0.69	
22e. Kneeling or Crouching[b]	1.04	0.70	0.87	1.18	0.45	0.77			0.64	

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Table 7-14 (continued)

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Context

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
22f. Keeping/Regaining Balance[b]	0.76	0.62	0.77	0.46	0.34	0.56			0.47	
22g. Handling Tools, Objects[b]	2.57	1.00	0.76	2.13	0.62	0.77			0.64	
22h. Bending/Twisting Body[b]	1.70	0.99	0.90	1.20	0.43	0.65			0.72	
22i. Making Repetitive Motions[b]	2.70	0.91	0.78	1.60	0.44	0.66			0.66	
23. Work Attire										
23b. Special Uniform[b]	1.21	1.47	0.92	1.49	1.21	0.94			0.85	
23d. Common Safety Attire[b]	2.78	2.48	0.95	1.26	1.25	0.97			0.88	
23e. Special Safety Attire[b]	0.67	0.96	0.89	0.30	0.42	0.87			0.62	
24. Consequence of Error	3.54	1.32	0.88	3.84	1.11	0.86	1.07	1.41	0.57	0.09
28. Frustrating Circumstances	3.41	0.96	0.68	3.03	0.66	0.73	1.99*	2.12*	0.61	0.14
29. Level of Automation	3.13	0.90	0.72	3.19	0.85	0.78	0.28	1.12	0.52	0.00
31. Accuracy/Exactness	4.10	0.43	0.72	3.54	0.70	0.77	4.20*	2.65*	0.56	0.31
32. Details and Completeness	4.22	0.37	0.60	3.70	0.53	0.71	4.84*	2.05	0.35	0.27
33. Constant Awareness	2.47	0.85	0.73	2.04	0.72	0.73	2.36*	1.39	0.41	0.18
34. Repetitive Activities	2.52	0.82	0.72	1.46	0.56	0.62	6.55*	2.14*	0.46	1.12
39. Machine Driven Pace	1.75	0.98	0.78	1.16	0.72	0.81	2.97*	1.85	0.69	0.35

Note. Incumbent statistics are based on 37 occupations with Work Context questionnaire responses from at least 4 incumbents (mean number of incumbents=19.68, median=12.5, harmonic mean=9.44). Analyst statistics are based on the same 37 occupations with Work Context questionnaire responses from at least 6 analysts (mean number of analysts=9.73, median=6.00, harmonic mean=8.00). The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation. The t statistic tests for differences in the incumbent and analyst group means. The F statistic tests for differences in the incumbent and analyst group standard deviations. The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings. The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings. *$p < .05$. [a]Analysts used a 0 to 4 rating scale (Never to Always) and incumbents used a 0 to 7 rating scale (Never to Hourly) for this item. [b] Analysts used a 0 to 4 rating scale (Never to Always) and incumbents used a 0 to 5 rating scale (Never to Almost Continually) for this item.

Table 7-16
Principal Components Analysis Pattern Matrix for the Analyst Data: Work Context

	Descriptor	Factors F1	F2	F3	F4	F5	F6	F7	Communality
3.	Communication Subjectivity	.75	-.01	-.07	.23	-.03	.06	-.52	.90
4.	Social Interaction	.21	-.08	.00	.73	-.30	.04	-.44	.87
6a.	Supervise/Develop Others	.94	-.11	.02	.08	-.10	.05	.01	.91
6b.	Persuade or Influence	.38	-.01	-.19	.58	.08	.17	-.41	.85
6c.	Provide Service to Others	-.19	-.12	-.09	.88	-.15	.17	-.12	.90
6d.	Take Opposing Position	.90	-.03	-.00	.17	-.04	-.15	-.19	.89
6f.	Deal With Public	.01	-.14	-.05	.93	-.06	-.03	-.03	.93
6g.	Coordinate/Lead Activity	.87	-.03	.06	-.06	-.13	-.01	-.36	.92
7.	Health/Safety of Others	.34	.44	.58	.05	.03	.18	-.05	.87
8.	Responsible Others' Work	.95	-.15	.07	-.02	-.08	-.04	-.07	.90
9.	Conflict Situations	.56	.08	-.03	.65	-.02	-.24	-.29	.92
10.	Unpleasant Individuals	.08	.00	-.01	.89	-.13	-.08	-.18	.96
11.	Physical Aggression	.25	.28	.43	.57	.13	-.05	-.16	.92
12a.	Indoors, Controlled	.03	-.93	-.04	-.01	-.16	.13	.08	.92
12c.	Outdoors, Exposed	.04	.91	-.06	.12	.27	.05	-.19	.95
15a.	Distracting Noise	.04	.74	.11	-.25	.32	.18	.40	.92
15b.	Extreme Temperature	.01	.79	-.02	-.10	.38	.29	.01	.90
15c.	Poor Lighting	-.02	.82	.18	-.09	.35	.09	.09	.87
15d.	Contaminants	-.03	.40	.57	-.40	.30	.30	.21	.88
15e.	Cramped Work Space	-.10	.44	.24	-.16	.67	.26	.28	.88
15f.	Whole Body Vibration	.13	.82	.10	-.26	.10	-.08	.22	.91
16a.	Radiation	-.08	.13	.90	-.01	-.05	.11	-.09	.86
17a.	Diseases	.09	-.20	.85	.06	-.12	.26	-.10	.91
18a.	High Places	.05	.27	.11	-.07	.90	.12	.02	.92
19a.	Hazardous Conditions	.13	.14	.57	-.48	.45	.23	.10	.86
20a.	Hazardous Equipment	.00	.47	.17	-.39	.51	.28	.41	.92
21a.	Hazardous Situations	.01	.23	.31	-.28	.22	.67	.29	.86
22a.	Sitting	.15	-.07	-.17	.08	-.25	-.90	-.04	.93
22b.	Standing	-.11	.03	.16	.03	.25	.91	.05	.95
22c.	Climbing Ladders, etc.	-.09	.25	-.06	-.18	.84	.28	-.00	.91
22d.	Walking or Running	.06	-.08	.16	.29	.36	.70	-.32	.84
22e.	Kneeling or Crouching	-.20	.36	.11	-.11	.62	.45	.00	.80
22f.	Keeping/Regaining Balance	.01	.28	.08	-.03	.88	.15	.05	.90
22g.	Handling Tools, Objects	-.25	.21	.32	-.34	.29	.23	.60	.82
22h.	Bending/Twisting Body	-.19	.45	.28	-.10	.59	.45	.22	.93
22i.	Making Repetitive Motions	-.45	-.02	.00	-.19	.00	.09	.80	.88
23b.	Special Uniform	.03	.06	.70	.32	.15	.45	.22	.91
23d.	Common Safety Attire	.08	.10	.75	-.34	.35	.30	.17	.93
23e.	Special Safety Attire	.17	.10	.84	-.21	.38	.08	.04	.90
24.	Consequence of Error	.52	.15	.67	.10	.12	-.30	.20	.92

Table 7-16 (continued)
Principal Components Analysis Pattern Matrix for the Analyst Data: Work Context

Descriptor	F1	F2	F3	F4	F5	F6	F7	Communality
	Factors							
28. Frustrating Circumstances	.81	.11	.22	-.00	.21	-.21	.06	.83
29. Level of Automation	.27	-.17	.27	-.34	-.18	-.45	.50	.89
31. Accuracy/Exactness	.28	-.48	.51	-.14	-.12	-.41	.19	.85
32. Details and Completeness	.44	-.42	.57	-.10	-.03	-.31	.12	.83
33. Constant Awareness	.54	.41	.44	.31	.06	-.02	-.05	.85
34. Repetitive Activities	-.42	-.20	-.22	-.19	.22	-.10	.68	.83
39. Machine Driven Pace	-.10	.32	.14	-.52	.06	.01	.70	.91
Percent of Variance	31	19	14	9	6	3	3	
Eigenvalue	14.54	9.01	6.58	4.50	2.99	1.85	1.39	

Note. N = 37. The Correlation Matrix was based on means calculated at the occupation level. These loadings are based on an orthoganal varimax rotation. F1 = Managerial Relations, F2 = Environmental Conditions, F3 = Health and Safety Conditions, F4 = Interacting with Public, F5 = Physical Activity, F6 = Body Movement, F7 = Structured/Machine Operations.

Table 7-17a
Mean Differences Between Exempt and Non-Exempt Jobs: Work Context

Descriptor	Exempt (n = 36) M	Exempt (n = 36) SD	Non-Exempt (n = 112) M	Non-Exempt (n = 112) SD	t
6. Job Interactions					
6a.Supervise/Develop Others	3.53	1.30	2.90	1.51	2.24*
6b.Persuade or Influence	2.78	2.03	1.62	1.80	3.24*
6g.Coordinate/Lead Activity	3.42	1.40	2.74	1.60	2.27*
8. Responsible Others' Work	3.92	2.32	3.36	2.40	1.21
12. Work Settings					
12c. Outdoors, Exposed	0.58	1.22	2.29	2.65	-3.74*
12e. Open Vehicle/Equip.	0.00	0.00	0.49	1.44	-2.03*
12f. Enclosed Vehicle/Equip.	0.81	1.85	1.72	2.50	-2.03*
15. Environmental Conditions					
15a. Distracting Noise	2.92	2.70	3.27	2.54	-0.72
15b. Extreme Temperature	1.28	2.13	2.08	2.38	-1.90*
15c. Poor Lighting	0.58	1.48	1.32	2.23	-2.27*
15d. Contaminants	1.64	2.52	2.66	2.52	-2.12*
15e. Cramped Work Space	0.47	1.25	1.59	2.03	-3.93*
15f. Whole Body Vibration	0.14	0.83	0.42	1.39	-1.47
16. Radiation					
16a. Exposure	0.03	0.17	0.44	1.36	-3.18*
17. Diseases/Infections					
17a. Exposure	0.67	1.69	2.48	2.63	-4.81*
18. High Places					
18a. Exposure	0.39	1.42	0.90	1.74	-1.78*
19. Hazardous Conditions					
19a. Exposure	0.22	0.54	1.44	2.13	-5.55*
20. Hazardous Equipment					
20a. Exposure	0.72	1.75	1.89	2.60	-3.07*
21. Hazardous Situations					
21a. Exposure	0.92	1.61	2.62	2.37	-4.86*
22. Body Positioning					
22a. Sitting	3.03	1.63	2.44	1.49	2.02*
22b. Standing	2.81	1.58	3.11	1.51	-1.03
22c. Climbing Ladders, etc.	0.25	0.55	0.43	0.80	-1.24
22d. Walking or Running	1.92	1.63	2.27	1.47	-1.21
22e. Kneeling or Crouching	0.67	1.07	1.00	1.21	-1.48
22f. Keeping/Regaining Balance	0.47	1.18	0.66	1.11	-0.86
22g. Handling Tools, Objects	1.86	1.78	2.74	1.93	-2.42*
22h. Bending/Twisting Body	1.03	1.52	1.62	1.57	-2.00*
22i. Making Repetitive Motions	2.14	1.93	2.77	1.68	-1.88*
29. Level of Automation	2.96	1.73	3.22	1.93	-0.75

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Table 7-17a (continued)
Mean Differences Between Exempt and Non-Exempt Jobs: Work Context

Descriptor	Exempt (n = 36) M	Exempt (n = 36) SD	Non-Exempt (n = 112) M	Non-Exempt (n = 112) SD	t
35. Unstructured Tasks/Goals	4.83	1.98	4.24	1.44	-1.65
39. Machine Driven Pace	1.35	1.83	1.71	1.72	-1.08

*p < .05

Note. A total of 9 occupations are classified as Exempt and 28 occupations are classified as Non-Exempt. Four individuals were randomly sampled from each occupation to be included in these analyses.

Non-Exempt Occupations
Educational Administrators
General Managers & Top Executives
Chemical Engineers
Mechanical Engineers
Teachers, Preschool
Teachers, Elementary School
Salespersons, Except Scientific & Retail
First-Line Supervisors, Clerical & Administrative
Police & Detective Supervisors
Insurance Claims Clerks
Teachers' Aides & Assistants, Clerical
Secretaries, Except Legal & Medical
Receptionists & Information Clerks
Bookkeeping, Accounting & Auditing Clerks
General Office Clerks
Police Patrol Officers
Waiters & Waitresses
Cooks, Restaurant
Food Preparation Workers
Medical Assistants
Nursing Aides, Orderlies & Attendants
Janitors & Cleaners
Maintenance Repairers, General Utility
Earth Drillers, Except Oil & Gas
Machinists
Packaging & Filling Machine Operations
Truck Drivers, Heavy or Tractor-Trailer
Bus Drivers, Schools

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Table 7-17a (continued)
Mean Differences Between Exempt and Non-Exempt Jobs: Work Context

Exempt Occupations
Computer Programmers
Registered Nurses
Medical & Clinical Laboratory Technologists
Medical & Clinical Laboratory Technicians
Salespersons, Retail
Stock Clerks, Sales Floor
Cashiers
Tellers
Loan & Credit Clerks

Table 7-17b
Mean Differences Between High Teamwork and Low Teamwork Jobs: Work Context

Descriptor	High Teamwork (n = 44) M	High Teamwork (n = 44) SD	Low Teamwork (n = 52) M	Low Teamwork (n = 52) SD	t
1. Communication Formality	4.52	1.81	3.71	1.55	2.36*
2. Communication Methods					
2a. Face-to-Face Individuals	5.64	1.71	4.77	2.26	2.09*
2b. Face-to-Face Groups	2.43	1.81	1.12	1.00	4.30*
2c. Public Speaking	1.37	2.26	0.44	1.38	2.38*
2d. Video Conference	0.34	1.16	0.04	0.19	1.71
2e. Voice Mail	1.05	1.57	1.57	2.11	-1.38
2f. Telephone	4.07	2.06	4.11	2.50	-0.09
2g. Interactive Computer	1.39	2.42	1.54	2.49	-0.30
2h. Electronic Mail	1.14	1.65	1.15	1.97	-0.05
2i. Handwritten Notes	3.23	1.57	3.38	1.83	-0.45
3. Communication Subjectivity	3.75	1.73	3.00	1.47	2.31*
4. Social Interaction	5.95	1.51	5.53	2.00	1.19
6. Job Interactions					
6a. Supervise/Develop Others	3.56	1.41	2.42	1.45	3.90*
6b. Persuade or Influence	2.00	2.05	1.13	1.44	2.34*
6c. Provide Service to Others	3.91	1.68	2.96	2.03	2.50*
6d. Take Opposing Position	1.85	1.66	1.23	1.29	2.00*
6e. Work/Contribute To Team	4.41	0.58	3.37	1.43	4.82*
6g. Coordinate/Lead Activity	3.07	1.62	2.44	1.65	1.88*
8. Responsible Others' Work	3.57	2.50	2.94	2.43	1.24
9. Conflict Situations	1.91	1.01	1.62	0.91	1.50
24. Consequence of Error	4.21	2.25	2.62	1.87	3.78*
25. Impact of Decisions					
25a. Level of Decisions	4.75	1.53	3.90	1.90	2.37*
25b. Frequency of Decisions	3.91	2.41	3.25	2.50	1.31
28. Frustrating Circumstances	3.02	1.87	3.33	1.59	-0.86
35. Unstructured Tasks/Goals	4.34	1.83	4.38	1.59	-0.13
38. Work With Distractions	3.31	1.30	3.15	1.49	0.54

*$p < .05$

Note. A total of 11 occupations are classified as High Teamwork and 13 occupations are classified as Low Teamwork. Four individuals were randomly sampled from each occupation to be included in these analyses.

Low Teamwork
Educational Administrators
Computer Programmers
Insurance Claims Clerks

Table 7-17b (continued)
Mean Differences Between High Teamwork and Low Teamwork Jobs: Work Context

General Office Clerks
Police & Detective Supervisors
Medical Assistants
Nursing Aides, Orderlies & Attendants
Janitors & Cleaners
Earth Drillers, Except Oil & Gas
Packaging & Filling Machine Operations
Bus Drivers, Schools
Machinists
Truck Drivers, Heavy or Tractor-Trailer

High Teamwork
Mechanical Engineers
Salespersons, Except Scientific & Retail
Salespersons, Retail
Stock Clerks, Sales Floor
Cashiers
First-Line Supervisors, Clerical & Administrative
Receptionists & Information Clerks
Bookkeeping, Accounting & Auditing Clerks
Police Patrol Officers
Waiters & Waitresses
Maintenance Repairers, General Utility

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Chapter 8

Organizational Context:

Evidence for the Reliability and Validity of the Measures

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Background

The inclusion of a set of organizational context descriptors in the O*NET content model was driven by the growing demand for descriptive information about organizations in the United States on the part of many Dictionary of Occupation Titles (DOT; U.S. Department of Labor, 1991) users. It is reasonable to expect the organizations that provide the context within which jobs occur to affect the very nature of the jobs themselves. Thus, descriptive information about organizations is likely to aid in classifying and clustering occupations. Concern about the organizational and administrative effectiveness of American business has led to the identification of a set of business practices typical of organizations competing effectively in the national and global economies (U.S. DOL, 1994). This concept of "high-performance" business practices and workplaces is a new one, and only a limited amount of information is available concerning the

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extent to which businesses actually use these "high-performance" practices, as well as the extent to which these practices are related to organizational effectiveness when they are used. Thus, the description of high-performance business practices was a high priority in developing the content model underlying the O*NET.

Taxonomy

The O*NET measures of organizational context characteristics were derived from the taxonomy of organizational context proposed by Arad, Schneider, and Hanson (1995). This taxonomy was based on an extensive review and integration of major theoretical and empirical writings on organizations. Constructs were selected for the taxonomy based on the following criteria: (1) they had been measured with reasonable levels of reliability and validity in past research, or had good potential for being reliable and valid, (2) they could be generalized to a wide variety of different types of organizations without losing their meaning, and (3) they were expected, based on theory or past research, to be useful in describing or classifying occupations, or in describing important features of organizations that might be of interest to O*NET users. In addition to these criteria, objectivity of descriptors was considered important. The simplest approach to collecting organizational data is to survey a single organizational representative, but this makes it impossible to even assess the reliability of the resulting data. However, reliability can be viewed as less of a concern for questions that ask for relatively objective information (e.g., numbers of employees, types of forms used); thus, an additional goal was to keep the descriptors as objective and concrete as possible.

Based on these criteria, Arad, Schneider, and Hanson (1995) identified a variety of relatively specific organizational context constructs that appeared useful, and organized these constructs into a hierarchical taxonomy. These constructs were grouped according to six higher-order topic areas, which provide a useful heuristic for categorizing the lower-order constructs: type of industry, organizational structure, human resources (HR) systems and practices, culture, goals, and roles. Organizational structure and HR systems and practices are both structural characteristics, while culture, goals, and roles are social processes.

Type of industry was included in the organizational context taxonomy since it was part of the DOT and many users have indicated interest in this kind of information. Organizational structure constitutes a major element in the taxonomy. Structure plays a central role in virtually every organizational theory, and is generally viewed as affecting the behavior of job incumbents as well as the ability of organizations to adapt effectively to their environments. Seven important structural elements of organizations were included in the O*NET taxonomy: organization and establishment size, hierarchy, specialization, formalization, standardization, centralization and employee empowerment, specialization, and job characteristics (skill variety, task significance, task identity, autonomy, and feedback). Four additional structural constructs, often associated with high-performance organizations, were also included in the taxonomy: information sharing, team structure, type of work teams, and amount of change in the organization structure. Information sharing and amount of change in the organization structure were not included in the original organizational context taxonomy described by Arad, Schneider, and Hanson (1995), but were added based on subsequent discussions with organizational representatives. Two constructs that were in the original taxonomy were dropped: administrative intensity and span of control.

Arad, Schneider, and Hanson (1995) proposed that a comprehensive description of the human resources (HR) systems and practices of organizations needs to include various HR domains, such as organizational socialization practices, organizational reward systems, recruitment and selection practices, and employee training and development. Accordingly, the

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following HR constructs were included in the O*NET taxonomy: recruitment planning and operations, selection processes and methods used, group and individualized socialization, training topics/programs and methods used, extent/support of training, use of data in training process, basis for compensation, and benefits and compensation elements. Two additional constructs thought to be characteristic of high-performance organizations were also added to this domain: use of independent contractors, and use of data in organizational decision-making in general. The construct called all salaried system was not included as a separate category of variables.

Organizational culture was assessed by including measures of organizational values, while two distinct goal setting literatures were the basis for the development of goal setting descriptors: individual goal setting and organizational goal setting. For both the individual and organizational levels, three goal constructs were included: goal specificity, availability of goal feedback, and goal negotiability. These have been refined somewhat from the set of goal constructs in the earlier report (extent of individual goal setting, individual goal characteristics, availability of goal feedback, method of goal assignment, extent of organizational goal setting, and organizational goal characteristics).

Another organizational context construct likely to affect job requirements is roles. Role constructs included in the O*NET taxonomy are: role conflict, role overload, and role negotiability. Measures of four leader behaviors or styles were also included in the O*NET: consideration, task-orientation, visionary, and problem solving leadership (these were originally included in the work context domain). A measure of changes in leadership (i.e., changes in supervision) was also included in the taxonomy. Organizational culture was assessed by including measures of organizational values.

Samples and Measures

The general approach taken in measuring organizational context characteristics was to obtain as much of the information as possible from a single organizational representative. This was done for two reasons. First, incumbent time was at a premium in the O*NET data collection. Virtually all of the other areas in the content model rely heavily on incumbent data and require a fair amount of incumbent time. Secondly, incumbent data concerning organizational descriptors is confounded, because incumbents necessarily answer from the perspective of their job or occupation. Unless we are able to sample a large number of representative occupations from a single organization, it will be impossible to even assess the extent to which this confound affects the data.

Still, some of the organizational context constructs could not be measured appropriately at the organizational level and were therefore included in the incumbent questionnaire. Constructs reflecting elements of organizational structure, HR practices, and roles were therefore included in the incumbent questionnaire. For example, job characteristics have traditionally been measured by surveying individual incumbents, so scales targeting each of the five job characteristics associated with job enrichment (i.e., autonomy, skill variety, task identity, task significance, and feedback) were included in the incumbent questionnaire. Similarly, questions concerning employee empowerment, role conflict, and role overload seemed more appropriately asked of job incumbents and were included in the incumbent questionnaire. Leader behavior/style variables were also deemed more appropriate at the incumbent level for the present research. Leader behavior/style was measured by four items, written by the authors, which were designed to assess four different dimensions of leader behavior/style: consideration, task orientation, visioning, and problem solving. Incumbents were asked to rate the frequency with which their immediate supervisor demonstrated behaviors related to each of these dimensions. Information concerning recruitment sources and selection methods used is likely to be of most interest to O*NET users as it related to particular occupations, so data concerning these descriptors were collected from incumbents only as well. Finally, extent of technical training was measured by asking incumbents how often they receive job-related training.

Other organizational context constructs, where both the organizational and incumbent perspectives were expected to provide different but relevant information (e.g., goal setting, recruitment practices, and centralization), were included in the job incumbent questionnaire, as well as the organizational representative interview. These constructs comprised a variety of organizational structure, HR practices, and culture variables. We measured the following variables at both the organization and the individual level: centralization, training topics/programs and methods used, job rotation policies, extent of use of teams, benefits and compensation elements, and organizational values. Questions concerning these variables in the incumbent questionnaire asked respondents to focus on their specific jobs. Questions concerning these variables in the organizational representative survey asked about the organization as a whole. The organizational values questions in the incumbent survey were a subset of those included in the organizational representative survey. These items were reworded in order to ensure that they would be understandable to a wide variety of incumbents. Figure 8-1 lists the elements in the revised taxonomy and the items in the job incumbent and organizational representative surveys that measure them (a few items from the questionnaires were general background questions and as such do not fit into the taxonomy and are not included in this figure or in the analyses). Figure 8-2 assigns numbers and labels to and describes the 33 organizational context descriptors and scales used in the analyses of the incumbent questionnaire data. These descriptor labels and numbers will be used throughout the chapter in discussing the incumbent data.

Data concerning the remaining organizational context constructs in the content model were collected from the organizational representative only. In each sampled organization, we asked for a single organizational representative who was either a representative of the human resources function or someone from management. Data were collected from these individuals using a computer assisted telephone interviews (CATI). The CATI includes 70 questions measuring constructs from four of the organizational context content domains: organizational structure, HR practices, goal setting, and culture. The remaining topic area, type of industry, was not collected from the organizational representatives since it could be derived from the SIC codes (SIC manual, 1987). In general, the CATI interview items ask respondents to rate the extent, frequency, or existence of each of the organizational characteristics, using Likert-type rating scales, check lists, or simple yes/no questions.

The CATIs, each lasting approximately half an hour, were conducted by professional interviewers from Westat, Incorporated. The interview protocol is provided in Appendix A. This protocol shows the exact content and wording of each of the organizational representative interviews. The computer-assisted nature of the CATI allowed the interviewers to skip irrelevant or unnecessary questions, based on the interviewees responses to previous items. It also systematically prompted interviewers to ask follow-up questions or provide clarification when interviewees had trouble with particular questions.

Seven hundred and thirty-three respondents, representing 53 different occupations, completed the job incumbent survey. The sampled occupations ranged from general managers and top executives to janitors. The incumbents also represented a broad and diverse cross-section

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of the workforce in terms of age, sex, ethnic status, and education. The sample included both job holders (71%) and supervisors (29%). Six hundred and sixty-one organizational representatives were interviewed; the majority worked in personnel or human resources (61%) and virtually all of the others were managers or representatives of higher management. The 661 sampled establishments represented almost every industry category as well as private, government, profit, and non-profit organizations. The size of these establishments ranged from 5 to 6,000 employees (including both full and part-time). Seventy of the sampled establishments were also represented in the incumbent sample. The remaining establishments either refused to participate in incumbent surveying after completing the CATI survey or did not return any completed incumbent surveys. The entire CATI sample was used for many of the analyses presented here, but only the 70 for which incumbent data were available could be used in exploring relationships between incumbent and organizational representative data.

Overview of Organizational Context Analyses

Analyses for the organizational context descriptors are necessarily somewhat different from those for the other content model domains, in part because data were collected from both incumbents and organizational representatives and in part because the focus is on describing organizations in addition to occupations. The analyses of the organizational context data fall into three general categories: analyses of the incumbent data, analyses of the organizational representative (i.e., CATI) data, and analyses aimed at understanding the commonalities and differences between these two sources of data.

For both the incumbent and the organizational representative data analyses, descriptive statistics and reliability estimates were computed. For the incumbent data, this included estimating interrater reliabilities and the variance due to the descriptors, occupations,

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organizations and the relevant interactions. In both incumbent and organizational representative descriptors, data sets were intercorrelated and factor analyzed to assess the underlying structure, including both exploratory and confirmatory analyses. Comparisons of occupational means in the incumbent data and discriminant analyses were employed to assess the potential usefulness of these descriptors in describing and classifying occupations. For the organizational representative data, comparisons of mean scores obtained by organizations representing different types of industries were conducted to provide a preliminary assessment of the usefulness of these descriptors for describing and classifying organizations. Finally, comparisons between the incumbent and organizational representative data sets involved examining the underlying structure (i.e., factor analyses) and the correlations between conceptually related descriptors. Each of these analyses is described in more detail in the following section.

Results

Incumbent Data Analysis Results

It is important to keep in mind that even the incumbent-level descriptors in this domain were developed for the purpose of describing organizations, whereas descriptors in other domains were developed for the purpose of describing jobs and occupations. Data were collected from job incumbents only concerning those descriptors for which it was determined that the incumbent perspective was the most meaningful (e.g., Empowerment [Descriptor # 1]) and those descriptors for which data itself is interesting at the job or occupation level (e.g., Number of Selection Methods [Descriptor #29], Number of Compensation Elements [Descriptor #31]). Data collected from job incumbents concerning these organizational context descriptors can be viewed as containing variance due to the organizations in which they work, but also variance due to the way in which these organizations impact individual job holders. It is also likely that, for at least some of the descriptors, a portion of the variance is directly due the respondents' occupations. For example, one would expect managers to, on average, report more Empowerment (Descriptor #1) than janitors, even if there are also systematic differences in the overall degree of employee empowerment across organizations. Thus, these data were examined from three perspectives: (1) their usefulness in describing organizations, (2) their usefulness in describing occupations, and (3) their usefulness in describing occupation within organization "cells," that is, incumbents working in the same occupation and the same organizations.

Data Cleaning

In order to compute meaningful descriptive statistics and reliabilities across occupations and across organizations, we included occupations and organizations in our sample only if responses were available from four or more incumbents. As a result, the sample used in the analyses reported here included 554 incumbents who represented 30 occupations and 70 establishments. Figure 8-3 lists these occupations and the numbers of incumbents in each occupation who completed the organizational context questionnaire.

Descriptive Statistics

We computed means and standard deviations once across occupations (using occupational means as the unit of analysis) and once across organizations (using organizational means as the unit of analysis), and these descriptive statistics are presented in Table 8-1. For the a priori scales (i.e., scales adapted from the literature), Table 8-1 provides only scale-level statistics. Brief descriptions of the rating scales used to collect information concerning each scale/descriptor are also provided in Table 8-1. Not surprisingly, Table 8-1 shows very similar means and standard deviations across occupations and across organizations.

Reliability

For each of the a priori scales (i.e., scales adapted from the literature), we computed an estimate of internal consistency reliability (coefficient alpha), and these estimates are also presented on Table 8-1. For organizational values, the a priori scales were based on the factor analysis of the organizational representative data (described later), which partially replicated past research (O'Reilly, Chatman, & Caldwell, 1991). For most scales, the internal consistency reliability estimates were above .70. The lowest internal consistency estimates were for the two-item scales: Role Negotiability (Descriptor #10), Goal Specificity (Descriptor #11), Attention to Detail Values (Descriptor #16), and Role Overload (Descriptor #8) (.31, .44, .45, and .61, respectively).

Interrater reliability for these descriptors can be viewed in three ways: (1) agreement between incumbents who are in the same occupation, (2) agreement between incumbents who are in the same organization, regardless of their occupation, (3) and agreement between incumbents who are in the same occupation and the same organization. For descriptors that vary systematically across both occupations and organizations the latter type of reliability, across occupation within organization "cells," was expected to be the highest. Table 8-1 presents interrater reliabilities computed across occupations (based on a harmonic mean of 10.14 judges per occupation) and across organizations (based on a harmonic mean of 6.51 judges per organization), along with the associated standard errors of measurement. In general, reliabilities across occupations were higher than those across organizations, but the number of raters per occupation is higher than the number of raters per organization.

Table 8-2 shows estimates of the interrater reliability that would have been obtained if 30 judges had been available for each occupation and also the reliability of ratings provided by a single rater. This table also shows the one-rater and 30-rater reliability estimates across organizations, and across the occupation within organization cells. Table 8-2 shows that, in general, reliabilities across occupations are higher than those across organizations, even when the number of raters is the same. On the average however, reliabilities across the occupation within organization cells were the highest. Table 8-2 shows that for several variables--Task Identity (Descriptor #3), Feedback (Descriptor #6), the four organizational value scales (Descriptors #14, #15, #16, and #17), and two of the leader styles: Consideration (Descriptor #18) and Visionary (Descriptor #20)--these estimates are all quite low (all across occupation r_1 estimates < .05). These descriptors would have low reliabilities even if 30 judges were available for each occupation. Consequently, these descriptors were not included in subsequent advanced analyses. They were however included in other analyses designed to further assess the reliability of the descriptors (i.e., the ANOVAs and assessment of occupation differences).

A different way to examine the interrater reliability of the organizational context descriptors is to compare patterns or profiles of organizational context ratings within occupations to the patterns across occupations. A simple way to accomplish this is to identify a small subset of occupations for which we have relatively large samples of incumbents, randomly split the samples in two within each occupation, and then correlate the mean incumbent ratings within and across occupations. To ensure that the correlations are not inflated due to large differences in scale variances, the ratings were first standardized and then correlated. This comparison was obtained for three occupations: First-Line supervisors, Secretaries (Except Legal and Medical), and General Office Clerks.

Table 8-17 presents the 6x6 correlation matrix (3 occupations x 2 samples for each). This table shows that the only within-occupation, split-half significant correlation (r = .70) is for First-

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Line Supervisors, which is higher than any of the cross-occupation correlations. Interestingly, most of the correlations between First-Line Supervisors and the other two occupations are negative. This may suggest that First-Line Supervisors experience the organizational context very differently than Secretaries and Clerks.

Analyses of Variance

Another method of examining interrater agreement is by employing an analysis of variance (ANOVA), where the descriptors of organizational context characteristics are treated as repeated measures variables. Tables 8-4a, 8-4b, and 8-4c present the ANOVA results for occupations, organizations, and for occupations and organizations, respectively. These tables show that the organizational context descriptors, taken together, show significant differentiation between occupations and between organizations, and also that the interaction between occupations and organizations is important above and beyond each alone in accounting for the variance in the organizational context descriptors.

The analysis of variance that focused on occupations (Table 8-4a) shows significant differences among occupations and a significant effect for descriptor by occupation interaction. The analysis of variance that focused on organizations (Table 8-4b) shows significant differences among organizations and a significant effect for descriptor by organization interaction. The variance attributed to organizations is somewhat smaller than that attributed to occupations. Finally, the analysis of variance including occupations, organizations, and the occupation by organization interaction (Table 8-4c) shows significant effects for the descriptor by occupation interaction, the descriptor by organization interaction, and the descriptor by occupation by organization interaction.

The interrater reliability coefficients resulting from these analyses of variance are presented in Table 8-5. As was true of the data reported in Tables 8-1 and 8-2, agreement across occupations is better than agreement across organizations.

Tables 8-6a, 8-6b, and 8-6c present the results of a parallel set of analyses of variance using aggregate descriptors rather than the individual descriptors. These aggregates were based on each of the major content domains in our content model (i.e., structure, HR practices, goal setting, roles, leadership, and values). The aggregates were computed by standardizing and averaging the variables included in each domain. The results display similar patterns to the analyses of the individual descriptors, but the aggregates account for less variance than the individual descriptors. Table 8-6c shows significant interactions for aggregate by occupation, aggregate by organization, and aggregate by occupation by organization. The interrater reliability coefficients resulting from these aggregate-level analyses of variance are presented in Table 8-7. These coefficients, once again, support the finding that there is more agreement across occupations than across organizations.

Descriptor and Scale Relationships

Table 8-9a presents the intercorrelations of all of the organizational context descriptors and scales using occupation-level means as the unit of analysis, and Table 8-9b shows these same intercorrelations based on organization-level means. Tables 8-10a and 8-10b present intercorrelations of descriptors at the incumbent level (based on four randomly selected incumbents from each occupation or each organization, respectively). Because the emphasis here is on occupational description, the focus of this discussion will be on Tables 8-9a and 8-9b.

Overall, the magnitude and direction of these two sets of correlations appear similar. However, some differences are worth noting. First, the organization change descriptors (i.e., Number of Reorganizations [Descriptor #24] and Number of Changes in Job Duties [Descriptor #25]) were negatively correlated with Role Negotiability (Descriptor #10), Goal Specificity (Descriptor #11), and Goal Feedback (Descriptor #12) (-21, -.16, and -.14, respectively) at the occupation level, while positive correlations were observed at the organization level (.24, .25, and .19, respectively). Second, the job rotation policies descriptor was negatively correlated to Empowerment (Descriptor #1) and Autonomy (Descriptor #2) (-.22 and -.25, respectively) at the occupation level, but showed no significant correlations at the organization level. Third, the correlations between the team descriptors (i.e., Number. of Teams [Descriptor #23] and % Time Spent in Teams [Descriptor #26]) and Decentralization [Descriptor #13] were substantially higher at the occupation level (.62 and .34 compared to .14 and .19)). The correlations between the team descriptors (Descriptors #23 and #26) and Empowerment (Descriptor #1) and Autonomy (Descriptor #2) were also substantially higher at the occupation level than at the organizational level.

Factor Structure

We used principal components analysis with a varimax rotation to examine the underlying structure of the incumbent data. Occupation means were used in this analysis, in part because the organizational context descriptors appear most reliable across occupations and in part because occupation means were used for factor analyses in the other content model domains. Several different solutions with different numbers of factors were examined, and the four-factor solution was chosen based on a scree plot of the eigenvalues and the interpretability of the various solutions; this rotated factor pattern matrix is shown in Table 8-11. These four factors were labeled: decentralization and employee empowerment, work in teams, task-oriented leadership, and skill variety.

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Confirmatory factor analysis was conducted, using LISREL VIII, to confirm the structure of the organizational context content model (Jöreskog & Sörbom, 1993). Occupation means were also used in this analysis. Unfortunately, the model did not converge after 285 iterations. The very small sample size (n = 30) used in this analysis can perhaps explain this result.

Occupation Differences

Table 8-12 presents the means and standard deviations of the organizational context measures for six sample occupations: (1) General Managers and Top executives, (2) Computer Programmers, (3) Registered Nurses, (4) Police Patrol Officers, (5) Janitors and Cleaners, and (6) Maintenance Repairers, General Utility. As expected, some organizational characteristics were found to be associated with certain occupations. For example, General Managers and Top Executives showed the highest levels of Empowerment (Descriptor #1), Autonomy (Descriptor #2), Role Conflict (Descriptor #7), Decentralization (Descriptor #13), and the largest number of training topics (Number of Training Topics, Descriptor #28). Computer Programmers indicated they spent the most time working in teams. Police Patrol Officers experienced the least Empowerment (Descriptor #1), Role Negotiability (Descriptor #10), and Decentralization (Descriptor #13).

Discriminant Analyses

Two sets of discriminant analyses were conducted. The first used occupations as the unit of analysis, as was done for the discriminant analyses in all of the content model domains. However, as shown in Table 8-2, the organizational context descriptors were found to, in general, yield the most reliable data when used to rate the occupation within organization cells. Thus, we conducted a second set of discriminant analyses to assess how well these descriptors differentiate these cells.

The discriminant analysis for occupations provided four interpretable functions, and these were labeled: (1) decision making authority, (2) goal setting, (3) team structure, and (4) skill variety. Table 8-13a presents the correlations between the organizational context descriptors and each of these functions and the discriminating variance attributable to each organizational context descriptor. These four functions successfully classified 28% of the incumbents into the occupations they were drawn from. Using the full set of functions, 43% of incumbents were classified correctly.

The discriminant analysis across the occupation within organization cells yielded five interpretable functions, and these were labeled: (1) decision making authority, (2) organizational change, (3) goal setting, (4) changes in supervision, and (5) skill variety. These five functions successfully classified 43% of the incumbents into the occupation within organization cells they were drawn from. Using all 30 functions, 65% were classified correctly. It appears that, in both analyses, that decision making authority was the best discriminating function.

Tables 8-13a and 8-13b also show the sums of the squared discriminant function coefficients and the η^2 coefficients reflecting the variance in occupation or occupation by organization assignments accounted for by each of the organizational context descriptors.

In addition to finding that the classification functions derived from the analysis within organization cells yielded higher classification rates, Tables 8-13a and 8-13b provide additional information suggesting that the organizational context descriptors do, in fact, discriminate better across the occupation within organization cells than they do across occupations. Specifically, this information consists of the relevant canonical correlations (R_c) and eigenvalues. These correlations represent the strength of association between the relevant occupational groups and the set of organizational context variables. The mean R_c for the four functions from the across

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occupation analysis (Table 8-13a) was .56; the mean $\underline{R}_c$ for the five functions from the across occupation-within organization cells analysis was .77.

The eigenvalues represent the amount of between groups variance explained by the set of organizational context descriptors. Again, eigenvalues for the four functions from the across occupation analysis ($\underline{M}$ = .49) were smaller than those for the five functions from the within organization cells analysis ($\underline{M}$ = 1.56). Thus, together with the results of the classification analyses, these findings provide evidence that the organizational context descriptors discriminate better across occupation-within organization cells than they do across jobs.

Organizational Representative Data Analysis Results

Data Cleaning

Because of the structure of the CATI interview, several strategies were required for data clean-up. First, the CATI included three options for invalid responses: don't know, refuse (to answer), and cannot ascertain. All invalid responses were set to missing. In addition, the branching structure of the CATI allowed the interviewers to skip subsequent branch-related questions, resulting in missing data for these questions. For example, respondents who reported that they did not have selection systems were not asked later questions related to selection systems (e.g., how many selection systems are based on occupation analysis). When missing data were due to branching in the survey, it was replaced with the appropriate data. For example, respondents who reported that they did not have formal training programs obviously don't use any of the training methods listed in later questions, even though they did not respond to these questions (due to the branching in the CATI), so number of training methods was set to zero for these respondents.

Several financial (i.e., establishment and organization annual revenue and annual training budget) and organizational change (i.e., rightsizing and reorganization) questions had high percentages of missing data. On average, the financial items were missing for 37% of the establishments. These data were generally missing either because respondents were unable or refused to provide the information. The measures of organizational change had, on the average, 26% missing data. However, many of the change items asked about the rate of organizational changes over the previous five years, and were only asked by the CATI interviewers if the establishment had been in existence for at least five years. Consequently, 13% of the establishments in the sample did not answer the change questions simply because they were not asked. The financial and organizational change descriptors are not included in most of the analyses presented here in order to maximize the available sample size.

Descriptive Statistics

Most of the variables on the organizational representative survey provided continuous data (e.g., rating scales ranging from 1 to 7). For these variables, means and standard deviations were computed. Table 8-18a presents means and standard deviations for those descriptors on which the metric is self explanatory (e.g., number of training methods used). Table 8-18b presents means and standard deviations, along with the rating scale used to collect data concerning each descriptor, for those descriptors on which the metric requires some explanation. Table 8-18c presents descriptive statistics for the organizational values descriptors. Finally, for some of the descriptors, the answers are simply yes or no, and frequencies were computed. Table 8-18d presents frequencies for these variables.

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Reliability

For the a priori scales (e.g., scales adapted from the literature), we computed internal consistency reliability coefficients. For the organizational representative data, only one respondent was available for each organization (i.e., the organizational representative) so interrater reliability could not be assessed. All of the a priori scales included in the CATI had high internal consistency reliabilities: Formalization (CATI Item #21 [5 parts], $\alpha = .69$), Standardization (CATI Item #29 [14 parts], $\alpha = .88$), Specialization (CATI Item #28 [15 parts], $\alpha = .67$), Decentralization (CATI Item #30 [5 parts], $\alpha = .79$), Information Sharing (CATI Item #31 [5 parts], $\alpha = .73$), use of contractors (CATI Items #14 and #15, $\alpha = .79$), and Use of Data in Organizational Decision-Making (CATI Item #65 [6 parts], $\alpha = .80$). The items that measured changes in organizational structure were divided into two scales, representing two types of change: rightsizing (e.g., downsizing and removing layers of managers) and reorganization (e.g., Number of Reorganizations [CATI Item #25], Number of Organizational Chart Revisions [CATI Item #27]). Coefficient alpha was .68 for the rightsizing scale and .56 for the reorganization scale.

Factor Structure

The five categories that represent the highest level of the content model for organizational context (structure, organizational values, HR practices, goal setting, and roles) might best be viewed as a useful heuristic for organizing the constructs in the content model, but they were not necessarily expected to describe the empirical structure of the data. Constructs in the various categories come from different literatures and, in some cases, even different disciplines, so there is no readily available theory to predict or explain the relationships among them. However, within each of these broad domains there is a good deal of information in the literature concerning the expected structure. Roles were only measured in the incumbent questionnaire and thus not included in this analysis, and only a few questions concerning goals were included in the organizational representative questionnaire. Therefore, goal items were included in the factor analysis of HR practices. Descriptors from each of the remaining categories--structure and values--were factor analyzed separately.

Only half of the organizational representative sample (n = 326) was used to conduct these exploratory factor analyses. The remainder of the sample was held out for use in confirmatory analyses. We used principal factor analysis with a varimax rotation to examine the underlying structure of each of these three categories. Only cases with complete data were included, so sample sizes were slightly different for the three factor analyses. Several different solutions with different numbers of factors were examined, and one solution was chosen for each category based on a scree plot of the eigenvalues, results of a parallel analysis, and the interpretability of the various solutions.

A six-factor solution was selected for structure, and the factor pattern is shown on Table 8-19a. These factors were labeled: (1) use of teams, (2) formalization/standardization, (3) information sharing, (4) decentralization, (5) establishment size, and (6) organization size. Most of the structure descriptors load on at least one of these factors with the exception of Number of Management Levels (Descriptor #18, a measure of hierarchy) which does not correlate with any of the other structure variables. The six factors account for 40% of the total variance in these data and are highly interpretable; most of the variables load cleanly on only one factor.

Table 8-19b shows the results of the analysis of the domain of human resources (HR) systems and practices. The four-factor solution was selected. These factors were labeled: (1) multiple skill training, (2) employee benefits, (3) goal setting, and (4) high-performance HR practices. Table 8-19c shows the results for organizational values. The four-factor solution was selected, and the factors were labeled: (1) people orientation, (2) risk taking, (3) attention to detail, and (4) stability.

In order to examine relationships across these three broad domains, and to determine whether the items and factors thought to be high-performance do in fact tend to co-exist, we developed a set of unit weighted composites based on these three within-domain factor solutions. For each factor, a composite was identified that included all variables loading .30 or greater on that factor. The few items that loaded .30 or greater on more than one factor were assigned to the factor on which the loading was the highest. Variables assigned to each composite were then standardized and summed to form composite scores. We then examined the intercorrelations among scores on these factor-based composites across domains. Table 8-20 presents these factor-based composite intercorrelations.

Contrary to our expectations (based on the literature), size was not strongly related to any other organizational characteristic. Measures of establishment size had small correlations with the formalization composite ($r = .20$), training ($r = .26$), employee benefits ($r = .18$), and goal setting ($r = .17$). Organizational size correlated .20 or greater with only one other organizational context variable, information sharing ($r = .20$). The factor-based composites that included variables considered high-performance did, in fact, show moderate intercorrelations. For example, use of teams was correlated with information sharing ($r = .34$), decentralization ($r = .33$), extent of training ($r = .33$), and goal setting ($r = .37$). Also, information sharing was correlated with decentralization ($r = .46$), extent of training ($r = .36$), goal setting ($r = .43$), and risk-taking values ($r = .30$).

In order to further assess the interrelationships among these three content domains, explore the overall structure of these data, and perhaps identify a high-performance factor across the domains, we factor analyzed the data in Table 8-20. The three factor solution is presented in Table 8-21, and these factors were labeled: organizational values, high-performance practices, and establishment size.

As mentioned previously, the organizational change variables were not included in the factor analyses because of missing data, so relationships between these variables and the factor-based composites were examined separately. The correlation between the two organizational change scales (rightsizing and reorganization) was .57. Interestingly, even though these two scales are fairly highly correlated, when correlated with the factor-based composites measuring other aspects of organizational context, the two scales showed different correlation patterns. Reorganization was positively related to establishment size (r = .22) and employee benefits (r = .21). Rightsizing, however, was positively related to decentralization (r = .22), training (r = .21), and employee benefits (r = .24), and negatively related to formalization/standardization (r = -.21).

Confirmatory Factor Analysis

Using the remainder of the organizational representative sample, which was held out from the exploratory factor analyses (N = 335), we conducted a second-order confirmatory factor analysis to test the hypothesis that a single higher-order construct, which might be labeled "high-performance business practices," could explain the relationships between decentralization, information sharing, use of teams, use of data in decision making, risk-taking values, and multiple skill training. We used LISREL VIII (Jöreskog & Sörbom, 1993) to test this model. This model was selected in part based on the exploratory factor analysis and in part based on the literature and theory concerning high-performance organizations. The indicators for each of these

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latent variables, as well as the factor loadings obtained in the confirmatory factor analysis are shown in Table 8-22. Figure 8-4 presents structural coefficients and fit indices for the second-order factor analysis. All structural coefficients were significant and a relatively good fit was obtained (GFI = .92, AGFI = .90, RMSR = .06). Use of teams had the largest loading on the higher-order "high-performance" factor (.60), while risk-taking values had the smallest loading (.37).

We also developed a "high-performance business practices" factor score by first multiplying each of the six variables, in the above confirmatory model, by its loading. We then examined correlations between this composite and other more traditional organizational characteristics. The high-performance composite did not correlate significantly with establishment size. However, it showed small positive relationships with the items from the CATI that measure formalization and standardization (r = .16 and r = .30, respectively), and somewhat larger relationships with extent of organizational goal setting (r = .46), goal negotiability (r = .40), and compensation and benefits (r = .31 and r = .32, respectively). Interestingly, high performance showed small but positive correlations with rightsizing and reorganization (r = .11 and r = .19, respectively).

Industry Type Comparisons

Industry type was included in the O*NET organizational context taxonomy in part because the literature suggested that organizations from different industries would differ systematically in terms of certain organizational characteristics. Thus, in order to obtain a preliminary assessment of the usefulness of the variables measured in the CATI for describing organizations, we compared scores on the organizational context factor-based composites for organizations from different types of industries. We used multivariate analysis of variance, analysis of variance and t-tests to determine whether scores on the 14 factor-based organizational context composites (defined in Tables 21a, 21b, and 21c) differed significantly for organizations from eight major industries: construction, manufacturing, service, finance, retail and wholesale trade, transportation and public utilities, public administration, and high-technology (SIC manual, 1987).

The MANOVA for industry type was significant and 7 of the 14 factor-based organizational characteristics significantly differentiated among different industries (see Table 8-23). Formalization/standardization was the highest for organizations in public administration and the lowest in wholesale and retail organizations. High technology and finance establishments indicated the highest levels of information sharing, while construction companies showed the lowest levels. Establishment size/specialization was the highest for high technology establishments and lowest for public administration and construction establishments. High technology and public administration organizations scored the highest on employee benefits, while those involved in construction scored the lowest. High technology and finance establishments scored the highest on high-performance HR practices, while public administration establishments scored the lowest. Finally, people-oriented values were the most important in service and finance establishments and the least important in manufacturing and public administration establishments.

Comparing Incumbent and Organizational Representative Data

Factor Structure

For the purpose of comparing the factor structure of the incumbent data with that of the organizational representative data, we conducted another set of factor analyses using the incumbent data designed to replicate, to the extent possible, the factor analyses that were

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conducted using the organizational representative data. Specifically, we used organizations as the unit of analysis (i.e., organizational means were the data points), whereas in the factor analyses of incumbent data reported previously occupations were the unit of analysis. Also, we divided the descriptors according to the three broad content domains that were used in the organizational representative factor analyses. However, the values items showed poor reliability in the incumbent data, so only two domains were included in these analyses: HR practices (roles and goals were included here) and organizational structure.

We used principal components with a varimax rotation for these analyses. We examined several different factor solutions for each domain, and selected one based on a scree plot of the eigenvalues and the interpretability of the factor solutions. The results of the principal component analysis of the incumbent data by content domains are presented in Tables 8-24a and 8-24b. Three factors were chosen for organizational structure and labeled: decentralization and employee empowerment, task-oriented leadership, and work in teams. Three factors were also chosen for HR practices and labeled: <u>HR systems</u>, <u>role conflict</u>, and <u>individual goal-setting</u>.

Comparing the factor structure of the incumbent data (Tables 8-24a and 8-24b) with that of the organizational representative data (Tables 8-19a and 8-19b) demonstrates the structural similarities and differences between the two data sets. In the organizational structure domain, both data sets provide support for decentralization and use of teams as two distinct factors. In the HR practices domain, goal setting is the only factor common to both data sets. However, the incumbent HR systems factor (Table 8-24b) incorporates three factors from the organizational representative factor analysis: multiple skill training, employee benefits, and high-performance HR practices (Table 8-19b).

This comparison also highlights the complementary relationships between the structure of the two data sets. Constructs that were measured only at the incumbent level such as roles and leadership, were identified by the factor analysis of the incumbent data. Likewise, constructs measured only at the organization level such as formalization, standardization, information sharing, and size came out of the factor analysis of the organizational representative data.

Cross-Level Correlations

In order to examine the validity of some of our descriptors and their convergence across levels of measurement, we correlated several organization-level descriptors from the incumbent questionnaire with their parallel descriptors/scales from the organizational representative questionnaire.

We expected only a subset of the descriptors to correlate across levels. Specifically, we hypothesized that incumbent measures of decentralization, job rotation policies, extent of work in teams, and number of reorganizations would positively correlate with measures on the organizational representative survey targeting these same constructs. Also, we expected measures of individual goal setting (i.e., goal specificity and goal feedback) to correlate positively with measures of organizational goal setting (i.e., extent of goal setting and goal negotiability).

However, even for these parallel constructs we did not expect to find strong correlations between the two levels of measurement for several reasons. First, each level represents a different perspective or source of information about the relevant construct. Thus, one can expect that each level would include a substantial unique variance. Moreover, the emphasis in the organizational representative questionnaire was on the establishment, as a whole, while the incumbent questionnaire focused on the incumbent's specific job. As a result, organizational representatives could be viewed as providing information about the establishment, regardless of their jobs or

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occupations, whereas the incumbents provided information about the specific manifestation of the organizational context descriptors in their particular jobs. The second reason to expect only weak relationships concerns the sample restrictions. Due to the sampling strategy used (to limit the burden on any single establishment), we had a limited number of incumbent responses from any given organization, and these incumbents typically represented only a few occupations. Thus, the incumbent data cannot be viewed as representative of the organization as a whole.

The correlations between the incumbent and organizational representative measures of decentralization and job rotation were positive, .27 and .28, respectively, while the measures of the number of reorganizations and work in teams did not correlate significantly across levels. Surprisingly, organizational goal setting was negatively correlated with individual goal specificity and goal feedback ($r = -.24$ and $r = -.22$ respectively), and goal negotiability (for non-managers) was negatively correlated to individual goal feedback ($r = -.24$). Perhaps this latter result suggests that extensive use of organizational goal setting can actually hurt the quality of goal setting practiced by individuals (i.e., employees and managers) in the organization.

Conclusions

The purpose of the analyses described here was to evaluate the reliability and validity of the organizational context descriptors included in the O*NET content model. The descriptors in this domain were developed for the purpose of describing organizations, so one primary goal in these analyses was to evaluate their usefulness in describing organizations. However, because data concerning many of the descriptors were collected from the job incumbents in the O*NET prototype sample, we were also able to assess the usefulness of this subset of the descriptors for describing occupations and also for describing occupation within organization "cells." Results of these analyses offer preliminary answers to several key questions regarding the quality of the organizational context measures and the methodology used:

1. Can the O*NET measures be used to collect reliable data concerning the organizational context within which occupations occur?
2. Are the organizational context descriptors useful for differentiating among organizations?
3. Are the organizational context descriptors useful for differentiating among occupations?
4. Are the organizational context descriptors useful for describing and gathering information about high-performance organizations?
5. Do the data support the structure of the organizational context taxonomy?

Reliability of the Organizational Context Descriptors

Data concerning several of the organizational context descriptors in the O*NET content model have traditionally been collected using scales. The internal consistency reliability of the scales included in both the incumbent and organizational representative surveys was generally quite good, and comparable to that obtained using similar scales in previous research (see coefficient alphas in Table 8-1).

Interrater reliability could only be assessed for the data collected from incumbents, and these data were assessed in terms of reliability for describing occupations, reliability for describing organizations, and reliability for describing occupation within organization cells. As expected, individual descriptor reliabilities were generally highest for describing occupation within organization cells, suggesting that most descriptors capture both organizational and occupational differences. In addition, the majority of the descriptors showed better reliability for describing occupations than for describing organizations. Only a few elements of organizational context, as rated by job incumbents, were affected more by the incumbents' organizational

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affiliation than by their occupation (e.g., adequate resources, organizational change, and skill training).

The majority of the descriptors included in the incumbent questionnaire showed adequate interrater reliability for describing occupations (sixteen above .80 for 30 raters, nineteen above .70). The fact that the reliabilities are not higher may be because organizational context is not as immediate a part of incumbents' day to day working environment, or perhaps it is because many of the descriptors in this domain are quite abstract. A few of the organizational context characteristics in the incumbent questionnaire had generally poor interrater reliability (i.e., task identity, feedback, organizational values, leader consideration, and visionary leader). Accordingly, we excluded these descriptors from many of the analyses reported here and are considering dropping some of them from future O*NET data collection efforts.

In general, these findings suggest that the manifestations of organizational context characteristics vary across occupations. The same organizational structure, for example, may be experienced differently by a secretary, an engineer, or a top executive. It seems reasonable to hypothesize that the immediate work context of job incumbents (i.e., their job demands, requirements, characteristics) has a large impact on their experience of most organizational context characteristics. The sample available for the analyses described here did not allow us to systematically assess the extent to which respondents' occupations affect their perceptions of organizational characteristics, since, at best, data from incumbents in only a few occupations were available for any given organization.

The theoretical implications of these findings are even more far-reaching. The observed interactions between organizational and occupational effects highlight the shortcomings of most organizational and occupational theories. Traditionally, organizational theories do not include occupational variables nor do they propose how organizational variables will affect individuals who are working in different jobs. Similarly, occupational theories typically ignore the effects of organizational context on job requirements and characteristics. The findings in the present research emphasize the need for more integration between these two disciplines.

Differentiating Among Organizations and Occupations

In general, the organizational context descriptors showed sensible differences between organizations as well as between occupations. In terms of organization differences, we found expected differences between organizations representing different types of industries. For example, the results indicated that some of the organizational context descriptors show systematic differences between high-technology and low-technology (e.g., manufacturing, transportation, construction, retail) establishments. Specifically, high-technology establishments reported more information sharing, specialization, types of employee benefits, and high-performance HR practices than low-technology establishments. Public administration establishments, on the other hand, had higher levels of formalization/standardization and more types of employee benefits than other types of establishments.

The organizational context data collected from incumbents had mean differences across jobs that appear systematic and sensible as well. For example, workers in professional and managerial jobs (e.g., general managers and top executives, computer programmers) reported, on average, more empowerment, autonomy, role conflict, decentralization, and a larger number of training topics than did those in more traditionally blue collar jobs (e.g., janitors and cleaners, maintenance repairers). Also, police patrol officers reported the lowest average levels of empowerment, role negotiability, and decentralization. These results could be viewed as reflecting two patterns of relationships between occupations and organizational context:

occupation level exhibits a positive relationship with some of the organizational context descriptors and, as suggested before, job demands/activities/characteristics often overpower or limit the impact of the organizational context.

Describing High-Performance Organizations

The growing interest in high-performance organizations was at the core of the development of the O*NET content model for the organizational context domain. One of the goals in this area was to describe this high-performance phenomenon and collect information concerning the business practices of these high-performance organizations. Indeed, the exploratory and confirmatory analyses of the organizational representative data provide evidence for the existence of a high-performance syndrome/phenomenon. Many of the characteristics of high-performance organizations, identified in Arad, Schneider, and Hanson (1995), appear to be captured by the descriptors in this domain and the covariance in these descriptors can be accounted for by a single higher-order factor, which might be labeled "high-performance practices."

Confirmatory analyses supported the hypothesis that the high-performance phenomenon includes six organizational elements: decentralization, information sharing, use of teams, use of data in decision making, risk-taking values, and multiple skill training, which are consistent with Westat's literature-based list of high-performance characteristics (Westat, 1994). Moreover, use of teams appeared, in our sample, to be more closely tied to the high-performance phenomenon than were risk-taking values.

This constellation of high-performance practices also had positive relationships with other more traditional organizational constructs. Specifically, high-performance practices were positively associated with standardization and numbers of employee benefits and compensation elements. Also, high-performance practices were positively related to the extent to which employees are required to set goals and allowed to negotiate their goals.

Structure of the Organizational Context Data

The organizational representative data provided strong support for the O*NET organizational context taxonomy. Within the HR practices and structure categories, the factors that were identified resemble the constructs included in the O*NET organizational context taxonomy (Arad, Schneider, & Hanson, 1995). The four values factors identified (i.e., people oriented, risk taking, attention to detail, and stability) make a great deal of sense, and partially replicate previous findings (e.g., O'Reilly, Chatman, & Caldwell, 1991).

Factor analysis results for the incumbent data were also consistent with the O*NET organizational context taxonomy. When occupational-level data were used, four meaningful factors were identified: employee empowerment, team structure, task-oriented leadership, and skill variety. Employee empowerment, team structure, and skill variety are three structural variables from the organizational context taxonomy, while task-oriented leadership is one element of leadership included in the taxonomy. Overall, these factors suggest that some aspects of the organizational context taxonomy can be used to describe and differentiate between occupations.

The discriminant analyses of the incumbent data did not completely replicate the results of the factor analyses, but it did show a great deal of similarity. At the occupation-level, four meaningful functions were identified: decision making authority, goal setting, team structure, and skill variety. Decision making authority and goal setting taken together are virtually identical to the employee empowerment factor from the factor analysis; team structure and skill variety were identified in both analyses. The discriminant analysis at the occupation within organization cells level resulted in two additional unique functions: organizational change and change in supervision. These factors provide further support for the dual nature of the data concerning organizational context descriptors collected from incumbents, and suggest that descriptors measuring change were more affected by the incumbents' organizations than by their jobs.

Comparisons between the organizational representative and incumbent results show some structural similarities. In both data sets, use of teams, decentralization/employee empowerment, and goal setting were identified as distinct elements. Differences between the factor structure of the incumbent and organizational representative data sets should not be overinterpreted, since they could easily be explained by methodological issues. Specifically, not all of the organizational context descriptors were measured at both levels. The incumbent questionnaire included some constructs that were not measured at the organizational level, such as roles and job characteristics; while the organizational representative survey included some constructs that could only be appropriately measured at the organization level (e.g., size, formalization, specialization). In addition, our focus was on collecting as much data as possible from the organizational representative, so the incumbent questionnaire was much shorter and less comprehensive that the organizational representative survey, with fewer descriptors per construct. Even so, the factor analysis results for these two data sets appear complementary, and taken together they provide strong support for the various components of the organizational context taxonomy.

As expected, the correlations between parallel descriptors collected from organizational representatives and incumbents were generally significant but not large. This finding suggests that either these two sources of organizational information do in fact represent two distinct perspectives or that our samples of incumbents were not sufficiently representative of their organizations (or both). These results, along with the factor analyses findings, highlight the importance of including both organizational representative and incumbent perspectives in collecting organizational information, although our understanding of the similarities and differences between these two perspectives is still very incomplete.

Limitations

The limitations of the incumbent sample used in these analyses should be kept in mind when interpreting the results. This sample included a relatively small number of occupations within each organization, by design, thus restricting our ability to compare sources of variance (e.g., occupations, organizations) more rigorously. Consequently, only general trends concerning the effects of occupations and organizations on the organizational context descriptors could be identified in the incumbent data.

The organizational representative sample on the other hand was quite large, representing over 600 organizations, so these results should be quite robust. The fact that only one respondent was surveyed in each organization limited the extent to which we could evaluate the quality of these data, but the fact that the factor structure of the organizational representative data is highly interpretable along with the meaningful differences in scores obtained across industries suggests that these data are generally of good quality.

Another limitation pertains to the kind of analyses used in this study. All the analyses were designed to assess the internal validity of the descriptors and scales. The findings provided preliminary evidence for the reliability and meaningfulness of the descriptive organizational context information. Cross-domain and other external analyses are needed in order to provide evidence for the external validity of the measures.

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Finally, sampling limitations made it impossible to adequately address questions concerning relationships between data collected from the organizational representative and that collected from incumbents. We cannot determine the extent to which relationships between parallel organizational context constructs measured at these two levels are attenuated and/or confounded by the limited sample of occupations available from each sampled organization. These problems also make it difficult to assess the extent to which other occupational requirements (e.g., skills) are affected by organizational characteristics.

Recommendations

Results of the present analyses show that the organizational context data are adequately reliable, have an empirical structure that supports the O*NET content model, and appear to have potential for describing both occupations and organizations. Thus, we recommend that the majority of these descriptors be included in future O*NET data collections. However, a few of the organizational context descriptors were problematic and should be dropped from the surveys. In the organizational representative survey, respondents had a great deal of trouble providing financial data, so these questions should be excluded. Several of the variables in the incumbent survey had low interrater reliabilities--organizational values, leader consideration, visionary leadership, task identity, and feedback--and we might consider dropping these variables from the future data collections. Given that organizational context information is not typically included in job analysis surveys, it is not too surprising that some of these descriptors didn't perform well, since all of the organizational context descriptors could be viewed as somewhat experimental in this context.

Future research aimed at better understanding relationships between organizational and occupational variables would also be extremely useful. This could be done either by comparing

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the same occupations across organizations, or different occupations within the same organization. For example several organizations from the same industry that are made up of similar occupations could be identified, including some that are known to use high-performance business practices and others known to take a more traditional approach. A large sample of incumbents from each of these organizations, representing a wide variety of occupations, could then be surveyed concerning organizational context, skills and other relevant descriptors, in addition to collecting the organizational information from one or more organizational representatives. These data would allow us to assess the relationships between organizational and occupational characteristics with a minimum of confounds. It is unlikely that future O*NET data collections will provide such a data set, since the focus is on collecting data concerning a wide variety of occupations, rather than in depth information concerning just a few organizations. Still, this sort of targeted research could lead to a better understanding of the O*NET descriptors and aid in interpreting data collected as part of the O*NET.

The present research provides some support for the notion that many organizations do in fact employ a constellation of business practices that have previously been labeled "high-performance." Measures of many of the relevant variables (e.g., use of teams, risk-taking values) have been developed as part of the O*NET project and preliminary results indicate that these measures are likely to be useful for describing organizations. Further, the current analyses provide a great deal of information concerning the relationships among these high-performance variables as well as their relationships with other important organizational variables. However, this research did not address the critical question of whether these practices are actually related to organizational effectiveness. The survey used in the present research provides an excellent starting point for future research aimed at understanding the relationships between high-

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performance business practices and other organizational characteristics and organizational effectiveness and success.

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Figure 8-1
Taxonomy of Organizational Context Variables

Construct Label	Item Number on Incumbent Questionnaire	Item Number in Organizational Representative CATI
Type of Industry		
Type of Industry (i.e., Organizational Output)		(derived from Standard Industrial Classification Number)
Structural Characteristics		
Organizational Structure		
Organization and Establishment Size		6, 7, 8, 9, 10, 12, 18, 22
Hierarchy		
Specialization		28
Formalization		20, 21
Standardization		29
Centralization & Employee Empowerment	1, 2, 42a, 42b, 42c, 42d	30
Individual versus Team Structure	43	32, 33, 34
Type of Work Teams		35a, 35b, 35c, 35d, 35e
Skill Variety	5, 8, 11	
Task Significance	6, 12, 17	
Task Identity	4, 9, 14	
Autonomy	3, 13, 16	
Feedback	7, 10, 15	
Information Sharing		31
Amount of Change in the Organization Structure	23, 24, 25, 26	11, 13, 23, 24, 25, 27
Human Resources (HR) Systems & Practices		
Recruitment Planning and Operations	50	56, 58
Selection Processes and Methods Used	49	61

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Figure 8-1 (continued)
Taxonomy of Organizational Context Variables

Construct Label	Item Number on Incumbent Questionnaire	Item Number in Organizational Representative CATI
Group and Individualized Socialization		59
Training Topics/Programs and Methods Used	46, 48	45, 45a, 45b, 45c, 45d, 45e, 45f, 45g, 45h, 45i, 45j, 45k, 48, 48a, 48b, 48c, 48d, 48e, 48f, 48g, 50a
Extent/Support of Training	51	44, 46, 49a, 49b, 49c, 53, 54
Use of Data in Training Process		47
Basis of Compensation		66, 67, 68c, 68d, 68e, 68f, 68g, 68h
Benefit and Compensation Elements	44, 45	68a, 68b, 69a, 69b, 69c, 69d, 69e, 69f, 69g, 69h
Use of Independent Contractors		14, 15
Use of Data		65
Social Processes		
Culture		
Organizational Values	22a, 22b, 22c, 22d, 22e, 22f, 22g, 22h, 22i, 22j, 22k, 22l	70a-70bb
Goals		
Goal Specificity	37, 38	37, 38, 39, 41
Goal Feedback	39, 40, 41	43
Goal Negotiability		40, 42
Roles		
Role Conflict	27, 28, 29, 30	
Role Overload	31, 32, 33	
Role Negotiability	34, 35	

Figure 8-1 (continued)
Taxonomy of Organizational Context Variables

Construct Label	Item Number on Incumbent Questionnaire	Item Number in Organizational Representative CATI
Leadership		
Consideration	18	
Task-Orientation	19	
Visionary	20	
Problem Solving	21	
Changes in Leadership	23	

Note. See Appendix F of Development of Prototype Occupational Information Network (O*NET) Content Model (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1995) for the exact wording of the incumbent questionnaire items. See Appendix A of this report for the exact wording of the organizational representative CATI items. The constructs in the above taxonomy differ slightly from those in the original taxonomy described by Arad, Schneider, and Hanson (1995); the taxonomy has been modified, as described in the text, based in part on feedback from organizational representatives.

Figure 8-2
Description and Definitions of Organizational Context Descriptors and Scales (Incumbent Questionnaire)

Descriptor/Scale (# Items)	Definition	Item # (s) in Questionnaire
1. Empowerment (2)	Has influence and control over decisions made in unit or department	1, 2
2. Autonomy (3)	Has freedom and autonomy in job	3, 13, 16
3. Task Identity (3)	The job involves doing a 'whole' and identifiable piece of work	4, 9, 14
4. Skill Variety (3)	The job requires one to use many different skills and talents	5, 8, 11
5. Task Significance (3)	The job is important and affects the lives or well-being of other people	6, 12, 17
6. Feedback (3)	The job itself provides information about one's performance	7, 10, 15
7. Role Conflict (4)	Works with supervisors or groups that have conflicting requests	27, 28, 29, 30
8. Role Overload (2)	Does not have enough time to accomplish assigned work	32, 33
9. Adequate Resources	Has adequate resources and materials to complete assignments	31
10. Role Negotiability (2)	Can negotiate the nature of role/job with supervisor	34, 35
11. Goal Specificity (2)	Has individual goals that are specific and quantitative	37, 38
12. Goal Feedback (3)	Receives feedback on goal achievement	39, 40, 41
13. Decentralization (4)	Has the authority to monitor quality data, determine work flow, invest in new equipment, and develop new products	42a, 42b, 42c, 42d
14. People-Oriented Values (4)	Importance to the organization of the values that emphasize caring about employees, fairness, and openness	22b, 22f, 22i, 22k
15. Risk-Taking Values (6)	Importance to the organization of the values that emphasize taking chances, innovation, flexibility and aggressiveness	22a, 22d, 22e, 22g, 22h, 221

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Figure 8-2 (continued)
Description and Definitions of Organizational Context Descriptors and Scales (Incumbent Questionnaire)

Descriptor/Scale (# Items)	Definition	Item # (s) in Questionnaire
16. Attention to Details Values (2)	Importance to the organization of the values that emphasize precision and quality are important	22c, 22j
17. Stability Value	Importance to the organization of stability	22d
18. Leader: Consideration	Immediate supervisor acts in friendly and supportive manner	18
19. Leader: Task Orientation	Immediate supervisor sets goals and assigns tasks for the work group	19
20. Leader: Visionary	Immediate supervisor provides a clear vision for the work group and keeps everybody committed	20
21. Leader: Problem Solving	Immediate supervisor solves difficult problems quickly and effectively	21
22. No. Supervisors	Number of supervisors in the past year	23
23. No. Teams	Number of work teams belonged to in the past year	24
24. No. Reorganizations	Number of reorganizations of primary work group	25
25. No. Changes in Job Duties	Number of times the nature of job duties changed dramatically	26
26. % Time Spent in Teams	Percent of time spent working in an intact team	43
27. No. Training Methods	Number of training methods used in company training courses attended in the last two years	48
28. No. Training Topics	Number of content areas of formal training received in the last two years	46
29. No. Selection Methods	Number of assessment methods used to select people for this job	49
30. No. Recruitment Sources	Number of sources used to recruit people for this job	50
31. No. Compensation Elements	Number of elements included in the compensation package for this job	44

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Figure 8-2 (continued)
Description and Definitions of Organizational Context Descriptors and Scales (Incumbent Questionnaire)

Descriptor/Scale (# Items)	Definition	Item # (s) in Questionnaire
32. No. Benefit Elements	Number of elements included in the benefits package for this job	45
33. Job Rotation Practices	The scope of job rotation practices in this job	51

Note. See Appendix F of Development of Prototype Occupational Information Network (O*NET) Content Model (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1995) for the exact wording of the incumbent questionnaire items.

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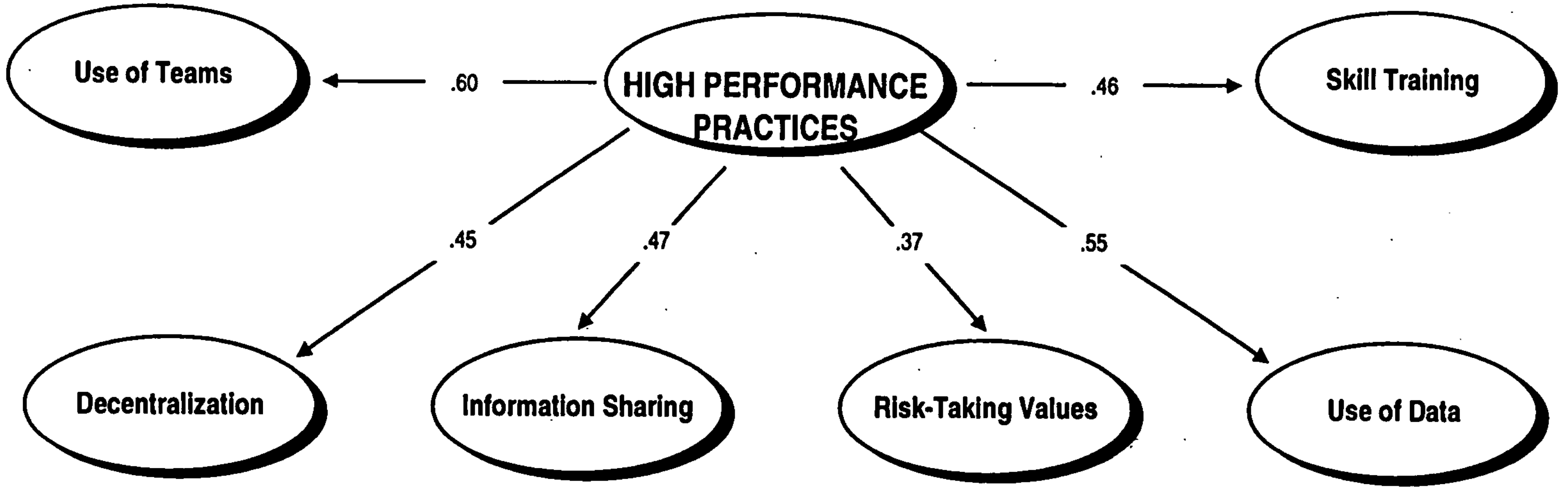
Figure 8-3
Thirty Occupations With Four or More Incumbents Completing the Organizational Context Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	8
19005	General Managers & Top Executives	40
22114	Chemical Engineers	4
25105	Computer Programmers	9
27311	Recreation Workers	6
31302	Teachers, Preschool	5
31305	Teachers, Elementary School	5
32502	Registered Nurses	27
32902	Medical $ Clinical Laboratory Technologists	4
49008	Salespersons, Except Scientific & Retail	11
49011	Salespersons, Retail	15
49021	Stock Clerks, Sales Floor	7
49023	Cashiers	15
51002	First line Supervisors, Clerical/Administrative	50
55108	Secretaries, Except Legal & Medical	64
55305	Receptionists & Information clerks	12
55338	Bookkeeping, Accounting, & Auditing Clerks	20
55347	General Office Clerks	68
61005	Police & Detective Supervisors	12
63014	Police Patrol Officers	20
65008	Waiters & Waitresses	12
65038	Food Preparation Workers	29
66008	Nursing Aids, Orderlies, & Attendants	17
67005	Janitors & Cleaners	21
85119	Other Machinery Maintenance Mechanics	5
85132	Maintenance Repairer, General Utility	30
87902	Earth Drillers, Except Oil & Gas	6
92974	Packing & Filling Machine Operators	12
97102	Truck Drivers, Heavy or Tractor Trailers	9
97111	Bus Drivers, School	11

Figure 8-4
Model and Structural Coefficients for Second-Order Confirmatory Factor Analysis: Organizational Context



$\chi^2/df = 1.71$
RMSR = .06
GFI = .92
AGFI = .90
NFI = .87
NNFI = .93

Table 8-1

Descriptive Statistics Across All Occupations and Organizations and Reliability Estimates for Rated Differences between Occupations and Organizations: Organizational Context

			Level of Analysis							
			Across Occupations[a]				Across Organizations[b]			
Descriptor/Scale (# Items)	Rating Scale	α	M	SD	SEM[c]	r_k[d]	M	SD	SEM	r_k
1. Empowerment (2)	1 = strongly disagree 5 = strongly agree	.91	3.17	0.49	.23	.77	3.16	0.46	.40	.27
2. Autonomy (3)	1 = very little autonomy 5=very much autonomy	.77	3.90	0.34	.21	.59	3.91	0.29	.27	.13
3. Task Identity (3)	1=my job is only part of the work 5=my job involved doing a whole piece of work	.71	3.79	0.32	.28	.26	3.79	0.31	.34	.00
4. Skill Variety (3)	1=very little variety 5=very much variety	.71	3.97	0.48	.24	.76	3.98	0.45	.27	.62
5. Task Significance (3)	1=not very significant 5=highly significant	.74	4.17	0.41	.23	.67	4.23	0.35	.24	.51
6. Feedback (3)	1=very little feedback 5=very much feedback	.77	3.89	0.30	.27	.23	3.95	0.24	.24	.00
7. Role Conflict (4)	1=strongly disagree 5=strongly agree	.70	2.74	0.34	.27	.42	2.80	0.25	.21	.32
8. Role Overload (2)	1=strongly disagree 5=strongly agree	.61	2.93	0.34	.26	.40	2.94	0.44	.32	.46
9. Adequate Resources	1=strongly disagree 5=strongly agree		3.09	0.44	.32	.46	3.24	0.48	.42	.24
10. Role Negotiability (2)	1=strongly disagree 5=strongly agree	.31	3.36	0.31	.21	.54	3.33	0.32	.28	.23
11. Goal Specificity (2)	1=none; 2=few; 3=some; 4=most; 5=all goals specific	.44	1.91	0.78	.36	.79	1.96	0.70	.50	.49

Table 8-1 (continued)

Descriptive Statistics Across All Occupations and Organizations and Reliability Estimates for Rated Differences between Occupations and Organizations: Organizational Context

			Level of Analysis							
			Across Occupations[a]				Across Organizations[b]			
Descriptor/Scale (# Items)	Rating Scale	α	M	SD	SEM[c]	r_k[d]	M	SD	SEM	r_k
12. Goal Feedback (3)	1=never; 2=once a year; 3=twice a year; 4=3 times a year; 5=4 times a year	.59	2.38	0.47	.28	.64	2.40	0.45	.36	.35
13. Decentralization (4)	1=not at all 5=to a great extent	.76	2.32	0.47	.20	.83	2.33	0.51	.40	.37
14. People-Oriented Values (3)	1=not important 5=extremely important	.74	3.41	0.45	.45	.00	3.34	0.29	.27	.15
15. Risk-Taking Values (6)	1=not important 5=extremely important	.80	3.30	0.32	.32	.00	3.31	0.24	.21	.24
16. Attention to Detail Values (2)	1=not important 5=extremely important	.45	3.84	0.34	.31	.19	3.82	0.27	.25	.12
17. Stability Value	1=not important 5=extremely important		3.41	0.50	.50	.00	3.37	0.36	.31	.26
18. Leader: Consideration	1=not at all 5=to a great extent		3.84	0.34	.28	.28	3.93	0.45	.42	.10
19. Leader: Task Orientation	1=not at all 5=to a great extent		3.62	0.37	.30	.41	3.56	0.49	.41	.30
20. Leader: Visionary	1=not at all 5=to a great extent		3.45	0.40	.36	.20	3.45	0.42	.42	.00
21. Leader: Problem Solving	1=not at all 5=to a great extent		3.58	0.38	.27	.48	3.57	0.46	.45	.04
22. No. Supervisors	1=only one; 2=2; 3=3; 4=4 or more		1.80	0.58	.31	.72	1.72	0.49	.36	.45
23. No. Teams	1=none; 2=1; 3=2-3; 4=4-6; 5=7-10; 6=11 or more		2.63	0.67	.31	.79	2.40	0.46	.41	.23

Table 8-1 (continued)

Descriptive Statistics Across All Occupations and Organizations and Reliability Estimates for Rated Differences between Occupations and Organizations: Organizational Context

			Level of Analysis							
			Across Occupations[a]				Across Organizations[b]			
Descriptor/Scale (# Items)	Rating Scale	α	M	SD	SEM[c]	r_k[d]	M	SD	SEM	r_k
24. No. Reorganizations	1=never; 2=once; 3=twice, 4=3-5 times; 5=6 times or more		2.12	0.32	.27	.27	2.02	0.45	.38	.28
25. No. Changes in Job Duties	1=never; 2=once; 3=twice, 4=3-5 times; 5=6 times or more		1.84	0.39	.36	.16	1.75	0.48	.39	.38
26. % Time Spent in Teams	1=none; 2=less than 25%; 3=25-50%; 4=51-75%; 5=more than 75%		2.91	0.82	.40	.76	2.72	0.78	.59	.42
27. No. Training Methods	# items checked out of 12		2.73	0.86	.49	.68	2.72	1.17	.76	.57
28. No. Training Topics	# items checked out of 7		1.45	0.72	.39	.71	1.52	0.87	.59	.55
29. No. Selection Methods	# items checked out of 13		4.11	1.21	.70	.67	4.21	1.22	.95	.39
30. No. Recruitment Sources	# items checked out of 16		3.42	0.61	.34	.34	3.51	0.82	.62	.44
31. No. Compensation Elements	# items checked out of 8		1.20	0.61	.50	.70	1.19	0.70	.46	.57
32. No. Benefit Elements	# items checked out of 8		4.13	1.03	.33	.61	4.25	1.19	.46	.70
33. Job Rotation Practices	1=no job rotation 2=rotate within workgroup 3=rotate across workgroups 4=rotate across departments		2.08	0.56	.35	.60	1.91	0.52	.44	.28

[a] Statistics across occupations are based on 30 occupations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents=18.47, median=12, harmonic mean=10.14).

[b] Statistics are across organizations based on 70 organizations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents=7.91, median=7.00, harmonic mean = 6.51).

[c] This estimate of the standard error of measurement was calculated as $\underline{SEM} = \underline{SD} * \sqrt{(1 - r_k)}$

[d] This estimate of reliability was obtained by calculating the intraclass correlation for the mean of k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each organization.

Table 8-2

Reliability of Rated Differences between Occupations and Organizations Considering Varying Numbers of Raters: Organizational Context

Descriptor/Scale	Number of Raters for Each Level of Analysis: Across Occupations[a] r_1[d]	r_{30}[e]	Across Organizations[b] r_1	r_{30}	Within Organization Cells[c] r_1	r_{30}
1. Empowerment	25	91	05	63	23	90
2. Autonomy	12	81	02	42	21	89
3. Task Identity	03	51	00	00	04	57
4. Skill Variety	24	91	20	88	21	89
5. Task Significance	17	86	14	82	13	82
6. Feedback	03	46	00	00	01	30
7. Role Conflict	07	68	07	69	06	64
8. Role Overload	06	66	11	80	14	82
9. Adequate Resources	08	71	05	59	11	79
10. Role Negotiability	11	78	04	58	07	68
11. Goal Specificity	27	92	13	82	30	93
12. Goal Feedback	15	84	08	72	21	89
13. Decentralization	32	93	08	73	23	90
14. People-Oriented Values	00	00	03	44	06	67
15. Risk-Taking Values	00	00	05	60	08	72
16. Attention to Detail Values	02	41	02	38	11	78
17. Stability Value	00	00	05	62	05	63
18. Leader: Consideration	04	54	02	33	03	52
19. Leader: Task Orientation	06	67	06	66	21	89
20. Leader: Visionary	02	43	00	00	03	49
21. Leader: Problem Solving	08	73	01	18	18	87
22. No. Supervisors	20	88	11	79	30	93
23. No. Teams	28	92	04	58	15	84
24. No. Reorganizations	04	52	06	64	21	89
25. No. Changes in Job Duties	02	37	09	74	16	85
26. % Time Spent in Teams	23	90	10	77	16	85
27. No. Training Methods	17	86	17	86	37	95
28. No. Training Topics	20	88	16	85	39	95
29. No. Selection Methods	17	86	09	75	27	92
30. No. Recruitment Sources	05	61	11	78	12	80
31. No. Compensation Elements	19	87	17	86	28	92
32. No. Benefit Elements	22	89	15	84	39	95
33. Job Rotation Practices	13	82	06	65	13	82

[a] Reliability estimates across occupations are based on 30 occupations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.47, median = 12, harmonic mean = 10.14).

Table 8-2 (continued)
Reliability of Rated Differences between Occupations and Organizations Considering Varying Numbers of Raters: Organizational Context

[b]Reliability estimates across organizations are based on 70 organizations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents = 7.91, median = 7.00, harmonic mean = 6.51). Decimals are omitted.
[c]Statistics are based on 50 cells where a cell is defined as incumbents in the same occupation and the same organization with Organizational Context questionnaire responses from at least 4 incumbents per cell (mean number of incumbents = 4.85, median = 4.00, harmonic mean = 4.72).
[d]Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judge ratings across occupations: ICC(1,1) = [BMS-WMS]/[BMS+(k-1)WMS] (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
[e]Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

Table 8-4a

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation: Organizational Context

Source of Variation	SS	df	MS	F
Occupations	580.22	29	20.01	3.10*
S(Occupations)	3379.80	524	6.45	
Descriptor	6830.05	31	220.32	173.42*
Descriptor x Occupations	3163.87	899	3.52	2.77*
Descriptor x S(Occupations)	20637.13	16244	1.27	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 8-4b

Analysis of Variance for Descriptor, Organization, and Relevant Interactions as Sources of Variation: Organizational Context

Source of Variation	SS	df	MS	F
Organization	691.61	69	10.02	1.48*
S(Organizations)	3268.41	484	6.75	
Descriptor	11041.27	31	356.17	282.35*
Descriptor x Organizations	4874.01	2139	2.28	1.81*
Descriptor x S(Organizations)	18926.99	15004	1.26	

Note. Organizations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

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Table 8-4c

Analysis of Variance for Descriptor, Occupation, Organization, and Relevant Interactions as Sources of Variation: Organizational Context

Source of Variation	SS	df	MS	F
Occupations	434.82	27	16.10	2.82*
Organizations	511.71	67	7.64	N.S
Occupations x Organizations	948.24	129	7.35	1.29*
S(Occupations) x S(Organizations)	1874.18	328	5.71	
Descriptor	5860.59	31	189.05	166.77*
Descriptor x Occupations	2078.07	837	2.48	2.19*
Descriptor x Organizations	3522.54	2077	1.79	1.50*
Descriptor x Occupations x Organizations	5250.45	3999	1.31	1.16*
Descriptor x S(Occupations) x S(Organizations)	11526.79	10168	1.13	

Note. Occupations and organizations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.

*$p < .05$

Table 8-5

Interrater Agreement Coefficients Across Occupations and Across Organizations: Organizational Context

Scale Type	Number of Raters for Each Level of Analysis r_k	r_1	r_{30}
Across Occupations[a]	64	15	84
Across Organizations[b]	45	11	79

Note. Full sample interrater agreement coefficients (r_k) were obtained by considering the "Descriptor x Occupations" terms from Tables 8-4a and 8-4b as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

[a]Interrater agreement coefficient estimates are based on 30 occupations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents=18.47, median=12, harmonic mean=10.14).

[b]Interrater agreement coefficient estimates are based on 70 organizations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents= 7.91, median=7.00, harmonic mean=6.51).

Table 8-6a

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation: Organizational Context

Source of Variation	SS	df	MS	F
Occupations	75.49	29	2.60	2.37*
S(Occupations)	575.93	524	1.10	
Aggregate	1.06	5	0.21	N.S.
Aggregate x Occupations	129.60	145	0.89	2.51*
Aggregate x S(Occupations)	931.11	2620	0.36	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.
*$p < .05$

Table 8-6b

Analysis of Variance for Aggregate Descriptor, Organization, and Relevant Interactions as Sources of Variation: Organizational Context

Source of Variation	SS	df	MS	F
Organization	101.08	69	1.46	N.S.
S(Organizations)	550.33	484	1.14	
Aggregate	0.15	5	0.03	N.S.
Aggregate x Organizations	212.08	345	0.61	1.75*
Aggregate x S(Organizations)	848.63	2420	0.35	

Note. Organizations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.

*$p < .05$

Table 8-6c

Analysis of Variance for Aggregate Descriptor, Occupation, Organization, and Relevant Interactions as Sources of Variation: Organizational Context

Source of Variation	SS	df	MS	F
Occupations	61.20	27	2.27	2.24*
Organizations	88.95	67	1.33	NS.
Occupations x Organizations	158.09	129	1.23	NS.
S(Occupations) x S(Organizations)	332.32	328	1.01	
Aggregate	0.57	5	0.11	NS.
Aggregate x Occupations	106.94	135	0.79	2.56*
Aggregate x Organizations	175.94	335	0.53	1.70*
Aggregate x Occupations x Organizations	239.98	645	0.37	1.20*
Aggregate x S(Occupations) x S (Organizations)	506.59	1640	0.31	

Note. Occupations and organizations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.
*p < .05

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Table 8-7

Interrater Agreement Coefficients for Aggregate Descriptors Across Occupations and Across Organizations: Organizational Context

	Number of Raters for Each Level of Analysis		
	r_k	r_1	r_{30}
Across Occupations[a]	60	13	82
Across Organizations[b]	41	10	77

Note. Full sample interrater agreement coefficients (r_k) were obtained by considering the "Aggregate x Occupations or Organizations" terms from Tables 8-6a and 8-6b as true variance. Error variance was defined as the "Aggregate x S(Occupations) or S(Organizations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

[a] Interrater agreement coefficient estimates are based on 30 occupations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents=18.47, median=12, harmonic mean=10.14).

[b] Interrater agreement coefficient estimates are based on 70 organizations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents=7.91, median=7.00, harmonic mean=6.51).

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Table 8-9a

Intercorrelations of Descriptors/Scales (Occupation-Level Data): Organizational Context

Descriptor/Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Empowerment	--																
2. Autonomy	51	--															
3. Task Identity	08	-01	--														
4. Skill Variety	49	54	18	--													
5. Task Significance	16	18	03	50	--												
6. Feedback	38	10	46	23	28	--											
7. Role Conflict	22	16	45	40	18	22	--										
8. Role Overload	46	27	-18	32	00	05	18	--									
9. Adequate Resources	-37	-22	-19	-36	08	-34	-47	-18	--								
10. Role Negotiability	44	16	-17	05	-26	10	00	12	-46	--							
11. Goal Specificity	43	67	-04	15	02	07	25	26	-19	12	--						
12. Goal Feedback	59	53	-26	15	01	16	-07	40	-25	27	66	--					
13. Decentralization	67	45	18	46	10	12	46	51	-36	17	48	42	--				
14. People-Oriented Values	20	02	30	11	23	41	14	-17	17	10	05	19	-04	--			
15. Risk-Taking Values	26	27	41	43	08	43	51	12	-45	10	25	19	15	62	--		
16. Attention to Detail Values	12	-05	25	25	-07	27	35	04	-06	-20	-03	13	25	36	55	--	
17. Stability Values	17	04	18	04	19	25	07	-28	05	20	-11	16	-16	66	38	17	--
18. Leader: Consideration	39	18	-15	47	-10	-05	-04	48	-11	18	13	42	34	07	21	35	06
19. Leader: Task Orientation	-08	-11	20	-08	01	24	-28	-32	26	-22	-04	02	-38	50	38	-01	40
20. Leader: Visionary	14	-00	15	29	19	24	-09	-10	16	-24	-13	-10	-21	41	42	08	28
21. Leader: Problem Solving	-19	-33	05	-26	-23	12	34	-27	22	-03	-24	-01	-30	56	29	38	35
22. No. Supervisors	-38	-34	33	-29	-13	12	31	-51	00	-19	-21	-34	-23	50	41	26	30
23. No. Teams	42	36	28	36	15	32	50	16	-33	-07	33	24	62	15	26	16	10
24. No. Reorganizations	-14	-17	-09	-15	-18	17	29	-05	-12	-20	-04	-14	04	09	13	41	-07
25. No. Changes in Job Duties	-12	-45	14	-13	-03	20	32	-04	-13	-13	-21	-12	21	21	12	48	-07
26. % Time Spent in Teams	14	-07	17	21	13	32	33	32	-10	-29	-11	-16	34	07	29	46	-10
27. No. Training Topics	42	43	-31	29	05	06	24	24	-36	26	39	45	39	-05	05	31	09
28. No. Training Methods	21	24	-23	42	07	04	13	21	-12	15	20	09	11	-16	-04	20	-20

Table 8-9a (continued)
Intercorrelations of Descriptors/Scales (Occupation-Level Data): Organizational Context

Descriptor/Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
29. No. Selection Methods	12	31	-12	70	51	13	08	00	-11	-03	-00	00	11	-04	-06	08	-05
30. No. Recruitment Sources	29	18	22	35	-01	15	30	37	-10	-03	09	03	48	-04	08	49	-18
31. No. Compensation Elements	29	42	-24	01	-28	-20	-03	45	00	27	49	25	41	-30	-09	-28	-27
32. No. Benefits Elements	21	40	-42	26	04	-29	-09	40	10	111	38	20	31	-44	-25	-34	-31
33. Job Rotation Practices	-22	-25	-07	-11	-06	-10	17	14	-02	-17	-11	-29	11	-39	-23	-07	-04

Table 8-9a (continued)
Intercorrelations of Descriptors/Scales (Occupation-Level Data): Organizational Context

Descriptor/Scale	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
18. Leader: Consideration	--															
19. Leader: Task Oriented	12	--														
20. Leader: Visionary	33	75	--													
21. Leader: Problem Solving	25	62	46	--												
22. No. Supervisors	-35	31	21	51	--											
23. No. Teams	04	-06	04	-15	11	--										
24. No. Reorganizations	-11	-07	03	19	47	44	--									
25. No. Changes in Job Duties	01	-17	-10	30	50	16	53	--								
26. % Time Spent in Teams	01	-03	17	09	18	43	51	38	--							
27. No. Training Topics	36	-47	-14	-18	-23	19	21	03	04	--						
28. No. Training Methods	41	-33	-08	-20	-37	09	26	-04	05	46	--					
29. No. Selection Methods	30	-19	06	-23	-35	18	05	-11	-02	35	70	--				
30. No. Recruitment Sources	17	-18	-09	-06	-17	40	25	04	42	12	25	25	--			
31. No. Compensation Elements	13	-13	-18	-22	-32	28	00	-36	20	07	16	-15	20	--		
32. No. Benefits Elements	27	-24	-10	-47	-57	-08	-29	-29	-18	20	21	19	03	48	--	
33. Job Rotation Practices	-15	-37	-34	-10	05	26	40	40	43	-15	27	03	06	23	-14	--

Note. N=30. All correlations calculated based on the mean of ratings assigned on a given job and descriptor/scale. Decimals are omitted.

Table 8-9b

Intercorrelations of Descriptors/Scales (Organization-Level Data): Organizational Context

Descriptor/Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Empowerment	--																
2. Autonomy	57	--															
3. Task Identity	15	27	--														
4. Skill Variety	44	62	20	--													
5. Task Significance	37	33	10	38	--												
6. Feedback	36	25	50	25	40	--											
7. Role Conflict	27	23	08	36	27	06	--										
8. Role Overload	28	23	03	44	23	16	47	--									
9. Adequate Resources	-27	-09	-13	-27	-14	-27	-41	-44	--								
10. Role Negotiability	58	50	16	32	16	08	27	27	-20	--							
11. Goal Specificity	35	37	07	28	24	16	28	28	-36	31	--						
12. Goal Feedback	48	43	-04	33	29	13	25	26	-29	37	68	--					
13. Decentralization	64	50	26	48	24	23	32	33	-24	51	47	51	--				
14. People-Oriented Values	21	-01	02	-23	12	00	-14	-31	33	09	-04	01	06	--			
15. Risk-Taking Values	25	16	02	-09	11	-02	15	-04	15	17	30	26	20	67	--		
16. Attention to Detail Values	14	-04	-10	-23	-06	-12	03	-23	32	12	05	07	14	62	70	--	
17. Stability Values	-00	-09	04	-24	07	-06	-26	-43	40	-13	-25	-21	-15	76	41	49	--
18. Leader: Consideration	34	26	03	08	-09	-12	-17	-08	12	38	10	18	35	31	27	33	15
19. Leader: Task Orientation	-10	-04	-11	-19	-21	-11	-27	-33	35	-10	-04	-05	-21	40	32	28	33
20. Leader: Visionary	15	03	-01	08	-06	04	-12	-19	23	07	10	07	03	34	25	21	21
21. Leader: Problem Solving	-03	-13	-10	-09	-13	01	-23	-33	30	-03	-03	-08	-19	38	31	27	27
22. No. Supervisors	-19	-24	21	-13	02	10	24	-04	-08	-12	-04	-09	-16	15	19	09	11
23. No. Teams	24	13	16	42	14	19	54	17	-41	-05	18	06	14	-23	16	-21	-33
24. No. Reorganizations	10	09	-02	10	00	-14	48	39	-29	19	27	21	02	-12	15	01	-32
25. No. Changes in Job Duties	09	-06	02	13	10	-08	62	37	-32	30	23	16	08	-05	15	05	-12
26. % Time Spent in Teams	32	01	24	17	25	23	27	26	-14	02	10	13	19	-04	16	17	-04
27. No. Training Topics	36	28	-14	27	05	-04	24	17	-04	26	27	34	27	18	30	22	-01
28. No. Training Methods	23	16	-18	28	14	-03	27	18	-09	15	38	39	29	18	31	21	-05

Table 8-9b (continued)

Intercorrelations of Descriptors/Scales (Organization-Level Data): Organizational Context

Descriptor/Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
29. No. Selection Methods	01	14	-06	45	17	-07	13	05	-06	-08	12	17	06	-07	-06	-17	-04
30. No. Recruitment Sources	33	16	-05	23	-02	01	06	31	-20	26	21	18	22	-05	07	13	-11
31. No. Compensation Elements	28	26	-02	23	-17	00	20	22	-01	22	26	29	33	11	35	29	-16
32. No. Benefits Elements	04	35	-16	34	01	-27	12	32	-06	28	42	26	23	-26	05	-03	-28
33. Job Rotation Practices	11	07	03	18	07	-06	15	29	-11	12	08	06	06	14	10	-00	04

Table 8-9b (continued)

Intercorrelations of Descriptors/Scales (Organization-Level Data): Organizational Context

Descriptor/Scale	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
18. Leader: Consideration	--															
19. Leader: Task Oriented	28	--														
20. Leader: Visionary	38	67	--													
21. Leader: Problem Solving	36	70	67	--												
22. No. Supervisors	-15	-01	03	29	--											
23. No. Teams	-13	-12	08	03	22	--										
24. No. Reorganizations	08	-02	04	12	29	41	--									
25. No. Changes in Job Duties	-05	-13	05	11	35	42	60	--								
26. % Time Spent in Teams	05	-09	12	-03	17	23	11	13	--							
27. No. Training Topics	21	-10	03	01	-03	16	24	27	01	--						
28. No. Training Methods	18	-09	10	-02	-10	23	21	18	04	59	--					
29. No. Selection Methods	00	-15	09	-18	-20	18	04	02	-06	20	41	--				
30. No. Recruitment Sources	26	-15	07	-13	-22	02	14	06	05	32	36	35	--			
31. No. Compensation Elements	29	05	21	04	-04	15	22	-05	28	42	39	04	25	--		
32. No. Benefits Elements	10	-11	03	-22	-25	-03	19	10	-21	27	37	29	26	37	--	
33. Job Rotation Practices	20	04	22	14	11	13	29	27	12	27	19	12	11	30	-13	--

Note. N=70. All correlations calculated based on the mean of ratings assigned to a given organization and descriptor. Decimals are omitted.

Table 8-10a

Intercorrelations of Descriptors/Scales (Individual-Level Data): Organizational Context

Descriptor/Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Empowerment	--																
2. Autonomy	46	--															
3. Task Identity	11	31	--														
4. Skill Variety	34	37	13	--													
5. Task Significance	33	14	05	51	--												
6. Feedback	24	28	35	21	37	--											
7. Role Conflict	02	-02	-02	21	11	-06	--										
8. Role Overload	11	07	-01	22	24	-01	42	--									
9. Adequate Resources	-09	01	02	-19	-06	-08	-54	-32	--								
10. Role Negotiability	37	37	32	07	05	24	-09	00	-19	--							
11. Goal Specificity	14	-01	12	13	02	-01	03	-06	-10	02	--						
12. Goal Feedback	39	16	03	22	18	27	-19	08	-08	22	44	--					
13. Decentralization	48	33	15	32	10	23	02	21	-09	20	26	48	--				
14. People-Oriented Values	37	32	13	19	24	32	-23	-30	22	17	10	26	21	--			
15. Risk-Taking Values	40	36	20	24	26	33	-13	-13	06	25	12	22	18	73	--		
16. Attention to Detail Values	22	14	14	23	21	20	09	-16	05	02	11	10	13	55	72	--	
17. Stability Values	36	22	15	16	31	41	-15	-10	24	17	10	23	15	63	64	54	--
18. Leader: Consideration	31	19	03	13	01	19	-41	-18	22	31	11	34	13	44	47	23	33
19. Leader: Task Orientation	22	11	09	11	11	28	-27	-19	39	20	17	34	06	41	42	24	44
20. Leader: Visionary	26	21	09	32	27	40	-23	-19	34	26	05	27	04	39	42	25	38
21. Leader: Problem Solving	12	-01	03	09	03	25	-31	-32	37	26	12	30	05	39	40	27	31
22. No. Supervisors	-11	-26	-09	-17	-12	-21	23	-13	-08	-02	-13	-14	-07	-14	-13	-03	-12
23. No. Teams	20	11	00	01	-08	-02	24	16	-16	10	10	15	22	-02	-03	-00	-05
24. No. Reorganizations	-10	-26	-16	-08	-07	-20	39	17	-11	-20	-02	-19	-18	-19	-13	03	-15
25. No. Changes in Job Duties	-23	-23	-08	05	03	-10	39	24	-23	-11	09	-12	-07	-13	-17	-00	-14
26. % Time Spent in Teams	29	05	12	25	27	19	10	15	-17	10	09	16	21	07	17	14	14
27. No. Training Topics	24	17	07	19	10	05	10	-03	-11	09	25	30	34	-02	12	05	04
28. No. Training Methods	27	17	12	17	10	06	02	-14	08	12	23	29	17	20	28	11	04

Table 8-10a (continued)

Intercorrelations of Descriptors/Scales (Individual-Level Data[1]): Organizational Context

Descriptor/scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
29. No. Selection Methods	03	11	06	21	19	05	-03	-26	16	-01	09	-03	01	16	16	15	05
30. No. Recruitment Sources	09	04	10	03	13	-04	-06	-12	00	10	02	-12	01	10	08	07	10
31. No. Compensation Elements	21	18	-02	-08	-18	-09	-10	02	-06	15	27	09	11	19	22	07	05
32. No. Benefits Elements	21	18	-02	-08	-18	-09	-10	13	-09	-13	22	09	10	03	04	03	02
33. Job Rotation Practices	14	-06	-06	-05	13	07	04	03	-06	05	-09	-08	08	05	09	07	03

Table 8-10a (continued)
Intercorrelations of Descriptors/Scales (Individual-Level Data): Organizational Context

Descriptor/Scale	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
18. Leader: Consideration	--															
19. Leader: Task Oriented	50	--														
20. Leader: Visionary	63	66	--													
21. Leader: Problem Solving	65	62	61	--												
22. No. Supervisors	-18	-04	-19	03	--											
23. No. Teams	-07	03	01	-11	06	--										
24. No. Reorganizations	-23	-18	-16	-07	29	19	--									
25. No. Changes in Job Duties	-19	07	01	01	39	09	38	--								
26. % Time Spent in Teams	21	08	12	05	01	11	09	10	--							
27. No. Training Topics	07	-09	05	08	11	25	05	-10	07	--						
28. No. Training Methods	19	10	15	01	-11	24	05	-16	-01	34	--					
29. No. Selection Methods	16	-01	08	-03	-21	08	-02	13	08	17	25	--				
30. No. Recruitment Sources	07	-04	03	12	01	06	-04	09	11	08	03	17	--			
31. No. Compensation Elements	20	09	04	07	-06	17	-09	-18	15	09	17	-00	03	--		
32. No. Benefits Elements	16	02	05	-05	-29	-01	-10	-10	03	02	06	10	02	14	--	
33. Job Rotation Practices	-06	-02	-05	06	04	-01	10	08	12	07	07	06	05	06	-04	--

Note. N=112 (4 incumbents selected at random from each of 28 occupations). All correlations are based on individual incumbent ratings assigned on a given job and descriptor/scale. Decimals are omitted.

Table 8-10b

Intercorrelations of Descriptors/Scales (Individual-Level Data): Organizational Context

Descriptor/Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Empowerment	--																
2. Autonomy	46	--															
3. Task Identity	08	37	--														
4. Skill Variety	42	48	18	--													
5. Task Significance	39	31	21	51	--												
6. Feedback	31	39	42	37	47	--											
7. Role Conflict	08	-07	-09	14	07	-07	--										
8. Role Overload	02	03	-05	30	14	00	38	--									
9. Adequate Resources	-10	-04	01	-14	-06	-03	-49	-39	--								
10. Role Negotiability	41	50	30	21	18	22	-01	14	-16	--							
11. Goal Specificity	30	15	09	27	12	20	10	-04	-07	15	--						
12. Goal Feedback	37	19	11	29	25	29	-09	00	04	23	54	--					
13. Decentralization	51	34	06	41	18	26	15	19	-15	31	43	43	--				
14. People-Oriented Values	28	22	18	17	22	27	-19	-29	19	26	12	16	17	--			
15. Risk-Taking Values	29	28	25	16	21	30	-12	-16	11	29	19	23	16	70	--		
16. Attention to Detail Values	12	06	12	04	08	19	-04	-11	10	16	15	10	08	63	73	--	
17. Stability Values	17	12	10	02	10	16	-23	-21	17	14	04	04	05	64	57	58	--
18. Leader: Consideration	33	33	16	23	22	22	-32	-16	21	29	13	28	16	43	45	32	27
19. Leader: Task Orientation	09	11	12	08	14	17	-33	-27	33	10	11	30	-06	34	35	27	31
20. Leader: Visionary	26	27	17	26	26	36	-26	-20	27	20	15	32	07	42	38	31	31
21. Leader: Problem Solving	13	22	23	15	15	30	-30	-24	28	20	07	18	-00	41	36	33	26
22. No. Supervisors	-04	-13	-06	-03	00	-06	15	-04	-03	-07	04	-08	-05	02	03	05	-02
23. No. Teams	16	07	-02	14	06	11	25	14	-19	05	16	17	17	-07	01	-05	-06
24. No. Reorganizations	01	-11	-06	05	-03	-02	36	21	-13	-07	14	06	-02	-08	05	08	-08
25. No. Changes in Job Duties	-06	-17	-04	07	06	-07	31	23	-13	-03	19	01	03	-03	02	06	-02
26. % Time Spent in Teams	29	03	02	19	21	11	16	13	-18	08	20	23	22	02	08	05	03
27. No. Training Topics	42	22	02	26	15	09	18	04	-07	23	35	28	35	09	19	08	04
28. No. Training Methods	33	19	03	25	15	10	06	08	05	22	35	36	32	18	27	19	05

Table 8-10b (continued)

Intercorrelations of Descriptors/Scales (Individual-Level Data): Organizational Context

Descriptor/Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
29. No. Selection Methods	17	16	04	28	17	12	-02	-05	12	11	15	17	15	11	14	10	11
30. No. Recruitment Sources	10	01	-00	09	07	03	-00	04	-07	13	16	13	09	00	07	03	-03
31. No. Compensation Elements	24	20	04	09	-06	04	05	03	-07	21	25	19	23	19	25	17	06
32. No. Benefits Elements	09	20	-03	19	00	-06	06	08	-01	11	27	14	21	-02	09	05	-06
33. Job Rotation Practices	09	-00	05	10	13	08	16	08	-04	11	16	14	03	04	13	05	-04

Table 8-10b (continued)
Intercorrelations of Descriptors/Scales (Individual-Level Data): Organizational Context

Descriptor/Scale	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
18. Leader: Consideration	--															
19. Leader: Task Oriented	50	--														
20. Leader: Visionary	63	66	--													
21. Leader: Problem Solving	61	53	68	--												
22. No. Supervisors	-06	-07	-07	-02	--											
23. No. Teams	01	-01	06	-05	13	--										
24. No. Reorganizations	-14	-09	-08	-11	17	27	--									
25. No. Changes in Job Duties	-06	-01	-02	01	25	19	42	--								
26. % Time Spent in Teams	14	10	12	02	11	17	13	12	--							
27. No. Training Topics	08	-11	02	-03	05	19	12	05	18	--						
28. No. Training Methods	14	-00	07	04	-00	18	19	01	13	50	--					
29. No. Selection Methods	14	02	06	-02	-18	13	03	-02	11	25	30	--				
30. No. Recruitment Sources	10	-02	02	-03	-07	10	07	14	16	22	28	29	--			
31. No. Compensation Elements	20	05	10	-01	-00	14	07	-01	18	19	28	16	13	--		
32. No. Benefits Elements	12	-04	02	-07	-12	01	10	09	-03	22	23	19	18	24	--	
33. Job Rotation Practices	-01	04	07	04	12	11	18	18	16	17	16	04	15	16	-02	--

Note. N=272 (4 incumbents selected at random from each of 68 organizations). All correlations are based on individual incumbent ratings assigned on a given organization and descriptor/scale. Decimals are omitted.

Table 8-11

Principal Components Analysis Pattern Matrix: Organizational Context

Descriptor/Scale	Factor F1	F2	F3	F4	Communality
1. Empowerment	.80	.07	-.12	.18	.69
2. Autonomy	.72	-.15	-.21	.30	.68
3. Skill Variety	.38	.12	-.16	.78	.80
4. Task Significance	-.02	-.02	.05	.74	.55
5. Role Conflict	.26	.64	.00	.27	.54
6. Role Overload	.41	.17	-.57	-.07	.53
7. Adequate Resources	-.47	-.33	-.02	-.14	.35
8. Role Negotiability	.44	-.17	-.11	-.16	.26
9. Goal Specificity	.74	-.03	-.17	-.06	.58
10. Goal Feedback	.80	-.16	-.01	-.05	.66
11. Decentralization	.67	.44	-.32	.08	.75
12. Leader: Task Orientation	.01	-.26	.68	-.08	.53
13. Leader: Problem Solving	-.12	.06	.65	-.26	.51
14. No. Supervisors	-.24	.44	.71	-.20	.79
15. No. Teams	.46	.63	.00	.16	.64
16. No. Reorganizations	-.14	.76	.07	-.08	.62
17. No. Changes in Job Duties	-.21	.70	.22	-.09	.58
18. % Time Spent in Teams	-.02	.74	-.09	.01	.56
19. No. Training Topics	.48	.15	-.22	.29	.39
20. No. Training Methods	.05	.14	-.50	.45	.48
21. No. Selection Methods	-.02	.01	-.26	.87	.82
23. No. Compensation Elements	.43	.03	-.57	-.42	.68
24. No. Benefits Elements	.24	-.34	-.64	.04	.59
25. Job Rotation Practices	-.37	.57	-.44	-.16	.69
Percent of Variance	18	15	13	11	
Eigenvalue	4.60	3.80	3.36	2.85	

Note. N = 30. The correlation matrix was based on means calculated at the occupation level. F1 = Decentralization/Employee Empowerment; F2 = Work in Teams; F3 = Task-Oriented Leadership; F4 = Skill Variety. These loadings are based on orthogonal varimax rotation.

Table 8-12

Descriptor Means and Standard Deviations on Six Example Jobs: Organizational Context

Descriptor/Scale	General Managers and Top Executives (n=40) M	SD	Computer Programmers (n=9) M	SD	Registered Nurses (n=27) M	SD	Police Patrol Officers (n=20) M	SD	Janitors & Cleaners[a] (n=21) M	SD	Maintenance Repairs, General Utility (n=30) M	SD
1. Empowerment	4.15	1.03	3.33	.75	3.50	.91	2.35	.89	2.95	1.00	3.27	1.07
2. Autonomy	4.30	.60	4.19	.60	4.10	.66	4.15	.59	3.89	.65	3.99	1.03
3. Task Identity	3.60	.98	3.48	1.11	3.73	.86	3.40	.96	4.03	.64	4.03	.99
4. Skill Variety	4.39	.62	4.33	.44	4.48	.53	4.42	.48	3.56	.95	4.30	.86
5. Task Significance	4.44	.62	3.52	.56	4.60	.38	4.47	.69	4.27	.77	4.19	.89
6. Feedback	3.79	.82	3.59	.64	3.99	.58	3.72	.73	4.13	.65	3.93	1.08
7. Role Conflict	3.10	.62	2.75	.73	2.77	.70	2.71	.64	2.65	.71	2.88	.80
8. Role Overload	3.18	.63	3.50	1.00	3.26	.94	2.48	.59	2.79	.96	2.87	.86
9. Adequate Resources	2.88	.99	2.78	.83	3.52	1.19	3.35	1.04	2.90	1.00	3.20	1.30
10. Role Negotiability	3.71	.53	3.56	.30	3.57	.66	3.00	.78	3.29	.89	3.38	.76
11. Goal Specificity	2.98	1.04	2.28	1.42	2.46	1.42	1.73	1.25	1.74	1.33	1.92	1.37
12. Goal Feedback	2.90	1.05	2.41	.70	2.68	.97	2.27	.82	2.24	.96	2.28	.93
13. Decentralization	3.34	.68	2.75	.78	2.52	.89	1.50	.61	1.93	1.03	2.59	1.04
14. People-Oriented Values	3.58	.92	3.00	.88	3.88	.82	3.68	1.06	3.32	.99	3.48	.91
15. Risk-Taking Values	3.25	.76	3.46	.60	3.46	.60	3.27	.86	3.11	.80	3.26	.84
16. Attention to Detail Values	3.58	.68	4.06	.63	4.04	.71	3.72	.97	3.40	.83	3.55	.93
17. Stability Values	3.28	1.11	2.78	.97	3.67	.92	3.60	1.05	3.45	.97	3.13	1.17
18. Leader: Consideration	3.92	1.19	4.22	.83	4.44	.97	3.90	.97	3.43	1.25	4.36	.93
19. Leader: Task Orientation	2.94	1.05	3.67	1.22	3.63	1.11	3.85	.99	3.55	1.12	3.75	1.07
20. Leader: Visionary	3.16	1.10	3.56	.73	4.04	1.02	3.50	.89	3.38	1.20	3.78	1.24
21. Leader: Problem Solving	2.90	1.13	3.44	1.01	4.11	1.01	3.85	.88	3.33	1.11	3.72	1.17
22. No. Supervisors	1.58	1.13	1.22	.44	1.59	.84	2.35	1.23	2.05	1.16	1.63	1.10
23. No. Teams	2.90	1.10	2.22	.83	2.67	1.04	2.80	.83	1.86	.91	2.20	1.03

Table 8-12 (continued)

Descriptor Means and Standard Deviations on Six Example Jobs: Organizational Context

Descriptor/Scale	General Managers and Top Executives (n=40) M	SD	Computer Programmers (n=9) M	SD	Registered Nurses (n=27) M	SD	Police Patrol Officers (n=20) M	SD	Janitors & Cleaners[a] (n=21) M	SD	Maintenance Repairs, General Utility (n=30) M	SD
24. No. Reorganizations	2.20	.91	2.00	.87	2.04	.98	2.40	1.14	1.76	.89	1.57	.73
25. No. Changes in Job Duties	1.80	.99	1.33	.50	1.78	1.05	1.55	.83	1.71	.96	1.73	1.26
26. % Time Spent in Teams	3.05	1.38	3.89	1.54	3.33	1.69	2.15	1.31	2.00	1.10	2.17	1.18
27. No. Training Topics	2.78	1.87	1.22	1.48	2.17	2.17	1.65	1.57	1.24	1.64	1.57	1.65
28. No. Training Methods	3.92	2.37	2.78	2.44	4.14	1.98	4.15	2.35	1.81	1.86	2.40	2.31
29. No. Selection Methods	5.13	2.16	3.11	1.45	5.07	2.99	7.45	2.86	3.24	2.83	4.23	2.88
30. No. Recruitment Sources	3.37	1.79	4.60	1.55	3.96	2.15	3.34	2.20	2.95	1.51	3.15	1.53
31. No. Compensation Elements	1.85	1.48	2.78	1.64	1.85	1.26	1.05	1.15	.67	.97	.84	.95
32. No. Benefits Elements	4.95	1.06	6.78	0.44	4.15	1.43	4.10	1.33	4.33	1.59	4.20	1.67
33. Job Rotation Practices	1.90	1.30	1.89	1.27	2.26	1.16	2.15	1.35	1.66	.65	2.03	1.19

[a]The full title for this job is "Janitors and Cleaners, except Maids and Housekeeping".

Table 8-13a

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions Across Occupations: Organizational Context

	Functions					
Descriptor/Scale	F1	F2	F3	F4	$\Sigma \underline{F}^2$	η^2
1. Empowerment	.26	.42	.16	-.09	.28	.20
2. Autonomy	.10	.26	-.04	.26	.15	.12
4. Skill Variety	.22	.00	.22	.51	.36	.19
5. Task Significance	-.03	-.05	.26	.34	.19	.15
7. Role Conflict	.02	.15	.26	.05	.09	.09
8. Role Overload	.26	.03	.15	-.08	.10	.09
9. Adequate Resources	.03	-.25	-.06	.01	.07	.09
10. Role Negotiability	.19	.15	-.09	-.09	.08	.11
11. Goal Specificity	.09	.53	.11	.11	.31	.21
12. Goal Feedback	.06	.43	-.02	-.01	.19	.13
13. Decentralization	.41	.36	.29	-.04	.38	.24
19. Leader: Task Orientation	-.18	-.06	.01	-.04	.04	.09
21. Leader: Problem Solving	-.18	-.07	-.05	-.10	.05	.10
22. No. Supervisors	-.39	.01	.14	.11	.19	.16
23. No. Teams	-.13	.38	.46	.23	.42	.21
24. No. Reorganizations	-.16	.17	.13	.02	.07	.07
25. No. Changes in Job Duties	-.07	-.02	.11	-.15	.04	.06
26. % Time Spent in Teams	-.05	.01	.64	-.09	.42	.19
27. No. Training Topics	.10	.41	-.02	.16	.20	.16
28. No. Training Methods	.04	.21	.03	.34	.16	.15
29. No. Selection Methods	.00	.00	-.02	.59	.35	.14
30. No. Recruitment Sources	.10	.06	.16	.01	.04	.08
31. No. Compensation Elements	.23	.19	.29	.04	.17	.16
32. No. Benefits Elements	.59	-.10	-.08	.22	.42	.24
33. Job Rotation Practices	-.14	-.09	.33	.08	.15	.12
$\underline{R}_c$	.66	.57	.53	.49		
Percent of Variance	21	13	10	8		
Eigenvalue	.78	.49	.38	.32		

Note. Statistics are based on 30 occupations with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.47, median = 12, harmonic mean = 10.14). F1 = Decision Making Authority, F2 = Goal Setting, F3 = Team Structure, F4 = Skill Variety.

$\Sigma \underline{F}^2$ = Sum of squared rotated standardized discriminant function coefficients across 4 functions.

η^2 = Variance in Organizational Context ratings accounted by cells.

The statistics "$\underline{R}_c$", "Percent of Variance", and "Eigenvalue", were calculated based on the unrotated discriminant functions.

Table 8-13b

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions Across Job within Organization Cells: Organizational Context

Descriptor/Scale	F1	F2	F3	F4	F5	ΣF^2	η^2
	Functions						
1. Empowerment	.28	.18	.33	.05	-.07	.23	.37
2. Autonomy	.16	-.15	.14	.27	.11	.15	.36
4. Skill Variety	.13	.02	.03	.06	.37	.16	.35
5. Task Significance	-.04	-.02	.06	.17	-.05	.04	.30
7. Role Conflict	.06	.06	.11	.02	.01	.02	.24
8. Role Overload	.36	.18	.05	-.07	-.08	.17	.30
9. Adequate Resources	.01	.01	-.17	.00	.00	.03	.28
10. Role Negotiability	.25	.09	-.03	-.08	-.01	-.08	.24
11. Goal Specificity	.10	-.02	.50	.13	.01	.28	.42
12. Goal Feedback	-.01	.08	.45	-.13	-.12	.24	.36
13. Decentralization	.34	.02	.22	.01	-.01	.16	.37
19. Leader: Task Orientation	-.16	.21	.04	.08	.00	.08	.35
20. Leader: Problem solving	-.04	.30	-.10	.17	.16	.16	.33
22. No. Supervisors	-.13	.18	-.19	.46	.08	.31	.42
23. No. Teams	-.05	-.02	.25	.18	.08	.11	.31
24. No. Reorganizations	.11	.46	.10	.01	.12	.25	.36
25. No. Changes in Job Duties	.05	.39	.02	-.14	-.07	.18	.31
26. % Time Spent in Teams	.13	.34	.14	.09	-.07	.16	.31
27. No. Training Topics	.09	.15	.53	.12	.22	.38	.49
28. No. Training Methods	.00	.21	.50	-.14	.37	.46	.48
29. No. Selection Methods	-.17	.02	.13	-.08	.51	.31	.40
30. No. Recruitment Sources	.12	.17	.07	.09	.14	.08	.29
31. No. Compensation Elements	.39	.06	.25	.19	.06	.26	.41
32. No. Benefits Elements	.48	-.22	-.12	-.11	.16	.33	.49
33. Job Rotation Practices	.06	.18	.16	-.04	-.21	.11	.29
R_c	.85	.79	.77	.74	.70		
Percent of Variance	17	11	10	8	7		
Eigenvalue	2.50	1.69	1.42	1.22	.97		

Note. Statistics are based on 50 job within organization cells with Organizational Context questionnaire responses from at least 4 incumbents (mean number of incumbents = 4.85, median = 4.00, harmonic mean = 4.72). F1 = Decision Making Authority, F2 = Organizational Change, F3 = Goal Setting, F4 = Change in Supervision, F5 = Skill Variety.

ΣF^2 = Sum of squared rotated standardized discriminant function coefficients across 5 functions.

η^2 = Variance in Organizational Context ratings accounted by cells.

The statistics "R_c", "Percent of Variance", and "Eigenvalue", were calculated based on the unrotated discriminant functions.

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Table 8-17
Correlations Among Group Mean Ratings Profiles Between and Within Three Example Occupations: Organizational Context

	Occ. 1 Group 1 n=25	Occ. 1 Group 2 n=25	Occ. 2 Group 1 n=32	Occ. 2 Group 2 n=32	Occ. 3 Group 1 n=34	Occ. 3 Group 2 n=34
Occ. 1 Group 1	1.00					
Occ. 1 Group 2	0.70	1.00				
Occ. 1 Group 1	-0.51	-0.58	1.00			
Occ. 1 Group 2	-0.44	-0.27	0.14	1.00		
Occ. 1 Group 1	-0.29	-0.25	-0.31	-0.22	1.00	
Occ. 1 Group 2	-0.57	-0.61	0.19	-0.10	0.14	1.00

Note. N=33. Correlation coefficients greater than |0.32| were significant at the $p<.05$ level. Occ. 1=First line Supervisors and Managers/Supervisors, Clerical and Administrative Workers, Occ. 2=Secretaries Except Legal and Medical, Occ. 3=General Office Clerks.

Table 8-18a
Descriptive Statistics for Organizational Representative (CATI) Data: Organizational Context

Item # (s)	Item/Scale Label	N	M	SD
6	No. of Org. Locations	661	177.24	527.88
7	No. of Countries do Business	661	12.37	40.17
8	Full Time Org. Employees	661	13703.37	51304.79
9&10	Total Employees (Establishment)	661	322.71	659.21
11	No. New Employees Joined Last Year	620	55.77	120.25
12	No. Employees Last Year	630	298.58	601.02
18	No. Management Levels	605	10.18	38.50
22	No. Job Titles	661	57.55	117.37
24	No. New Jobs Created (Last 5 Yrs)	553	10.04	25.15
31	Information Sharing (% Informed)	659	49.69	29.52
34	% Working in Teams	661	31.78	36.57
35a	% in Functional Teams	661	29.25	34.71
35b	% in Cross-Functional Teams	661	19.21	28.40
35c	% in Management Teams	661	8.41	17.59
35d	% in Project Teams	661	7.37	16.86
35c	% in Quality Improve Teams	661	12.90	24.22
39	% Managers Set Goals	649	70.05	41.60
40	% Managers Negotiate Goals	640	64.97	44.02
41	% Non-Managers Set Goals	650	56.79	44.58
42	% Non-Managers Negotiate Goals	647	44.09	45.28
43	No. Performance Reviews in Last 2 Yr	652	2.17	1.50
49a	% Attend No Training	523	20.59	29.71
49b	% Attend One Training Courses	522	24.47	28.75
49c	% Attend Two+ Training Courses	640	40.16	38.17
50d	% Get Quality Control Training	642	25.06	38.33
66	% Pay Adjusted on Evaluate Studies	638	50.18	44.97
67	% Pay Adjusted on Comparisons	642	54.93	43.53
68a	% w/ Salary	650	52.17	40.16
68b	% w/ Profit-Sharing	655	25.57	40.34
68c	% w/ Skill-Based Pay	642	26.62	38.70
68d	% w/ Indiv Performance-Based Pay	650	52.29	44.46
68e	% w/ Team Performance-Based Pay	649	12.50	29.10
68f	% w/ Custm Satisfaction-Based Pay	647	17.45	34.70
68g	% w/ Seniority-Based Pay	646	31.08	41.45
68h	% w/ Hay Points	638	13.91	30.51
69a	% w/ Stocks	654	13.97	31.36
69b	% w/ Retirement Plan	657	73.99	39.46
69c	% w/ Medical Insurance	659	81.00	32.06
69d	% w/ Life Insurance	656	76.18	37.16

Table 8-18a (continued)
Descriptive Statistics for Organizational Representative (CATI) Data: Organizational Context

Item # (s)	Item/Scale Label	N	M	SD
69e	% w/ Disability Insurance	653	70.21	41.48
69f	% w/ Flex Hours	651	35.44	41.28
69g	% w/ Daycare	659	7.77	25.88
69h	% w/ Paid Vacation	660	84.90	28.93

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Table 8-18b

Descriptive Statistics and Rating Scales Used for Organizational Representative (CATI) Data: Organizational Context

Item #	Item/scale Label (# items)	Rating Scale	N	M	SD
14	Use of Contractors: Extent	1=not at all 5=to a great extent	658	2.25	1.10
15	Use of Contractors: Freq	1= never 5=always	657	2.66	1.19
20	No. Formal Documents	# checked out of 7	661	5.72	1.34
21	Document Relate to Perform (5)	1=not at all 5= to a great extent	585	3.81	0.88
23	Changes in Job Duties: Freq	1= never 5=always	656	2.69	0.90
25	No. Reorganizations	0=never, 1=1, 2=2, 3=3, 4=4, 5=5, 6=6 or more	562	0.91	1.26
27	No. Org Chart Revisions	0=never, 1=1, 2=2, 3=3, 4=4, 5=5 or more	266	2.96	1.88
28	No. Specializations	# checked out of 15	661	10.76	3.02
29	Standardization (14)	1=not standardized 5=completely standardized	661	3.84	0.68
30	Decentralization (5)	1=not at all 5= to a great extent	658	2.33	0.84
32	Extent Use of Teams	1=not at all 5= to a great extent	661	3.03	1.49
33	Team Accountability	1=not at all 5= to a great extent	661	3.03	1.50
37	Dept Heads Set Quant Goals	1=none 5=all	655	3.29	1.63
45	No. Training Methods	# checked out of 11	659	6.56	2.61
46	Trg Based on Needs Analysis	1=few 5=all	648	2.76	1.42
47	Freq of Training Evaluation	1=never 5=always	650	3.04	1.38
48	No. Training Topics	# checked out of 7	658	4.47	1.92
55	Job Rotation Policies	1=no job rotation 2=rotate within workgroup 3=rotate across workgroups 4=rotate across departments	654	2.48	1.20
57	Types of Recruit Data Collected	# checked out of 6	654	1.13	1.82
62	Select Systems Based on Job Analysis	1=none 5=all	653	2.94	1.49

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Table 8-18b (continued)

Descriptive Statistics and Rating Scales Used for Organizational Representative (CATI) Data: Organizational Context

Item #	Item/scale Label (# items)	Rating Scale	N	M	SD
63	Select Systems Validated	1=none 5=all	649	2.86	1.43
64	Spend Money on Data	1=not at all 5= to a great extent	634	2.36	1.18
65	Use Data for Org. Decisions	1=not at all 5= to a great extent	642	2.93	1.21

Table 8-18c
Descriptive Statistics for Organizational Representative (CATI) Data: Organizational Values

Item #	Organizational Value[a]	N	M	SD
70a	Employment Security	653	5.43	1.47
70b	Risk Taking	645	3.42	1.75
70c	Flexibility	654	5.06	1.52
70d	Analytical Oriented	646	4.05	1.75
70e	People Oriented	657	5.87	1.32
70f	Fairness	656	6.10	1.07
70g	Competitiveness	656	5.07	1.69
70h	Collaboration	650	5.28	1.44
70i	Adaptability	656	5.52	1.26
70j	Predictability	653	4.87	1.44
70k	Innovation	656	4.95	1.45
70l	Social responsibility	653	5.41	1.52
70m	Quality	657	6.23	0.99
70n	Results oriented	653	5.76	1.29
70o	Tolerance	654	5.52	1.24
70p	Taking Advantage of Opportunity	655	5.42	1.28
70q	Customer Oriented	655	6.06	1.37
70r	Action Oriented	648	5.47	1.32
70s	Stability	655	5.52	1.36
70t	Autonomy	646	4.75	1.49
70u	Attention to Details	656	5.68	1.15
70v	Team Oriented	657	5.27	1.51
70w	Sharing Information Freely	656	5.33	1.41
70x	Willing to Experiment	655	4.64	1.52
70y	Aggressiveness	654	4.90	1.43
70z	Precision	653	5.37	1.22
70aa	Achievement Oriented	656	5.53	1.30
70bb	Supportiveness	657	5.73	1.17

[a]The values were rated on a 7-point Likert-type scale where 1 = least characteristic and 7 = most characteristic.

Table 8-18d

Descriptive Statistics for Organizational Representative (CATI) Data: Dichotomous Organizational Context Variables

Item #	Item Label	N	Percentage Yes	Percentage No
13	Downsized in Last 5 Years	567	74.5	25.5
38	Publicize One Quantitative Goal	645	65.4	34.6
44	Formal Training	660	82.1	17.9
45a	Training Method 1: Case Studies	528	52.1	47.9
45b	Trg Method 2: Conference/Discuss	537	90.1	9.9
45c	Trg Method 3: Lectures	537	84.4	15.6
45d	Trg Method 4: Business Games	527	30.6	69.4
45e	Trg Method 5: Simulators	537	20.3	79.7
45f	Trg Method 6: Films	540	88.7	11.3
45g	Trg Method 7: Interact Videos	530	40.2	59.8
45h	Trg Method 8: Workbooks	538	74.9	25.1
45i	Trg Method 9: Role-Play	536	67.4	32.6
45j	Trg Method 10: Comput Inst	537	61.5	38.5
45k	Trg Method 11: Audio Cassettes	534	53.0	47.0
48a	Diversity Training	532	54.9	45.1
48b	Team Skills Training	536	70.3	29.7
48c	Quality Control Training	530	68.7	31.3
48d	Basic Business Training	535	32.5	67.5
48e	Problem Solving Training	534	70.6	29.4
48f	Leadership Training	538	75.5	24.5
48g	Customer Service Training	538	78.4	21.6
53	Continuous Learning Programs	657	67.1	32.9
54	Financial Assist for Training	660	70.0	30.0
56	Formal Recruitment Plan	656	43.0	57.0
58	Realistic Job Previews	654	39.1	60.9
59	Formal Orientation Programs	659	64.8	35.2
60	Formal Mentoring Programs	655	28.8	74.2
61	Formal Selection Systems	657	83.7	16.3

Table 8-19a

Principal Factor Analysis Pattern Matrix for Organizational Representative (CATI) Data: Organizational Structure

Item #	Item Label	F1	F2	F3	F4	F5	F6	Communality
		Factor						
6	No. Locations	-.01	.03	.00	.03	.73	.09	.54
7	No. Countries do Business	.12	-.10	.04	.01	.26	.24	.15
8	Full Time Org. Employees	.01	.02	.04	.13	.73	.07	.55
9+10	Total Employees (Establishment)	-.08	.16	.05	.05	.05	.62	.42
18	No. Management Levels	.05	.14	-.03	.07	.24	-.05	.09
20	No. Formal Documents	.12	.68	.12	.01	-.01	.28	.57
21a	Formal 1: Employ Contracts	.17	.20	.19	-.05	-.07	.12	.12
21b	Formal 2: Org. Chart	.06	.43	.07	.07	-.04	.15	.22
21c	Formal 3: Job Descriptions	.04	.56	.05	.07	.04	-.03	.33
21d	Formal 4: Procedure Manuals	.10	.78	.02	.05	.06	-.01	.62
21e	Formal 5: Policy Manuals	.02	.81	.00	.03	.10	.08	.67
22	No. Job Titles (Establishment)	-.11	.12	.05	.06	.07	.59	.38
28	No. Specializations (Establishment)	.08	.10	.23	-.10	-.04	.27	.16
29	Standardization	.19	.29	.19	.09	.06	-.02	.17
30a	Decentral 1: Monitor Quality	.09	.06	.63	.07	.10	.20	.46
30b	Decentral 2: Work Flow	.05	.11	.66	.11	.08	-.03	.46
30c	Decentral 3: New Equipment	.13	.06	.45	.16	-.07	.00	.25
30d	Decentral 4: New Products	.16	.09	.57	.21	-.08	.03	.42
30e	Decentral 5: New Members	.20	-.01	.46	.12	.04	.07	.28
31a	Info Sharing 1: Finance	.17	.13	.00	.69	.10	.26	.60
31b	Info Sharing 2: Unit Finance	.20	.07	.04	.68	.07	.23	.57
31c	Info Sharing 3: New Tech.	.12	.06	.21	.46	.05	-.11	.29
31d	Info Sharing 4: Bus. Plans	.03	.13	.26	.60	.03	-.12	.46
31e	Info Sharing 5: Competitors	.08	-.05	.25	.48	.11	-.07	.32
32	Extent Use of Teams	.76	.15	.22	.06	.07	-.14	.67
33	Team Accountability	.73	.20	.19	.09	.10	.05	.64
34	% Working in Teams	.76	.07	.08	.05	.10	-.13	.62
35a	% in Functional Teams	.73	.03	.08	.07	.14	-.13	.58
35b	% in Cross-Functional Teams	.62	.09	.12	.07	.01	-.09	.42
35c	% in Management Teams	.40	.07	-.03	.14	-.15	.04	.21
35d	% in Project Teams	.38	.01	.28	.22	.02	.11	.28
35e	% in Quality Improve Teams	.38	.00	.24	.08	-.01	.03	.21
	Percent of Variance	11	8	7	6	4	4	
	Eigenvalue	3.38	2.58	2.15	2.01	1.34	1.27	

Note. N=245. Factor labels: F1=Use of Teams, F2=Formalization/Standardization, F3=Information Sharing, F4=Decentralization, F5=Establishment size/Specialization, F6=Organization Size.

Table 8-19b

Principal Factor Analysis Pattern Matrix for Organizational Representative (CATI) Data: HR Practices

Item #	Item Label	Factor F1	F2	F3	F4	Communality
36	Formal mission statement	.46	.37	.17	.05	.37
37	Dept heads set quant goals	.29	.21	.52	.05	.40
38	Publicize one quantitative goal	.23	.22	.53	.19	.42
39	% managers set goals	.17	.11	.72	.17	.59
40	% managers negotiate goals	.08	.14	.74	.06	.58
41	% non-managers set goals	.23	.10	.58	.34	.51
42	% non-managers negotiate goals	.13	.01	.62	.13	.42
43	No. performance reviews in 2 years	.17	-.01	.21	.14	.09
45a	Trg method 1: Case studies	.56	.27	.13	-.02	.41
45b	Trg method 2: Conf/group	.78	.12	.18	-.01	.66
45c	Trg method 3: Lectures	.76	.14	.17	-.05	.64
45d	Trg method 4: Business games	.41	.04	.06	.28	.25
45e	Trg method 5: Simulators	.26	.05	.04	.11	.08
45f	Trg method 6: Film/video	.79	.21	.09	-.01	.68
45g	Trg method 7: Interact videos	.49	.14	.07	.10	.28
45h	Trg method 8: Workbooks	.66	.16	.12	.10	.48
45i	Trg method 9: Role-play	.73	.10	.17	.01	.57
45j	Trg method 10: Comput Inst	.53	.19	.20	.12	.38
45k	Trg method 11: Audio Cassettes	.49	.25	.15	-.07	.33
46	Trg based on needs analys	.73	.02	.20	.09	.57
47	Freq. of training evaluation	.79	.10	.15	.00	.66
48a	Diversity training	.57	.18	.18	.06	.39
48b	Team training	.71	.08	.19	.11	.56
48c	Quality control training	.64	.01	.10	.07	.43
48d	Basic business training	.38	.04	.08	.19	.19
48e	Problem solving training	.75	.09	.11	.04	.59
48f	Leadership training	.79	.15	.11	-.03	.66
48g	Customer service training	.64	-.02	.14	.12	.44
49b	% attend one training course	.24	.22	.21	.04	.15
49c	% attend 2+ training courses	.66	.02	.00	-.08	.44
50a	% get quality control training	.42	.22	.06	.16	.26
53	Continuous learning programs	.26	.12	.12	.31	.19
54	Financial assist for training	.24	.38	.16	-.02	.23
55	Job rotation policies	.27	.06	.14	.43	.28
57	Types of recruit data collected	.41	.13	.14	.30	.30
58	Realistic job previews	.50	.11	.13	.21	.32
62	Select systems based on job analysis	.43	.10	.06	.25	.26
63	Select systems validated	.45	.01	.09	.28	.29
66	% pay adjusted on evaluate studies	.16	.11	.10	.46	.26

Table 8-19b (continued)
Principal Factor Analysis Pattern Matrix for Organizational Representative (CATI) Data: HR Practices

Item #	Item Label	Factor F1	F2	F3	F4	Communality
67	% Pay Adjusted on Comparisons	.27	.25	.08	.29	.23
68a	% w/ Salary	.05	.41	.05	.00	.18
68b	% w/ Profit Sharing	.02	.31	.07	.36	.23
68c	% w/ Skill-Based Pay	.03	.01	.05	.40	.16
68d	% w/ Indiv Perform-Based Pay	-.05	.11	.00	.52	.28
68e	% w/ Team Perform-Based Pay	-.04	.03	.08	.46	.22
68f	% w/ Custm Satis-Based Pay	-.02	-.15	.10	.58	.37
68g	% w/ Seniority-Based Pay	.08	-.01	.07	-.05	.01
68h	% w/ Hay Points	.07	.22	.07	.17	.08
69a	% w/ Stock Options	.11	.18	.04	.25	.11
69b	% w/ Retirement Plan	.16	.76	.11	.01	.62
69c	% w/ Medical Insurance	.10	.83	.03	.04	.69
69d	% w/ Life Insurance	.11	.84	-.01	.06	.73
69e	% w/ Disability Insurance	.19	.64	.07	.09	.46
69f	% w/ Flex Time	.02	-.22	-.02	.33	.16
69g	% w/ Day Care	.14	.03	.16	.01	.04
69h	% w/ Paid Vacation	.11	.61	.08	.08	.39
	Percent of Variance	19	8	6	5	
	Eigenvalue	10.63	4.22	3.06	2.66	

Note. N=256. Factor labels: F1=Multiple Skill Training, F2=Employee Benefits, F3=Goal Setting, F4=High Performance HR Practices.

Table 8-19c

Principal Factor Analysis Pattern Matrix for Organizational Representative (CATI) Data: Organizational Values

Item #	Item Label	F1	F2	F3	F4	Communality
		Factor				
70a	Security of Employment	.07	.05	.08	.54	.31
70b	Risk-Taking	.04	-.10	.42	-.05	.19
70c	Flexibility	.56	-.07	.20	.10	.37
70d	Analytical Orientation	.08	.22	.47	.02	.27
70e	People Orientation	.61	.18	.11	.04	.42
70f	Fairness	.49	.30	.11	.25	.40
70g	Competitiveness	.05	.16	.51	-.03	.29
70h	Collaboration	.54	.16	.18	.09	.36
70i	Adaptability	.60	.18	.16	.18	.45
70j	Predictability	.09	.19	.00	.54	.34
70k	Innovation	.34	.26	.47	.11	.42
70l	Social Responsibility	.40	.31	.14	.27	.35
70m	Quality	.44	.53	.09	.21	.53
70n	Results Orientation	.25	.57	.32	.14	.51
70o	Tolerance	.56	.32	-.04	.22	.47
70p	Taking Advantage of Opportunity	.30	.39	.52	.07	.52
70q	Customer Service Orientation	.43	.19	.12	-.12	.25
70r	Action Orientation	.32	.53	.33	-.01	.48
70s	Stability	.29	.20	-.02	.66	.56
70t	Autonomy	.25	.18	.34	.36	.34
70u	Attention to Detail	.25	.63	.06	.28	.54
70v	Team Orientation	.50	.30	.13	.22	.41
70w	Sharing Information Freely	.54	.16	.15	.31	.44
70x	Willingness to Experiment	.37	.01	.49	.17	.41
70y	Aggressiveness	.09	.17	.59	.16	.40
70z	Precision	.20	.60	.14	.35	.55
70aa	Achievement Orientation	.17	.59	.38	.25	.59
70bb	Supportiveness	.60	.34	-.02	.43	.66
	Percent of Variance	15	11	9	8	
	Eigenvalue	4.15	3.07	2.45	2.14	

Note. N = 295. Factor labels: F1 = People Orientation, F2 = Risk Taking, F3 = Attention to Detail, F4 = Stability.

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Table 8-20

Factor-Based Composite Intercorrelations for Organizational Representative (CATI) Data: Organizational Context

Composite Label	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Use of Teams	--													
2. Formalization/Standardization	.15	--												
3. Info. Sharing	.34	.12	--											
4. Decentralization	.33	.16	.46	--										
5. Establishment Size	.08	.20	.08	.04	--									
6. Organization Size	.10	.10	.20	.14	.05	--								
7. Skill Training	.33	.38	.36	.34	.26	.13	--							
8. Employee Benefits	.17	.12	.28	.28	.18	.10	.37	--						
9. Goal Setting	.37	.17	.43	.31	.17	.06	.39	.25	--					
10. High Performance HR	.26	.00	.27	.20	.02	.01	.14	.14	.28	--				
11. People Orientation	.35	.10	.30	.19	-.05	.08	.21	.07	.34	.24	--			
12. Risk Taking	.22	.05	.30	.24	.05	.10	.22	.17	.30	.31	.66	--		
13. Attention to Detail	.26	.09	.30	.22	.05	.05	.27	.30	.35	.26	.69	.73	--	
14. Stability	.17	.05	.06	.02	.00	.01	.09	.05	.18	.11	.59	.39	.57	--

Note. N = 288. Correlation coefficients greater than .08 are significant at the $p<.05$ level.

Table 8-21

Principal Factor Analysis Pattern Matrix for Organizational Representative (CATI) Data: Factor-Based Composites

Composite Label	F1	F2	F3	Communality
	Factor			
People Orientation	.74	.25	.00	.61
Attention to Detail	.73	.19	.15	.59
Risk-Taking	.62	.36	.06	.51
Stability	.55	-.06	-.03	.31
Goal Setting	.15	.54	.27	.39
Information Sharing	.09	.51	.32	.37
Use of Teams	.22	.46	.22	.31
High Performance HR Practices	.15	.46	-.07	.23
Multiple Skill Training	.20	.19	.58	.41
Formalization/Standardization	.06	.11	.50	.27
Employee Benefits	.01	.24	.43	.25
Establishment Size	-.05	-.08	.41	.18
Decentralization	.06	.33	.38	.26
Organization Size	-.04	.15	.19	.06
Percent of Variance	13.71	10.36	9.79	
Eigenvalue	1.92	1.45	1.37	

Note. N = 288. Factor labels: F1 = Organizational Values, F2 = High-Performance Practices, F3 = Establishment Size.

Table 8-22

Factor Loadings for Second-Order Confirmatory Factor Analysis: Organizational Context

Item #(s)	Indicator Label	Factor F1	F2	F3	F4	F5	F6
32	Extent Use of Teams	.96					
33	Team Accountability	1.00					
34	% Working in Teams	.85					
30a	Decentral 1: Monitor Quality		.89				
30b	Decentral 2: Work Flow		1.00				
30c	Decentral 3: New Equipment		.90				
30d	Decentral 4: New Products		.95				
31a&31b	Info Sharing 1: Finance						
31c	Info Sharing 3: New Tech			.71			
31d	Info Sharing 4: Bus. Plans			.68			
31e	Info Sharing 5: Competitors			.68			
70b&70k&70x	Risk-Taking Values 1: Innovation				1.00		
70g&70p&70q&70r&70y&70aa	Risk-Taking Values 2: Competitiveness				.70		
70c&70t	Risk-Taking Values 1: Autonomy				.59		
46&47	Use Data to Develop & Evaluate Trg					1.00	
62&63	Use Data to Develop Selection Sys					.87	
64&65	Collect/Use Data for Org Decisions					.67	
55	Job Rotation Policies						.95
48	No. Training Topics						1.00

Note. N = 326. Factor labels: F1 = Use of Teams, F2 = Decentralization, F3 = Information Sharing, F4 = Risk-taking Values, F5 = Use Data in Decision Making, F6 = Multiple Skill Training.

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Table 8-23

Adjusted Means of Factor-Based Composites by Industry Type: Organizational Context

Industry Type	n	Composite Label: Formal/ Standard[1]	Information Sharing	Est. Size/ Specialization	Employee Benefits[a]	High Performance HR Practices	People-Oriented Values[1]
High Technology	17	4.18	60.04	58.31	79.99	52.51	5.44
Service	312	4.12	49.99	50.08*	59.72	49.28*	5.71
Manufacturing	97	3.98*	50.18	51.73*	71.91	49.64*	5.29*
Transportation	32	4.08	52.86	50.78*	66.37	49.42*	5.62
Wholesale & Retail	92	3.85*	45.19	57.71	53.49*	51.19	5.53
Finance	61	4.02	58.92	49.80*	73.48	52.83	5.67
Construction	28	3.74	40.38	48.36*	47.10*	50.51	5.34
Public Administration	19	4.60	35.34	47.31*	77.92	47.16*	5.20*

Note. MANOVA was run for all 14 composites ($p<.05$). ANOVAs were also run for each of the composites separately and only composites with statistically significant differences ($p < .05$) were included in this table. Values with an asterisk are significantly ($p<.05$) different than the highest mean in the column.

[a]For these composites, this table presents raw (rather than standardized) means.

Table 8-24a
Principal Components Analysis Pattern Matrix of Incumbent Data: Organizational Structure

Descriptor/Scale	Factor F1	F2	F3	Communality
1. Empowerment	.78	.00	.11	.61
2. Autonomy	.78	.01	-.07	.61
3. Skill Variety	.72	-.10	.21	.57
4. Task Significance	.42	-.17	.16	.23
5. Decentralization	.68	-.15	.01	.49
6. Leader: Task Oriented	-.10	.80	-.11	.67
7. Leader: Problem Solving	-.11	.80	.20	.69
8. No. Teams	.25	-.04	.60	.42
9. No. Supervisors	-.27	.10	.55	.38
10. No. Reorganizations	.05	.07	.51	.27
11. % Time Spent in Teams	.21	-.08	.36	.18
Percent of Variance	23.27	12.55	10.82	
Eigenvalue	2.56	1.38	1.19	

Note. N = 30. The correlation matrix was based on means calculated at the organization level.
F1 = Decentralization\Employee Empowerment; F2 = Task-Oriented Leadership; F3 = Work in Teams. These loadings are based on orthogonal varimax rotation.

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Table 8-24b

Principal Components Analysis Pattern Matrix of Incumbent Data: Human Resources (HR) Practices

Descriptor/Scale	Factor F1	F2	F3	Communality
1. No. Training Topics	.62	.18	.15	.44
2. No. Training Methods	.69	.12	.22	.55
3. No. Selection Methods	.49	.00	.00	.24
4. No. Recruitment Sources	.49	.10	.15	.27
5. No. Compensation Elements	.54	.04	.21	.34
6. No. Benefits Elements	.52	.07	.29	.36
7. Job Rotation Policies	.34	.30	-.09	.22
8. Role Conflict	.12	.74	.15	.59
9. Changes in Job Duties	.06	.74	.05	.56
10. Role Overload	.20	.58	.22	.42
11. Adequate Resources	.04	-.49	-.33	.35
12. Role Negotiability	.16	.30	.37	.25
13. Goal Specificity	.24	.19	.73	.63
14. Goal Feedback	.25	.14	.72	.60
Percent of Variance	14.64	12.50	12.29	
Eigenvalue	2.05	1.75	1.72	

Note. N = 30. The correlation matrix was based on means calculated at the organization level.
F1 = HR Systems; F2 = Role Conflict; F3 = Individual Goal Setting. These loadings are based on orthogonal varimax rotation.

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Chapter 9

Abilities:

Evidence for the Reliability and Validity of the Measures

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The term ability has been assigned a variety of meanings. Fleishman (1972a, 1972b, 1975a, 1975b, 1982) defines abilities as relatively enduring attributes of an individual's capability for performing a particular range of different tasks. Abilities are regarded as traits in that they exhibit some degree of stability over relatively long periods of time. It is recognized, however, that abilities may develop over time and with exposure to multiple situations (Snow & Lohman, 1984). Additionally, there is a distinction between abilities and skills (Bilodeau, 1966; Fleishman, 1966, 1972a). An ability is a general trait of an individual that is based on relationships among performances of individuals observed across a range of different tasks.

As jobs are often described in terms of the tasks required to perform them, the identification and analysis of job tasks and of the abilities that are relevant to those tasks can provide essential information in describing and understanding various occupations. In the remainder of this chapter, we first briefly discuss the nature and characteristics of job-relevant

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abilities, as well as how the abilities taxonomy was developed and evaluated in the present effort. Second, we present the results of the measurement of the abilities constructs in the O*NET data collection. Finally, we discuss the implications of these findings.

Background

Much of our knowledge of human abilities derives from programmatic factor analysis research. Critical research questions in the realm of abilities concern the generality of the constructs used to describe human abilities. Constructs such as "mental abilities," "motor abilities," "problem-solving ability," "decision-making ability," and "agility" have turned out to be too broad; the tasks required by such broad categories are too diverse to yield high correlations between performances in these tasks. However, factor analyses of the correlations among performances within these domains typically yield somewhat more narrowly defined abilities (see e.g., Carroll, 1993; Ekstrom, French, & Harman, 1976; Guilford & Hoepfner, 1971; Fleishman, 1964, 1972b). Similarly, expressions like "athletic ability" and "musical ability" are often used, but it is known that there are a number of separate constructs that better define several different abilities involved in the tasks comprising these broad activities. On the other hand, characterizing an individual as having the ability to "lift barbells of a given weight" or to "solve quadratic equations of a given complexity" yields information that is too specific and not very descriptive of an ability trait that extends to performance in a variety of tasks requiring the same underlying ability.

Taxonomy

Although no one ability taxonomic system can meet all of the requirements for an occupational information system which has the scope of O*NET, the Ability Requirements Taxonomy developed by Fleishman and his colleagues provides a foundation that meets several

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of the outlined criteria. The taxonomy has a research base spanning nearly 40 years and covers constructs included in the psychomotor, physical, cognitive, and sensory-perceptual domains of human abilities. The job analysis measurement system based on this taxonomy, called the Fleishman-Job Analysis Scales (F-JAS; Fleishman, 1975b, 1992) now has a long history of use and evaluation for jobs in industry, state and federal government agencies, and military occupational specialties (for one review see Fleishman, 1988). The system has been used successfully in nationwide job analysis studies (e.g., Landy, et al., 1992). To further facilitate their use in large scale administration, these scales have undergone some modifications to suit the specific purposes of the present effort.

The ultimate objective of any taxonomic development is to identify the most comprehensive, but parsimonious categories which are, at the same time, the most useful and meaningful. The ability taxonomy developed by Fleishman and his associates (see, e.g., Fleishman, 1964, 1972b; Fleishman & Quaintance, 1984; Fleishman & Reilly, 1992a, 1992b) followed a programmatic process to develop a set of physical and psychomotor abilities. Briefly, a series of interlocking experimental and factor analytic studies involving hundreds of tasks among a variety of jobs was used to begin development of the taxonomy. Experimental studies designed to elicit the identification and definition of human physical and psychomotor abilities were conducted over many years (see Fleishman, 1954, 1956, 1958, 1964, 1966, 1967a, 1967b, 1972b; Fleishman & Ellison, 1962; Parker & Fleishman, 1960; Hempel & Fleishman, 1955; Fleishman & Reilly, 1992b; Meyers, Gebhardt, Crump, & Fleishman, 1993). A project sponsored by the U.S. Defense Advanced Research Projects Agency expanded the taxonomy to include cognitive and sensory-perceptual categories (Theologus & Fleishman, 1973; Theologus, Romashko, & Fleishman, 1973).

Subsequently, this initial taxonomy was reviewed and refined to ensure comprehensive coverage of all ability domains. The physical, psychomotor, cognitive, and sensory-perceptual abilities were combined into a single list and operational definitions were written for each ability. This provisional list was reviewed by leading psychologists in human abilities measurement in a series of discussions and interviews. Feedback from the reviewers identified areas needing improvement and efforts were undertaken to clarify the definitions and include more task examples for each category. Further research and literature review led to the inclusion of additional categories that seemed applicable to human task performance such as Time Sharing (Descriptor #21) and Selective Attention (Descriptor #20). The resulting list of 52 abilities comprised the taxonomy that was incorporated into the Manual for Ability Requirements Scales (MARS) (Fleishman, 1975a, 1975b) and, later, in the Fleishman Job Analysis Survey (F-JAS) (Fleishman, 1992).

The next phase of the programmatic effort was to develop a measurement system for evaluating the ability requirements levels of various jobs and job tasks using this taxonomy. A series of expert panels and interviews (see Fleishman, 1975b; Fleishman & Mumford, 1988, 1991; and Fleishman & Quaintance, 1984 for a complete, detailed description) resulted in the identification, development, and refinement of behaviorally-anchored rating scales for each of the abilities in the taxonomy. High and low behavioral descriptions, empirically established task examples, and the ability definitions produced in the initial measurement development process were presented to additional expert panels for comment and review. The final product of this effort was the F-JAS ability measurement system, consisting of 52 abilities spanning the cognitive, psychomotor, physical, and sensory-perceptual domains of human performance capabilities.

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As noted previously, this Ability Requirements Taxonomy and measurement system has been extensively evaluated. While a full discussion of the extensive literature supporting the system is beyond the scope of this chapter (see an earlier report under this project by Fleishman, Wetrogan, Uhlman, & Marshall-Mies, 1995 and a review by Fleishman & Mumford, 1988; 1991), it can be said that the F-JAS system has been shown to have substantial reliability, and internal and external validity. For example, the F-JAS typically evidences reliability coefficients of .80 and above in a variety of occupations when 15 or more judges are used (e.g., Hogan, Ogden, & Fleishman, 1978; Myers, Jennings, & Fleishman, 1981). Further, these reliabilities hold up across rater level (incumbent, supervisor, subordinate) and generally do not show common rater biases such as the halo effect. Additionally, studies show high agreement between ability profiles provided by different rater groups such as job incumbents and occupational analysts.

A variety of studies have demonstrated aspects of the validity of the F-JAS. For example, Hogan, Ogden & Fleishman (1979) found that 80 percent of the tasks performed by warehouse workers could be assigned to one or more of the ability categories. Similar findings were obtained for Army officers (Mumford, Yarkin-Levin, Korotkin, Wallis, & Marshall-Mies, 1985), FBI special agents (Cooper, Schemmer, Jennings, Korotkin, 1983) and for New York City Police officers (Landy, 1988). These findings provide some evidence for the Ability Requirements Taxonomy's parsimony, or internal validity. The external validity of the taxonomy has also been amply demonstrated. For example, Hogan et al. (1978) found that ability tests, based on ability requirements, derived from the F-JAS scales produced a multiple R of .45 in predicting performance on the job sample. Further, Gebhardt & Schemmer (1985) found validities in the .80s for generic tests of abilities in the taxonomy against job samples of tasks performed by dock

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workers. More recently, the ability scales have been used to define the ability requirements of managerial jobs (Friedman, Fleishman, & Fletcher, 1992) and to predict the error rates associated with tasks performed by technicians in nuclear power plants (Fleishman, Buffardi, Morath, McCarthy, & Friedman, 1994). Such findings are but one approach in demonstrating the validity of the abilities taxonomy to predict task performance, a key marker of external validity.

Thus, the selection of the F-JAS abilities taxonomy as one of the systems for gathering information for O*NET is well supported, empirically and rationally, by a variety of applications and findings from research efforts. However, in order to ensure the applicability and utility of this taxonomy for the present effort, the entire system was reassessed in light of the demands and requirements of the project's objectives. This review and revision process in discussed below.

Sample and Measures

One issue arising in the current project was that the data collection effort would entail not only ability ratings, but also ratings on a variety of other job descriptors (e.g., skills, knowledges, work activities) across a wide range of occupations. Accordingly, there would likely be less time available for completing the survey and it was possible that the reading levels of job incumbents would vary. Thus, several modifications were made to adjust reading difficulty and instrument completion time. First, some ability definitions and task examples were revised to reduce the reading demands on the raters. Further, a number of the task examples used to anchor the rating scales were revised to include more occupationally-oriented tasks as well as tasks more likely to be familiar to raters regardless of their job. All of the anchors were reviewed for appropriateness and potential cultural bias, as well as to ensure that they could be understood without benefit of specialized experiences or knowledge. It is worth noting that new or revised anchors were empirically rescaled before being positioned on the scales. Finally, the original F-JAS tables

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which demonstrate how a particular ability is different from other abilities with which it might be confused were removed to further reduce the reading time and reading level required. The revised scales were tested during an initial pilot study (Mumford & Sager, 1995), with assistance from the Occupational Analysis Field Center (OAFC) staff. The comments of OAFC personnel and the data received from this administration were particularly helpful in modifying the scales. Figure 9-1 shows the names of the 52 ability descriptors organized into 15 higher-order aggregates with four highest-order categories. Figure 9-2 presents a sample page from the questionnaire.

In the data collection effort, two groups of judges provided ratings on the abilities required to perform the target occupations. This initial data collection included job incumbents from 80 occupations. For the analyses reported, only occupations for which at least four (4) incumbents provided ratings were used. This criterion resulted in a sample of 613 incumbents from 33 occupations. Figure 9-3 lists these occupations and the numbers of incumbent respondents completing the Abilities Questionnaire in each occupation.

The second group of raters included occupational analysts provided or trained by the OAFCs. In this sample, a minimum of six analysts rated the ability requirements for each of the 80 target occupations. Because incumbents' ratings for only 33 occupations were available, only the analysts' ratings on the same 33 occupations were used for comparison purposes. The analyst sample totaled 347 raters, although many analysts rated more than one occupation each.

The incumbents and analysts rated each of the abilities on two scales. First, they rated the <u>level</u> of the ability required for the occupation on a one to seven scale. This scale also included a "Does not apply" option to allow for abilities that were not at all required for the target occupation. Second, the incumbents and analysts rated the <u>importance</u> of the ability to job

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performance, this time on a one to five scale. If a judge rated the level "zero," they were instructed to skip the importance rating.

Results

Descriptive Statistics

Table 9-1 presents the means, standard deviations, standard error of measurements, and interclass correlations obtained for the level and importance scales for each of the 52 abilities. The means are averaged across the 33 occupations for which there were at least four respondents per occupation. As these are averaged, only broad interpretation of these results is possible. In terms of the level scale, what emerges is a general trend for the more cognitive abilities to be rated higher than the more physical ones. For example, the abilities rated highest (on the seven point level scale) across occupations include Oral Expression (Descriptor #3), ($\underline{M}$ = 4.58), Written Comprehension (Descriptor #2) ($\underline{M}$ = 4.29), and Problem Sensitivity (Descriptor #7) ($\underline{M}$ = 4.21) while those rated lowest include Explosive Strength (Descriptor #33) ($\underline{M}$ = 1.52), Gross Body Equilibrium (Descriptor #40) ($\underline{M}$ = 1.68), and Rate Control (Descriptor #28) ($\underline{M}$ = 1.75). This suggests that most of the occupations included were more office-type and/or administrative, rather than physical, outdoor occupations. The standard deviations were relatively consistent across all the abilities with most being at or around 2.0. The exceptions here were the more highly rated cognitive abilities, which had standard deviations of approximately 1.75.

Among the importance ratings (using a five point scale), a similar pattern emerges with the cognitive abilities, such as Oral Comprehension (Descriptor #1) ($\underline{M}$ = 3.70) and Written Expression (Descriptor #4) ($\underline{M}$ = 3.40) rated higher than most of the physical abilities, including Dynamic strength (Descriptor #34) ($\underline{M}$ = 1.81) and Dynamic Flexibility (Descriptor #38) ($\underline{M}$ = 1.90). Again, the standard deviations were generally around 1.20, with the cognitive abilities a

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little lower (around 1.1) and the physical abilities a little higher (approximately 1.2 to 1.3). These findings also support the conclusion that the occupational sample represents predominately indoor, office-type occupations.

Reliability

Table 9-1 also presents the intraclass correlations (reliabilities) of the abilities. Overall, these reliabilities reflect general agreement among the job incumbents across occupations. Most of the reliabilities for both the level and importance scales were sufficiently high, generally above .80 (range .33 to .91; for level, M = .79; for importance, M = .75). These high overall reliabilities led to relatively low standard error of measurement results, with almost all being below 1.0 for level and .75 for importance. From these findings, we can conclude that the abilities showed acceptably high reliabilities across occupations and that there is some variation between the occupations as to the level and importance of these human abilities.

In order to assess both the lower limits of reliability and optimal reliabilities, the reliability for a single rater was estimated as was the reliability for 30 raters. Table 9-2 shows the reliability for each ability transformed into single and 30-rater estimates. The single rater reliability estimates are, for the most part, low to moderate, with level reliabilities ranging from .06 to .46 and importance from .04 to .49. The Spearman-Brown corrected reliabilities for 30 raters are, as might be expected, much larger, with almost all coefficients for both level and importance in the .80s and .90s.

Scoring

An analysis was run in an attempt to determine whether the number of points on the rating scales had any impact on the ratings. In order to investigate this possibility, reliability estimates were calculated on the incumbent data for three variations of the level scale: zero (not

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relevant) to seven (high), one (low) to seven (high) (i.e., not relevant responses omitted), and zero (not relevant)-one (relevant). In the first two cases, the reliabilities were sufficiently high and, in fact, did not differ substantially. The average difference between r_a and r_b for both level and importance was about .01. The binary coding scheme for level, r_c, was about .12 lower, on average, than the full scale reliability coefficient, suggesting that it does appear to have significantly lower reliability.

Analyses of Variance

Another way of looking at the reliability of the ratings is to assess the amount of variance that the abilities and the occupations being rated account for in an ANOVA framework. Accordingly, ANOVAs were run for the abilities across occupations and these results are presented in Tables 9-4a and 9-4b. These findings showed that the ability ratings did significantly differentiate the occupations for both level ($F = 5.84$, $p < .05$) and importance ($F = 4.99$, $p < .05$). Furthermore, there were both significant differences between abilities (as might be expected) as well as interactions between occupations and abilities for both scales. These findings replicated when the abilities were grouped into their higher-order taxonomy (see Tables 9-6a and 9-6b). That is, mean ratings were calculated by combining scales according to 15 higher-order groups (e.g., verbal abilities, which included four scales of oral and written comprehension and expression).

Table 9-5 shows the reliabilities as calculated using the results of Tables 9-4a and 9-4b, with the descriptor by occupations effect as true variance, and descriptor by occupations within subjects as error variance. These estimates were very high across the board with the actual rater results for level and importance ($r_k = .82$ for both) being substantial. Again, Spearman-Brown was used to calculate reliability estimates for one and 30 raters. The findings here echo the above, as the one rater estimates for level and importance are .32, and the 30 rater estimates are both .93. These results lead to the conclusion that, if there are a sufficient number of incumbents rating a given occupation for the abilities, they can be reliably rated by individuals in a variety of occupations and the mean rating profiles differentiate occupations. Table 9-7 shows similar effects for aggregated scales.

What can be concluded from these analyses is that the abilities, individually, incrementally aggregated, and as a whole, were able to reliably account for a significant amount of the variance both within and across occupations. Additionally, these results can be considered as further support for the previously established reliability and validity of the ability requirements scales (Fleishman, 1992).

Descriptor and Scale Relationships

Table 9-8 shows the correlations between ratings made on the level and importance scales. The two scales correlated .82, on average, when the correlations are calculated within each occupation (across the 52 ability scales) and show considerable variation in their relationship across the 33 occupations (SD = .30). The average correlation was ten points higher (.92) when calculated within each descriptor (across the 33 occupations) and showed much less variation across the 52 descriptors (SD = .07). We interpret this to mean that, for a considerable number of occupations, the importance and level scales are providing non-redundant information--some abilities may be at relatively low levels, but still be important for a given occupation. On the other hand, level and importance ratings do provide highly similar information for a given descriptor when looked at across occupations.

Tables 9-9a, 9-9b, 9-10a, and 9-10b show the correlations among the abilities for the level and importance scales, for occupation-level (correlating mean occupation ratings) and individual-level ratings (made by four individuals randomly selected for each of the 33 occupations). These 52 by 52 matrices provide a wealth of information, only a small part of which can be discussed herein. However, the primary conclusion from these correlational analyses is that they further support the meaningfulness and coherence of the ability scales as occupation descriptors. For example, for the level ratings of ability levels required, we again see that abilities tend to "cluster" together as expected, with groups of highly correlated cognitive abilities (e.g., Oral Expression [Descriptor #3] and Written Expression [Descriptor #4], $r = .80$), psychomotor (e.g., Perceptual Speed [Descriptor #17] and Selective Attention [Descriptor #20], $r = .68$) and physical (e.g., Static Strength [Descriptor #32] and Dynamic strength (Descriptor #34), $r = .93$) all in evidence. The correlations among importance ratings also reflect similar patterns. While other examples could be cited, these results, in general, provide evidence for the meaningfulness of the abilities as they relate to each other and as they work together to describe occupational requirements.

Factor Structure

To summarize these between-scale relationships, we conducted a factor analysis on the ability level ratings. The ability ratings were entered into a principal components analysis. The results, shown in Table 9-11, suggested that seven components/factors should be retained. The first factor was a broad psychomotor/perceptual factor and included a number of the physical abilities as well. Several of the abilities loaded above .90 on this factor including Depth Perception (Descriptor #46) ($r = .95$) and Rate Control (Descriptor #28) ($r = .92$), along with Dynamic strength (Descriptor #34) ($r = .88$) and Explosive Strength (Descriptor #33) ($r = .85$). Given that there were 27 abilities loading above .60 on this factor, it is clearly a kind of "g" ability factor covering the basic physical and psychomotor areas. Factor number two was a

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relatively broad <u>cognitive</u> factor, with high loadings on Deductive Reasoning (Descriptor #8) (r = .95), Written Expression (Descriptor #4) (r = .93), and Written Comprehension (Descriptor #2) (r = .89), along with the other cognitive abilities. Once again, this general factor had a large number (18) of abilities loading above .50. The third factor was marked by high Visualization (Descriptor #19) (r = .71), Finger Dexterity (Descriptor #24) (r = .60), and Perceptual Speed (Descriptor #17) (r = .59) and was termed <u>visualization</u>. Given the nature of the occupations sampled, this group probably represents a cluster of particular occupations in the study. Factor four, <u>time sharing</u>, was characterized primarily by the loading on Time Sharing (Descriptor #21) (r = .57), along with Memorization (Descriptor #14) (r = .51) and Selective Attention (Descriptor #20) (r = .52). Since the two abilities marking factor five were Speech Recognition (Descriptor #51) (r = .86) and Speech Clarity (Descriptor #52) (M = .72), this factor was clearly a <u>speech</u> factor. The last interpretable factor was termed <u>wrist-finger speed</u>, from the loadings of abilities such as Wrist-Finger Speed (Descriptor #30) (r = .84), as well as Near Vision (Descriptor #41) (r = .59) and Perceptual Speed (Descriptor #17) (r = .47). The last factor appeared to be a non-interpretable, residual factor. Overall, these seven factors were able to account for 59.72% of the variance.

<u>Occupation Differences</u>

To illustrate the degree to which abilities distinguish occupations, we looked at the descriptive statistics (means and standard deviations) for a sample of specific occupations for which the abilities might prove useful. As with other domains of O*NET descriptors, the representative occupations included General Managers and Top Executives, Computer Programmers, Registered Nurses, Police Patrol Officers, Janitors and Cleaners, and Maintenance Repairers, General Utility. The results for the level and importance scales appear in 9-12a and 9-12b. From these results, several broad trends emerge. First, as noted above, the more cognitive abilities were rated higher on level for most of the representative occupations. For example, Written Comprehension (Descriptor #2) was rated high by Managers (M = 5.21), Police Officers (M = 4.70), and Maintenance Workers (M = 4.26) alike. The only occupation not generally rated above the midpoint on this and other cognitive abilities (e.g., Oral Expression [Descriptor #3], Problem Sensitivity [Descriptor #7]) was Janitors/Cleaners. On the other hand, the physical and psychomotor abilities were generally rated low by several of these occupations, with Computer Programmers' ratings of Gross-Body Equilibrium (Descriptor #40) (M = .50) and Nurses' ratings of Rate Control (Descriptor #28) (M = 1.43) almost negligible. As expected in the more physical occupations, such as Police Officers and Maintenance Repairers, there were, of course, higher ratings on these abilities. Among them, Police Officers rated abilities like Reaction Time (Descriptor #29) (M = 6.00), Response Orientation (Descriptor #27) (M = 5.00), and Night Vision (Descriptor #44) (M = 5.09) very high, as did Maintenance Repairers' rate on Static Strength (Descriptor #32) (M = 4.87) and Control Precision (Descriptor #25) (M = 4.26).

The second interesting finding is that the pattern of responses within occupations seemed to do a very good job of describing those occupations. For example, Computer Programmers rated the more cognitive abilities at the mid-point of the level scale with most means in the upper fours and fives. Conversely, almost all of the concrete, physical abilities were rated near or below one, reflecting the sedentary nature of their work. Police Officers, on the other hand, displayed a more stable, even distribution across the abilities, with many of the cognitive, psychomotor, and physical ability groups evidencing level ratings above four. The only abilities rated exceptionally low by Police Officers were several narrow cognitive abilities such as Information Ordering (Descriptor #11) (M = .87) and Math Reasoning (Descriptor #12) (M = 1.65). Janitors showed a similar pattern of response as the Police Officers, but at a lower mean level. There responses were relatively similar across all the abilities, but in only a few cases did any of the level ratings exceed three and none exceeded three and a half.

The results for the importance ratings on the abilities for these six occupations appear in Table 9-12b, and these are generally similar to those for the level scale. The level and importance scales were correlated at .92 across descriptors within occupations and .82 across occupations within descriptors (see Table 9-8), so this is not too surprising. Once again, Managers and Programmers rated the cognitive abilities as more important and the physical ones less so, while Police Officers rated most of them across the board as at least somewhat important. Nurses, Police Officers, Janitors, and Maintenance Repairers evidenced similar response patterns as for the level scale results.

Discriminant Analysis

A discriminant function analysis was run to identify the way in which the level ratings on abilities differentiated occupations. For this analysis, the level ratings for each of the abilities were used as independent variables and occupational membership was used as the dependent variable. Each incumbent was reclassified into one occupation, using the discriminant functions identified in the analysis. The analysis found five significant functions. Using all 20 functions, 60% of the total variance was accounted for, and 62% of incumbents correctly classified into their occupations, suggesting some utility in discriminating occupations. Table 9-13 shows the five significant functions, the sum of squared rotated correlations of the descriptor ratings with the functions, and the η^2 values for the descriptor ratings. The five functions were quite interpretable based on the ability loadings. The first function, physical, was characterized by abilities such as Static Strength (Descriptor #32) ($r = .73$) and Gross-Body Coordination ($r = .60$), while the second function, cognitive, had high loadings on abilities such as Written Expression

(Descriptor #4) ($\underline{r}$ = .62) and Fluency of Ideas (Descriptor #5) ($\underline{r}$ = .54). The third function was unique in that it had only one significant ability loading on it, Wrist-Finger Speed (Descriptor #30) ($\underline{r}$ = .69), so is labeled wrist-finger speed. The fourth function was a psychomotor-speed group, characterized by Reaction Time (Descriptor #29) ($\underline{r}$ = .50) and Rate Control (Descriptor #28) ($\underline{r}$ = .49) and the final significant function was termed mathematics, due to the loadings of Number Facility (Descriptor #13) ($\underline{r}$ = .65) and Math Reasoning (Descriptor #12) ($\underline{r}$ = .59). The sum of the squared function coefficients are mostly in the .30s to .40s and the η^2 coefficients range from .09 to .37. The coefficients for both of these indices demonstrate the overall contribution of many of the individual abilities to discriminating occupations.

Convergence With Analysts' Ratings

The fact that we were able to collect ratings from both job incumbents and occupational analysts allowed for some comparisons between these two groups' views of the target occupations. The results of these comparisons for both the level and importance scales, including means, standard deviations, $\underline{t}$- and $\underline{F}$ tests, along with correlations and d^2, are shown in Tables 9-14a and 9-14b. Overall, both the analysts and the incumbents were generally in agreement with regards to their ratings assigned to the abilities. The correlations ranged from .37 to .88 for level, with the mean of .70 and majority of correlations in the .70s and .80s. For importance, the correlations ranged from .14 to .88, again, mostly in the .70s and .80s, and the mean was .65.

The occupational analysts' level ratings were more reliable than those of the incumbents ($\underline{M}_{analysts}$ = .87 vs. $\underline{M}_{incum.}$ = .79), even considering that there were fewer analysts rating these occupations ($\underline{M}_{analysts}$ = 10.51 vs. $\underline{M}_{incum.}$ = 18.57). The importance scale showed a similar pattern, with analyst reliabilities slightly higher than those for incumbents.

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There were some significant differences between analysts and incumbents in the actual level ratings of certain individual abilities, as evidenced by the significant t-test results and significant F tests for variance differences. Practically speaking, though, these differences were not large. The mean d^2 was about one point for level and .40 for importance, indicating that the differences between analysts and incumbents were not large, on average. A few abilities did show larger differences, notably Selective Attention (Descriptor #20), Time Sharing (Descriptor #21), and Descriptors #49 through #52, having to do with auditory and speech recognition abilities.

What these differences show is that for level, the incumbents in the samples rated more abilities higher than did the analysts. Interestingly, this pattern reversed itself for the importance ratings, with the analysts rating the abilities as more important than did the incumbents. However, the major finding was the high correlations between the mean ratings of analysts and those received from incumbents across different jobs.

Since the ratings obtained from incumbents and occupational analysts were generally in agreement (although there were some mean level rating differences), we ran a principal components analysis on the analyst data to see how it compared to the incumbent factor structure. This analysis was run with the same assumptions and rotation procedures carried out on data from the incumbents. The factor analysis data from the analysts are presented in Table 9-16. While there was a great deal of overlap between the two solutions, there were some disparities that are worth noting. Two factors were, for the most part, the same for the two solutions. For example, factor one for the analysts was a broad <u>cognitive</u> component with high loadings on Deductive Reasoning (Descriptor #8) (r = .94) and Oral Comprehension (Descriptor #1) (r = .93) among the highest. The second factor was a broad <u>psychomotor/perceptual</u> one characterized by

Response Orientation (Descriptor #27) (r = .92) and Rate Control (Descriptor #28) (r = .90). The first two incumbent factors were a psychomotor/perceptual and then a cognitive factor. Analyst factor three was a clear physical ability factor, marked by Extent Flexibility (r = .83) and Trunk Strength (Descriptor #35) (r = .79). Several other abilities, with loadings on the perceptual/psychomotor factor in the factor analysis of incumbent ratings, also loaded highly on this analyst factor (e.g., Explosive Strength [Descriptor #33], .65, and Gross Body Coordination [Descriptor #39], .59).

The fourth analysts' factor was called sensory/dexterity as it was marked by Visual Color Discrimination (Descriptor #43) (r = .75), Finger Dexterity (Descriptor #24) (r = .63), and Arm-hand Steadiness (Descriptor #22) (r = .61). This factor had no comparable counterpart in the analysis based on incumbents. Rather, the abilities in this factors loaded in a broader psychomotor factor. Factor five was also similar to the incumbents' results, as it was marked by Wrist-Finger Speed (Descriptor #30) (r = .80) and Flexibility of Closure (Descriptor #16) (r = .74) and is called wrist-finger speed. Finally, the sixth factor, speech, mirrors another incumbent factor, that of speech recognition.

Based on the above results, the incumbents seemed to provide slightly less reliable and somewhat higher level ratings. On the other hand, the reliabilities are still high and the pattern of relationships and the tightness of the factor structure seemed clearer for the incumbents than for the analysts. It is interesting to note that this pattern is similar to that obtained in comparing the incumbents and analysts on the knowledge ratings (see Chapter 4). Although these findings are qualitative interpretations, they do provide some additional evidence for the general similarity of the incumbents and analysts' ratings. However, they also raise the possibility that the analysts

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and the raters have somewhat different views of at least some of the ability requirements of these target occupations.

To see if analyst and incumbent ratings differed depending on the scale coding, means, standard deviations, reliabilities, and t-tests were calculated for each ability using the relevant/not relevant (zero-one) coding scheme. The results of this analysis are presented in Table 9-15. For a number of descriptors (e.g., Oral Comprehension [Descriptor #1] and Number Facility [Descriptor #13]), analysts were unanimous in their judgment that the abilities were relevant for all occupations, while incumbents varied in their ratings. Across occupations, the analysts were more likely than incumbents to judge abilities to be relevant. However, examination of the reliabilities reveal that incumbents' ratings generally are at least as reliable as the analysts' ratings. In fact, they are often more reliable than the analysts' ratings (e.g., Information Ordering [Descriptor #10], Speed of Closure [Descriptor #15], and Visualization [Descriptor #19]). These results are consistent with the hypothesis that incumbents' ratings show more differentiation among occupations than analysts' ratings, based on the relevance of abilities.

Conclusions

This chapter has summarized the development of the ability taxonomy and associated measurement system for determining the ability requirements of jobs. The taxonomy, which spans the cognitive, psychomotor, physical, and sensory-perceptual domains of human performance capabilities, is based on earlier work of Fleishman and associates and adapted to the requirements of the O*NET system. For the present effort, special attention was given to making the measures more readable, understandable, and user-friendly so that they would be as applicable as possible across the wide range of target occupations.

The results of this study confirm the findings from earlier work with this taxonomy and measurement system. They indicate that the ability requirements approach provides reliable, useful descriptive and interpretative information that contribute to the understanding and measurement of the kinds and levels of human abilities required in a wide range of occupations. The fact that the profiles of ability ratings were interpretable for both top Managers and Janitors is but one piece of evidence supporting this conclusion. Although only 33 occupations were represented in these analyses, the consistency and coherence across the occupations and types of ratings makes it reasonable to conclude that the abilities taxonomy would prove useful for other occupations not included herein.

The data collection and rating methodology for determining both the level and importance of these abilities in performing these occupations was shown to have high reliabilities and internal validity. Missing from the present effort is additional evidence for the criterion-related validity of the ratings. Certainly, one avenue for future research would be to gather job performance criteria and demonstrate the predictive power derived from the ability ratings as well as from the other descriptive systems developed in this project. However, we do know that earlier studies have shown that tests and assessments developed on the basis of ability requirements derived from this system have high criterion related validity (e.g., Hogan, 1978; Gebhardt & Schemmer, 1985). Thus, we can be reasonably confident that additional criterion studies will further support the body of research demonstrating the overall validity of the abilities taxonomy.

With respect to the reliability of the ratings, it was shown that job incumbents and occupational analysts showed a high degree of agreement on the profiles of abilities derived to describe the ability requirements of different occupations. While there were some differences in

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mean scores in particular abilities, the reliabilities of ratings of individual ability requirements were mostly high. The discriminant function analyses and factor analyses supported the internal validity of the system, but interpretations are necessarily constrained by the particular mix of occupations in the sample. However, there was ample evidence that the system differentiates occupations in a meaningful way.

With respect to the rating scale formats evaluated, there were relatively high correlations between level and importance scales and comparable reliabilities. Further, regardless of the scoring scheme used, these reliabilities remained reasonably high (except for the binary-coded scale), and there was little difference between analysts and incumbents across coding approaches. Given the relatively high correlations across occupations and individuals between the level and importance and level ratings, the utility of using both scales in data collection is a question that is worthy of further attention. On balance, however, it appears that the "level" scale has more advantages conceptually for future use.

In summary, it appears that the content, structure, and scaling methodology developed should be useful in areas such as job analysis, person-job matching, occupational and career counseling, and the development of job families having similar ability requirements. It should be noted that the present effort was somewhat limited in the number of occupations and incumbents represented. However, the diversity of the included occupations along with the opportunity to compare the ratings of incumbents and analysts provide some assurance that the above results are both representative and generalizable to the larger population of occupations. That said, we feel safe in concluding that the ability taxonomy and scaling methodology should assist in the overall effort to develop a more complete understanding of the requirements of human work.

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Table 9-1
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Abilities

	Variable							
	Level				Importance			
Descriptor	M	SD	SEM[a]	r_k[b]	M	SD	SEM	r_k
1. Oral Comprehension	4.31	1.66	.82	.75	3.70	1.06	.61	.66
2. Written Comprehension	4.29	1.73	.70	.83	3.59	1.06	.52	.75
3. Oral Expression	4.58	1.69	.83	.73	3.71	1.06	.56	.71
4. Written Expression	3.98	1.85	.65	.87	3.40	1.11	.42	.85
5. Fluency of Ideas	2.77	1.97	.79	.84	2.51	1.18	.51	.81
6. Originality	3.34	1.99	.82	.83	2.72	1.18	.52	.81
7. Problem Sensitivity	4.21	1.86	.71	.85	3.41	1.16	.50	.81
8. Deductive Reasoning	3.64	1.96	.80	.83	3.01	1.17	.55	.78
9. Inductive Reasoning	3.37	2.08	.73	.88	2.79	1.23	.44	.87
10. Information Ordering	3.75	1.87	1.00	.70	3.19	1.17	.82	.50
11. Category Flexibility	2.46	2.17	1.10	.74	2.28	1.23	.69	.68
12. Math Reasoning	2.74	2.01	.86	.82	2.57	1.23	.58	.78
13. Number Facility	3.61	1.86	.79	.82	3.08	1.19	.60	.74
14. Memorization	4.06	1.66	1.15	.52	3.25	1.05	.85	.33
15. Speed of Closure	3.27	1.92	.91	.77	2.71	1.15	.60	.73
16. Flexibility of Closure	2.45	2.22	1.22	.69	2.25	1.25	.78	.61
17. Perceptual Speed	2.76	2.08	1.54	.45	2.46	1.22	.99	.34
18. Spatial Orientation	2.68	2.25	1.27	.68	2.36	1.27	.68	.71
19. Visualization	2.79	2.11	1.16	.69	2.42	1.22	.79	.58
20. Selective Attention	3.98	1.88	1.51	.63	3.23	1.13	.69	.62
21. Time Sharing	4.10	1.95	1.13	.66	3.16	1.17	.77	.57
22. Arm-hand Steadiness	2.26	2.32	.94	.83	2.12	1.28	.47	.86
23. Manual Dexterity	2.63	2.29	.98	.82	2.31	1.33	.54	.83
24. Finger Dexterity	2.41	2.20	1.27	.66	2.21	1.22	.70	.67
25. Control Precision	2.13	2.18	.81	.86	2.07	1.21	.45	.86
26. Multi-limb Coordination	2.14	2.25	.87	.85	2.05	1.23	.45	.86
27. Response Orientation	2.50	2.28	.85	.86	2.29	1.32	.49	.86
28. Rate Control	1.75	2.26	.69	.90	1.83	1.19	.34	.92
29. Reaction Time	2.63	2.63	.92	.88	2.37	1.48	.57	.87
30. Wrist -finger Speed	3.50	2.25	1.01	.80	2.78	1.34	.55	.83
31. Speed of Limb Movement	2.45	2.43	.95	.84	2.17	1.31	.50	.85
32. Static Strength	2.38	2.32	.70	.91	2.14	1.25	.37	.91
33. Explosive Strength	1.52	2.15	.69	.90	1.70	1.13	.37	.89
34. Dynamic Strength	1.61	2.13	.76	.87	1.81	1.16	.44	.85
35. Trunk Strength	2.14	2.05	.87	.82	2.15	1.20	.57	.77
36. Stamina	1.90	2.03	.79	.85	2.01	1.19	.47	.85

Table 9-1 (continued)
Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Abilities

Descriptor	Level M	Level SD	Level SEM	Level r_k	Importance M	Importance SD	Importance SEM	Importance r_k
37. Extent of Flexibility	2.52	2.10	.81	.85	2.25	1.20	.47	.85
38. Dynamic Flexibility	1.80	2.01	.83	.83	1.90	1.13	.48	.82
39. Gross Body Coordination	2.01	2.03	.77	.86	2.04	1.17	.47	.84
40. Gross Body Equilibrium	1.68	2.09	.75	.87	1.89	1.19	.43	.87
41. Near Vision	3.63	1.92	1.15	.66	2.90	1.16	.80	.51
42. Far Vision	2.52	2.16	.91	.82	2.26	1.19	.52	.81
43. Visual Color Discrimin	2.21	2.20	.88	.84	2.16	1.26	.50	.84
44. Night Vision	1.88	2.23	.77	.88	1.93	1.22	.36	.92
45. Peripheral Vision	2.02	2.24	.70	.90	2.03	1.28	.38	.91
46. Depth Perception	1.73	2.13	.67	.90	1.91	1.21	.38	.90
47. Glare Sensitivity	1.72	2.07	.74	.87	1.87	1.13	.42	.86
48. Hearing Sensitivity	2.25	2.14	.91	.82	2.14	1.21	.56	.78
49. Auditory Attention	3.17	2.20	1.39	.60	2.63	1.24	.81	.57
50. Sound Localization	2.56	2.34	.88	.86	2.26	1.25	.48	.85
51. Speech Recognition	4.10	2.04	1.46	.49	3.12	1.21	.88	.47
52. Speech Clarity	4.34	1.86	1.21	.57	3.45	1.12	.08	.46

Note. Statistics are based on 33 occupations with Abilities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 13.0, harmonic mean = 9.65).
[a]This estimate of the standard error of measurement was calculated as $\underline{SEM} = \underline{SD} * \sqrt{(1 - r_k)}$.
[b]This estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

Table 9-2

Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Abilities

	Variable			
	Level		Importance	
Descriptor	r_1[a]	r_{30}[b]	r_1	r_{30}
1. Oral Comprehension	.21	.89	.14	.83
2. Written Comprehension	.30	.93	.21	.89
3. Oral Expression	.19	.87	.18	.87
4. Written Expression	.37	.95	.33	.94
5. Fluency of Ideas	.30	.93	.27	.92
6. Originality	.29	.93	.26	.92
7. Problem Sensitivity	.33	.94	.27	.92
8. Deductive Reasoning	.30	.93	.24	.90
9. Inductive Reasoning	.38	.95	.36	.94
10. Information Ordering	.16	.85	.08	.72
11. Category Flexibility	.20	.88	.15	.85
12. Math Reasoning	.28	.92	.24	.90
13. Number Facility	.28	.92	.20	.88
14. Memorization	.08	.73	.04	.56
15. Speed of Closure	.22	.90	.18	.87
16. Flexibility of Closure	.16	.85	.12	.80
17. Perceptual Speed	.06	.67	.04	.57
18. Spatial Orientation	.15	.84	.17	.86
19. Visualization	.16	.85	.10	.78
20. Selective Attention	.13	.81	.12	.81
21. Time Sharing	.14	.83	.10	.77
22. Arm-hand Steadiness	.30	.93	.35	.94
23. Manual Dexterity	.28	.92	.30	.93
24. Finger Dexterity	.14	.84	.15	.84
25. Control Precision	.35	.94	.35	.94
26. Multi-limb Coordination	.32	.93	.35	.94
27. Response Orientation	.35	.94	.35	.94
28. Rate Control	.45	.96	.49	.97
29. Reaction Time	.38	.95	.37	.95
30. Wrist-finger Speed	.25	.91	.29	.93
31. Speed of Limb Movmnt.	.32	.93	.34	.94
32. Static Strength	.46	.96	.47	.96
33. Explosive Strength	.42	.96	.42	.96
34. Dynamic Strength	.37	.95	.34	.94
35. Trunk Strength	.28	.92	.22	.90
36. Stamina	.32	.93	.32	.93
37. Extent Flexibility	.33	.94	.32	.93
38. Dynamic Flexibility	.29	.93	.28	.92

Table 9-2 (continued)
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Abilities

Descriptor	Level r_1	Level r_{30}	Importance r_1	Importance r_{30}
39. Gross Body Coord.	.34	.94	.31	.93
40. GrossBody Equilib.	.36	.94	.36	.94
41. Near Vision	.14	.83	.08	.73
42. Far Vision	.28	.92	.26	.92
43. Visual Color Discrim	.31	.93	.31	.93
44. Night Vision	.38	.95	.48	.97
45. Peripheral Vision	.44	.96	.47	.96
46. Depth Perception	.44	.96	.44	.96
47. Glare Sensitivity	.37	.95	.35	.94
48. Hearing Sensitivity	.28	.92	.24	.90
49. Auditory Attention	.11	.79	.10	.77
50. Sound Localization	.34	.94	.33	.94
51. Speech Recognition	.07	.71	.07	.69
52. Speech Clarity	.10	.78	.07	.69

Note. Reliability estimates are based on a 33 occupations with Abilities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 13.0, harmonic mean = 9.65).
[a]Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judges ratings across occupations: ICC(1,1) = [BMS-WMS]/[BMS+(k+1)WMS] (Strout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
[b]Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

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Table 9-3
Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Abilities

	Type of Scale and Recoding Applied				
	Level			Importance	
Descriptor	r_a	r_b	r_c	r_a	r_b
1. Oral Comprehension	75	79	60	66	74
2. Written Comprehension	83	85	59	75	80
3. Oral Expression	73	77	55	71	80
4. Written Expression	87	88	67	85	87
5. Fluency of Ideas	84	83	69	81	80
6. Originality	83	84	58	81	84
7. Problem Sensitivity	85	87	50	81	85
8. Deductive Reasoning	83	81	70	78	79
9. Inductive Reasoning	88	86	71	87	88
10. Information Ordering	70	68	62	50	46
11. Category Flexibility	74	75	63	68	70
12. Math Reasoning	82	81	70	78	81
13. Number Facility	82	85	61	74	74
14. Memorization	52	60	56	33	55
15. Speed of Closure	77	78	73	73	77
16. Flexibility of Closure	69	72	53	61	65
17. Perceptual Speed	45	46	31	34	00
18. Spatial Orientation	68	71	47	71	76
19. Visualization	69	72	56	58	63
20. Selective Attention	63	67	65	62	67
21. Time Sharing	66	71	60	57	69
22. Arm-hand Steadiness	83	82	67	86	84
23. Manual Dexterity	82	80	69	83	82
24. Finger Dexterity	66	62	41	67	66
25. Control Precision	86	85	72	86	85
26. Multi-limb Coord.	85	85	74	86	86
27. Response Orientation	86	87	69	86	87
28. Rate Control	90	91	86	92	91
29. Reaction Time	88	88	76	87	85
30. Wrist-finger Speed	80	75	63	83	82
31. Speed of Limb Mvmt.	84	84	76	85	85
32. Static Strength	91	91	79	91	91
33. Explosive Strength	90	90	86	89	90
34. Dynamic Strength	87	87	81	86	86
35. Trunk Strength	82	81	65	77	80
36. Stamina	85	84	75	85	83
37. Extent Flexibility	85	85	72	85	86
38. Dynamic Flexibility	83	84	78	82	83
39. Gross Body Coord.	86	84	80	84	83

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Table 9-3 (continued)
Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Abilities

Descriptor	Level r_a	Level r_b	Level r_c	Importance r_a	Importance r_b
40. Gross-body Equilib.	87	87	85	87	87
41. Near Vision	66	65	56	51	42
42. Far Vision	82	83	60	81	81
43. Visual Color Discrim.	84	80	74	84	81
44. Night Vision	88	88	81	92	92
45. Peripheral Vision	90	91	81	91	90
46. Depth Perception	90	90	84	90	89
47. Glare Sensitivity	87	87	78	86	84
48. Hearing Sensitivity	82	82	71	78	72
49. Auditory Attention	60	66	45	57	53
50. Sound Localization	86	86	78	85	82
51. Speech Recognition	49	60	41	47	68
52. Speech Clarity	57	63	42	46	63

Note: Reliability estimates are based on 33 occupations with Abilities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 13.0, harmonic mean = 9.65). Reliability estimates stipulated as r_a were calculated using the full eight point scale for level, and retaining all of the data for the importance scale. Reliability estimates stipulated as r_b were calculated using a reduced seven point scale for level, and excluding the data for importance scale where the rater marked "NR" on the level scale. Reliability estimates stipulated as r_c were calculated using binary coded scale for level (relevant/not relevant). Decimals are omitted.

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Table 9-4a

Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Abilities

Source of Variation	SS	df	MS	F
Occupations	12416.76	32	388.02	5.84*
S(Occupations)	38535.39	580	66.44	
Ability	10016.13	51	196.39	86.09*
Ability x Occupations	20852.72	1632	12.78	5.60*
Ability x S(Occupations)	67481.18	29580	2.28	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.

*$p<.05$

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Table 9-4b
Analysis of Variance for Descriptor, Occupation, and Relevant interactions as Sources of Variation on the Importance Scale: Abilities

Source of Variation	SS	df	MS	F
Occupations	3316.19	32	103.63	4.99*
S(Occupations)	12037.71	580	20.75	
Ability	4159.78	51	81.56	102.08*
Ability x Occupations	7115.01	1632	4.36	5.46*
Ability x S(Occupations)	23634.86	29580	.80	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.
*p<.05

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Table 9-5
Interrater Agreement Coefficients for Each Scale Type: Abilities

	Number of Raters on Each Variable		
Scale Type	r_k	r_1	r_{30}
Level	.82	.32	.93
Importance	.82	.32	.93

Note. Interater agreement coefficient estimates are based on 33 occupations with Abilities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 13.00, harmonic mean = 9.65). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Descriptor x Occupations" terms from tables 9-4a and 9-4b as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimates for reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation.

Table 9-6a

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Abilities

Source of Variation	SS	df	MS	F
Occupations	3540.17	32	110.63	5.69*
S(Occupations)	11273.01	580	19.44	
Aggregate	2632.56	14	188.04	142.35*
Aggregate x Occupations	4229.49	448	9.44	7.15*
Aggregate x S(Occupations)	10726.37	8120	1.32	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.

*$p<.05$

Table 9-6b

Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Abilities

Source of Variation	SS	df	MS	F
Occupations	3316.19	32	103.63	4.99*
S(Occupations)	12037.71	580	20.75	
Aggregate	4159.78	51	81.56	102.08*
Aggregate x Occupations	7115.01	1632	4.36	5.46*
Aggregate x S(Occupations)	23634.86	29580	.80	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within subjects effects.

*$p<.05$

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Table 9-7
Interrater Agreement Coefficients for Aggregate Descriptors for Each Scale Type: Abilities

Scale type	Number of Raters on Each Variable		
	r_k	r_1	r_{30}
Level	.86	.39	.95
Importance	.82	.32	.93

Note. Interrater agreement coefficients estimates are based on 33 occupations with Abilities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 13.0, harmonic mean = 9.65). Full sample interrater agreement coefficients (r_k)were obtained by considering the "Aggregate x Occupations" term from Tables 9-6a and 9-6b as true variance. Error variance was defined as the "Aggregate x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability esitmates, where k is the harmonic mean of the number of raters for each occupation.

Table 9-8
Means and Standard Deviations of Correlations Between the Level and the Importance Scales Across Occupations and Descriptors: Abilities

	Level			Importance		
Scale	n[a]	M	SD	n	M	SD
Level	---	---	---	33	.82	.30
Importance	52	.92	.07	---	---	---

Note. All correlations were calculated based on the mean of ratings assigned by raters for a given occupation, descriptor, and scale. Level-Importance Means above the diagonal were calculated by taking the level scale means on a given occupation for all descriptors, correlating them with importance scale means, for that occupation, and then averaging them with the correlations for other occupations. Level-Importance Means below the diagonal were calculated by taking the level scale means for a given descriptor for all occupations, correlating them with importance scale means, for that descriptor, and averaging them with correlations for other descriptors. Other means in the table were calculated in a similar manner.
[a]Number of correlations averaged, not number of observations on which correlations were calculated.

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Table 9-9a

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Oral Comprehension	--										
2. Written Comprehension	70	--									
3. Oral Expression	66	81	--								
4. Written Expression	77	90	81	--							
5. Fluency of Ideas	75	68	73	77	--						
6. Originality	67	79	74	79	82	--					
7. Problem Sensitivity	71	69	65	70	71	67	--				
8. Deductive Reasoning	72	90	74	91	73	83	71	--			
9. Inductive Reasoning	60	75	67	78	69	71	81	84	--		
10. Information Ordering	61	78	65	77	54	68	61	83	79	--	
11. Category Flexibility	41	43	48	48	68	69	39	51	49	59	--
12. Math Reasoning	67	60	41	64	55	59	50	73	61	75	45
13. Number Facility	66	52	37	54	45	42	46	61	49	67	32
14. Memorization	46	61	74	67	49	53	52	63	56	63	34
15. Speed of Closure	73	80	67	83	68	64	73	79	81	82	43
16. Flexibility of Closure	44	45	51	46	59	60	62	58	74	66	56
17. Perceptual Speed	19	27	28	16	20	28	30	38	45	57	41
18. Spatial Orientation	-05	-05	01	-04	-13	16	15	04	18	02	01
19. Visualization	26	27	38	19	37	48	29	35	34	39	39
20. Selective Attention	28	52	39	45	24	46	45	58	55	63	43
21. Time Sharing	40	71	77	66	41	55	55	68	65	74	37
22. Arm-hand Steadiness	0	-05	06	-13	-13	0	27	-01	16	10	-16
23. Manual Dexterity	01	-13	-08	-22	-19	0	17	-03	07	02	-10
24. Finger Dexterity	16	-07	-13	-15	-03	01	22	04	10	06	-07
25. Control Precision	06	-02	-10	-07	-15	03	15	13	25	13	-11
26. Multi-limb Coordination	-21	-25	-22	-30	-29	-10	-02	-18	-03	-15	-09
27. Response Orientation	01	-04	01	-06	-03	06	21	03	22	-05	-11
28. Rate Control	-10	-10	-06	-11	-16	-02	08	01	19	-07	-20

Table 9-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Reaction Time	-09	-06	-09	-11	-20	-02	13	04	22	-0	-23
30. Wrist -finger Speed	-05	-10	-20	-15	-25	-30	-21	-15	-09	06	-06
31. Speed of Limb Movement	-16	-36	-26	-37	-32	-27	02	-35	-11	-33	-32
32. Static Strength	-34	-32	-25	-36	-36	-12	-10	-26	-08	-24	-27
33. Explosive Strength	-26	-24	-17	-21	-15	-02	02	-20	08	-14	-13
34. Dynamic Strength	-20	-25	-15	-26	-19	01	-05	-17	03	-12	-08
35. Trunk Strength	-27	-40	-31	-45	-28	-18	-09	-37	-15	-29	-16
36. Stamina	-22	-41	-24	-39	-25	-14	-07	-35	-09	-24	-14
37. Extent of Flexibility	-29	-48	-42	-54	-42	-30	-14	-42	-25	-33	-30
38. Dynamic Flexibility	-37	-55	-41	-42	-38	-30	-17	-46	-24	-40	-26
39. Gross Body Coordination	-25	-43	-28	-48	-24	-17	-10	-39	-18	-37	-19
40. Gross Body Equilibrium	-16	-41	-35	-38	-20	-09	-09	-31	-12	-33	-20
41. Near Vision	39	31	26	29	16	20	40	35	37	37	07
42. Far Vision	-07	06	12	11	-01	13	23	09	17	-03	-10
43. Visual Color Discrimin	01	02	10	-01	-01	09	35	10	30	17	-02
44. Night Vision	-18	-14	-03	-12	-17	-05	14	-07	20	-11	-24
45. Peripheral Vision	-24	-17	-04	-18	-19	-02	07	-11	07	-12	-16
46. Depth Perception	-02	-01	-02	-03	-12	12	19	07	17	-03	-18
47. Glare Sensitivity	-01	02	-06	0	-15	01	19	08	19	-02	-20
48. Hearing Sensitivity	-16	-02	-01	-09	-14	05	18	05	21	02	-17
49. Auditory Attention	07	12	21	01	05	18	26	14	22	07	-01
50. Sound Localization	-09	-12	-07	-20	-08	-0	22	-09	17	-14	-19
51. Speech Recognition	37	10	34	23	42	19	49	10	28	06	23
52. Speech Clarity	59	43	63	59	66	46	69	44	57	41	41

Table 9-9a (continued)
Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Math Reasoning	--										
13. Number Facility	92	--									
14. Memorization	39	39	--								
15. Speed of Closure	61	62	53	--							
16. Flexibility of Closure	45	36	52	57	--						
17. Perceptual Speed	34	32	33	34	70	--					
18. Spatial Orientation	-19	-30	-02	-10	18	24	--				
19. Visualization	39	41	26	25	55	58	19	--			
20. Selective Attention	26	22	49	51	53	68	35	30	--		
21. Time Sharing	35	35	73	66	49	51	21	34	65	--	
22. Arm-hand Steadiness	-12	-15	10	03	31	47	59	28	27	24	--
23. Manual Dexterity	-11	-17	-03	-13	29	53	68	36	34	08	87
24. Finger Dexterity	15	13	-09	-06	35	52	36	50	15	-06	68
25. Control Precision	16	08	-01	-03	22	44	62	36	29	07	66
26. Multi-limb Coordination	-23	-35	-17	-36	10	30	80	13	15	-04	65
27. Response Orientation	-15	-23	03	-07	27	32	74	29	19	10	73
28. Rate Control	-13	-21	02	-16	19	27	74	24	17	04	65
29. Reaction Time	-11	-20	-03	-09	19	33	75	25	23	07	72
30. Wrist -finger Speed	-11	02	-11	06	02	33	-03	-09	12	07	17
31. Speed of Limb Movement	-41	-42	-22	-34	03	13	68	05	-05	-17	69
32. Static Strength	-31	-43	-24	-35	04	13	78	16	01	-12	67
33. Explosive Strength	-29	-41	-24	-20	17	07	73	15	-02	-11	53
34. Dynamic Strength	-18	-32	-21	-26	21	25	81	30	07	-09	61
35. Trunk Strength	-36	-44	-42	-36	12	22	68	21	-05	-25	66
36. Stamina	-27	-33	-32	-32	12	14	72	26	-11	-21	67
37. Extent of Flexibility	-35	38	-36	-45	02	22	66	17	-03	-30	71
38. Dynamic Flexibility	-38	-46	-33	-52	03	10	68	10	-15	-33	61
39. Gross Body Coordination	-38	-43	-31	-43	09	19	68	28	-13	-25	69

Table 9-9a (continued)
Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
40. Gross Body Equilibrium	-18	-28	-37	-37	03	02	67	22	-19	-38	53
41. Near Vision	18	23	29	39	43	68	33	41	62	40	52
42. Far Vision	-24	-28	26	-06	15	09	68	20	25	24	48
43. Visual Color Discrimin	-12	-19	13	11	43	46	50	27	36	24	70
44. Night Vision	-33	-37	04	-08	27	21	76	17	17	11	67
45. Peripheral Vision	-31	-39	08	-22	18	20	78	17	16	11	74
46. Depth Perception	-13	-23	0	-07	18	22	83	29	26	09	72
47. Glare Sensitivity	-16	-20	05	-01	08	15	69	06	27	09	62
48. Hearing Sensitivity	-06	-14	16	-12	25	35	64	38	28	17	75
49. Auditory Attention	-09	-16	17	-03	39	50	72	37	42	33	69
50. Sound Localization	-22	-25	01	-14	27	26	64	33	13	0	74
51. Speech Recognition	02	08	29	31	20	-07	-01	-02	06	27	09
52. Speech Clarity	27	27	58	55	48	07	02	-05	17	50	01

Table 9-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Manual Dexterity	--										
24. Finger Dexterity	82	--									
25. Control Precision	80	70	--								
26. Multi-limb Coordination	80	60	75	--							
27. Response Orientation	78	64	81	81	--						
28. Rate Control	73	54	88	81	91	--					
29. Reaction Time	80	62	90	80	91	94	--				
30. Wrist -finger Speed	15	26	15	22	21	11	14	--			
31. Speed of Limb Movement	77	62	63	86	79	76	74	24	--		
32. Static Strength	75	51	66	83	74	77	81	-01	74	--	
33. Explosive Strength	53	40	52	74	72	73	73	07	74	84	--
34. Dynamic Strength	72	53	67	80	77	80	80	-10	70	93	87
35. Trunk Strength	76	65	58	81	74	68	71	16	80	89	83
36. Stamina	69	56	58	74	71	70	70	05	78	85	84
37. Extent of Flexibility	84	71	67	84	69	69	75	14	85	88	73
38. Dynamic Flexibility	71	59	59	86	71	71	70	11	85	88	83
39. Gross Body Coordination	77	67	61	82	78	73	72	13	87	84	80
40. Gross Body Equilibrium	66	59	64	75	70	73	71	-03	76	86	82
41. Near Vision	62	61	51	39	49	38	47	44	40	24	15
42. Far Vision	46	31	48	62	72	69	62	01	63	51	61
43. Visual Color Discrimin	72	51	58	59	65	56	60	09	62	50	49
44. Night Vision	66	41	67	73	89	88	85	09	78	76	79
45. Peripheral Vision	66	71	63	78	86	83	80	07	73	76	75
46. Depth Perception	80	56	81	81	88	91	90	01	78	82	75
47. Glare Sensitivity	66	43	80	75	87	88	85	21	72	64	61
48. Hearing Sensitivity	73	57	79	72	82	82	85	02	64	72	61
49. Auditory Attention	71	57	56	65	77	64	68	08	55	60	49
50. Sound Localization	74	63	74	72	92	83	83	11	79	69	68

Table 9-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
51. Speech Recognition	-05	-08	-17	-13	10	-15	-17	0	02	-18	-14
52. Speech Clarity	-20	-20	-27	-21	-03	-18	-24	-11	-10	-32	-12

Table 9-9a (continued)

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	34	35	36	37	38	39	40	41	42	43	44
34. Dynamic Strength	--										
35. Trunk Strength	91	--									
36. Stamina	91	92	--								
37. Extent of Flexibility	83	92	86	--							
38. Dynamic Flexibility	85	90	89	93	--						
39. Gross Body Coordination	85	92	91	92	92	--					
40. Gross Body Equilibrium	87	87	90	87	89	90	--				
41. Near Vision	25	28	17	34	19	26	16	--			
42. Far Vision	48	40	44	43	54	52	44	36	--		
43. Visual Color Discrimin	47	51	41	52	48	49	35	55	56	--	
44. Night Vision	76	69	70	64	70	71	63	37	76	71	--
45. Peripheral Vision	74	67	71	67	75	75	65	27	81	59	88
46. Depth Perception	80	71	73	73	71	74	75	46	75	62	86
47. Glare Sensitivity	59	53	51	57	56	56	56	46	76	64	84
48. Hearing Sensitivity	65	56	59	65	64	65	59	44	72	59	77
49. Auditory Attention	66	60	56	58	55	64	48	53	60	49	65
50. Sound Localization	68	69	68	70	70	79	68	40	71	67	85
51. Speech Recognition	-18	-09	-07	-17	-09	-06	-12	11	08	17	04
52. Speech Clarity	-23	-28	-18	-37	-25	-23	-26	06	12	09	-0

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Table 9-9a (continued)
Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	45	46	47	48	49	50	51	52
45. Peripheral Vision	--							
46. Depth Perception	83	--						
47. Glare Sensitivity	80	88	--					
48. Hearing Sensitivity	86	83	76	--				
49. Auditory Attention	77	68	55	74	--			
50. Sound Localization	86	82	80	88	74	--		
51. Speech Recognition	02	-13	01	-05	11	14	--	
52. Speech Clarity	-02	-18	-09	-17	08	-05	73	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 9-9b

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Oral Comprehension	--										
2. Written Comprehension	60	--									
3. Oral Expression	67	64	--								
4. Written Expression	68	81	72	--							
5. Fluency of Ideas	65	52	57	68	--						
6. Originality	53	65	70	76	77	--					
7. Problem Sensitivity	62	60	56	61	58	56	--				
8. Deductive Reasoning	58	80	51	77	68	80	65	--			
9. Inductive Reasoning	55	69	46	71	60	63	79	76	--		
10. Information Ordering	39	53	51	57	35	56	29	59	45	--	
11. Category Flexibility	32	22	47	39	61	61	14	40	31	65	--
12. Math Reasoning	49	51	21	47	45	40	34	58	37	49	26
13. Number Facility	45	28	15	36	27	21	21	33	22	46	25
14. Memorization	35	33	53	40	26	22	39	15	23	39	23
15. Speed of Closure	70	79	61	80	50	54	63	74	66	64	23
16. Flexibility of Closure	32	31	31	40	46	54	69	56	71	52	42
17. Perceptual Speed	06	-0	03	0	03	15	27	30	19	50	35
18. Spatial Orientation	-09	-22	-03	-17	-14	08	09	03	07	-01	02
19. Visualization	06	-04	07	11	34	36	21	27	12	29	31
20. Selective Attention	14	21	19	18	04	21	27	25	28	54	43
21. Time Sharing	40	50	65	51	23	42	55	42	39	60	31
22. Arm-hand Steadiness	06	-18	-02	-13	-17	-05	40	02	13	01	-13
23. Manual Dexterity	-05	-32	-22	-29	-22	-15	23	-05	-02	-03	-07
24. Finger Dexterity	-01	-18	-38	-16	-05	-16	25	06	03	-04	-15
25. Control Precision	-07	-22	-38	-23	-25	-14	14	05	11	-16	-17
26. Multi-limb Coordination	-30	-41	-30	-40	-26	-23	-02	-25	-12	-27	-06
27. Response Orientation	-08	-16	-13	-14	-15	-05	25	02	15	-22	-15
28. Rate Control	-19	-19	-23	-21	-24	-11	14	-02	13	-28	-23

Table 9-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Reaction Time	-15	-21	-27	-25	-31	-17	15	-02	11	-21	-25
30. Wrist-finger Speed	-06	-18	-27	-15	-33	-41	-25	-23	-20	02	-09
31. Speed of Limb Movement	-16	-41	-33	-37	-31	-36	02	-32	-16	-37	-34
32. Static Strength	-30	-48	-26	-43	-34	-17	-08	-24	-16	-24	-15
33. Explosive Strength	-13	-29	-19	-17	-11	-09	09	-11	17	-19	-15
34. Dynamic Strength	-17	-37	-16	-26	-12	-02	10	-11	06	-09	0
35. Trunk Strength	-28	-52	-23	-42	-27	-23	-09	-33	-16	-21	-05
36. Stamina	-08	-49	-15	-30	-17	-13	01	-26	-08	-22	-11
37. Extent of Flexibility	-33	-60	-44	-55	-36	-43	-13	-43	-31	-34	-28
38. Dynamic Flexibility	-33	-61	-33	-46	-23	-28	-09	-41	-22	-32	-11
39. Gross Body Coordination	-28	-59	-27	-49	-25	-30	-04	-42	-23	-35	-18
40. Gross Body Equilibrium	-20	-57	-42	-43	-14	-22	-09	-31	-15	-40	-18
41. Near Vision	17	06	-06	07	-09	-14	24	15	06	21	-06
42. Far Vision	-08	01	-04	08	-09	03	20	01	06	-25	-30
43. Visual Color Discrimin	-12	-16	-30	-12	-10	-14	33	02	17	-11	-20
44. Night Vision	-13	-21	-15	-20	-22	-14	21	-11	15	-35	-28
45. Peripheral Vision	-23	-26	-07	-18	-17	-09	19	-14	04	-30	-17
46. Depth Perception	-10	-18	-15	-19	-27	-10	17	-04	05	-28	-31
47. Glare Sensitivity	-16	-09	-20	-16	-31	-17	12	-02	05	-22	-25
48. Hearing Sensitivity	-20	-15	-13	-19	-21	-06	28	-01	07	-21	-20
49. Auditory Attention	-01	-14	05	-21	03	-01	34	0	09	-10	08
50. Sound Localization	-18	-21	-16	-25	-11	-11	26	-12	01	-37	-22
51. Speech Recognition	37	-04	27	06	28	-06	40	-11	05	-22	02
52. Speech Clarity	64	23	47	35	43	13	59	13	29	01	06

Table 9-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Math Reasoning	82	--									
13. Number Facility	17	38	--								
14. Memorization	58	54	42	--							
15. Speed of Closure	27	18	33	48	--						
16. Flexibility of Closure	27	18	33	48	--						
17. Perceptual Speed	21	19	06	19	61	--					
18. Spatial Orientation	-44	-34	-09	-22	26	38	--				
19. Visualization	29	31	13	19	52	45	13	--			
20. Selective Attention	04	22	39	33	51	57	20	18	--		
21. Time Sharing	12	12	67	55	49	42	06	13	62	--	
22. Arm-hand Steadiness	-22	-19	06	-04	49	56	62	21	22	29	--
23. Manual Dexterity	-24	-18	-07	-17	40	61	67	24	28	16	92
24. Finger Dexterity	02	07	-10	0	37	49	32	35	12	-01	70
25. Control Precision	-12	-01	-27	-19	29	44	66	21	20	-06	70
26. Multi-limb Coordination	-48	-44	-14	-50	14	33	76	05	07	-07	65
27. Response Orientation	-40	-38	-07	-21	29	34	81	10	15	11	76
28. Rate Control	-38	-40	-18	-29	21	20	75	07	08	-05	62
29. Reaction Time	-34	-34	-23	-24	24	34	78	09	15	-04	70
30. Wrist-finger Speed	-19	-05	03	-05	-05	31	06	-21	25	10	19
31. Speed of Limb Movement	-49	-38	-13	-37	02	20	65	-01	-08	-08	66
32. Static Strength	-47	-41	-32	-45	14	28	82	06	-09	-23	67
33. Explosive Strength	-42	-38	-31	-22	22	13	72	05	-20	-27	52
34. Dynamic Strength	-37	-30	-21	-28	33	36	85	21	09	-14	66
35. Trunk Strength	-58	-44	-27	-40	16	32	74	08	-02	-21	64
36. Stamina	-43	-27	-19	-33	18	24	78	15	-14	-22	71
37. Extent of Flexibility	-46	-32	-22	-48	04	25	69	12	-10	32	63
38. Dynamic Flexibility	-53	-37	-14	-52	11	20	70	08	-10	-26	61
39. Gross Body Coordination	-58	-49	-17	-51	11	24	72	11	-14	-17	71

Table 9-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
40. Gross Body Equilibrium	-34	-26	-39	-48	09	13	64	19	-28	-49	54
41. Near Vision	05	11	12	33	30	56	23	18	45	36	45
42. Far Vision	-36	-29	06	-09	0	-06	59	03	-04	06	43
43. Visual Color Discrimin	-22	-21	01	-06	42	28	41	24	17	13	65
44. Night Vision	-50	-45	0	-26	24	09	74	-02	09	04	64
45. Peripheral Vision	-53	-50	05	-34	24	20	73	04	05	07	69
46. Depth Perception	-41	-38	-12	-21	20	19	78	90	09	03	72
47. Glare Sensitivity	-43	-44	-10	-19	14	21	66	-07	21	12	61
48. Hearing Sensitivity	-28	-31	-07	-20	36	41	61	30	19	12	73
49. Auditory Attention	-25	-27	13	-17	43	55	62	16	36	23	65
50. Sound Localization	-43	-45	-03	-31	26	24	60	20	06	04	67
51. Speech Recognition	-15	-04	30	07	04	-02	0	-08	05	27	20
52. Speech Clarity	08	21	44	38	18	02	-06	-04	13	35	16

Table 9-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Manual Dexterity	--										
24. Finger Dexterity	81	--									
25. Control Precision	78	66	--								
26. Multi-limb Coordination	76	53	73	--							
27. Response Orientation	77	54	82	85	--						
28. Rate Control	62	38	84	80	90	--					
29. Reaction Time	75	51	88	79	91	93	--				
30. Wrist-finger Speed	26	35	22	27	22	12	16	--			
31. Speed of Limb Movement	74	61	67	85	74	70	72	37	--		
32. Static Strength	74	45	62	70	72	67	76	06	69	--	
33. Explosive Strength	53	40	55	70	70	69	71	12	72	79	--
34. Dynamic Strength	72	48	65	80	77	72	78	05	68	91	88
35. Trunk Strength	71	49	51	79	68	58	66	28	72	90	84
36. Stamina	71	48	56	70	69	60	66	11	73	88	83
37. Extent of Flexibility	75	61	59	80	64	60	70	21	82	86	74
38. Dynamic Flexibility	70	52	51	85	65	58	61	19	78	86	78
39. Gross Body Coordination	74	53	54	83	73	64	66	22	85	84	77
40. Gross Body Equilibrium	62	56	64	73	63	64	65	10	75	81	83
41. Near Vision	56	60	44	32	37	25	40	58	50	14	18
42. Far Vision	41	35	51	60	72	70	62	07	71	43	56
43. Visual Color Discrimin	71	71	64	58	63	51	57	10	62	43	47
44. Night Vision	61	35	73	76	91	91	85	12	73	63	68
45. Peripheral Vision	60	34	61	76	67	83	75	10	67	65	63
46. Depth Perception	72	46	81	77	90	92	90	10	79	72	67
47. Glare Sensitivity	66	46	79	77	88	87	84	33	75	55	55
48. Hearing Sensitivity	70	50	74	68	80	79	81	0	60	62	49
49. Auditory Attention	64	38	50	62	70	56	62	12	43	52	35
50. Sound Localization	65	53	64	71	82	73	72	09	71	56	53

Table 9-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
51. Speech Recognition	16	15	-10	04	11	-14	-09	-02	14	-05	-05
52. Speech Clarity	03	05	-17	-17	-03	-24	-19	-06	01	-24	-11

Table 9-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	34	35	36	37	38	39	40	41	42	43	44
34. Dynamic Strength	--										
35. Trunk Strength	90	--									
36. Stamina	90	89	--								
37. Extent of Flexibility	83	86	85	--							
38. Dynamic Flexibility	87	90	88	90	--						
39. Gross Body Coordination	83	89	89	89	81	--					
40. Gross Body Equilibrium	83	81	88	87	86	86	--				
41. Near Vision	20	24	14	33	16	23	12	--			
42. Far Vision	49	40	47	47	48	52	47	31	--		
43. Visual Color Discrimin	48	42	38	49	49	51	44	49	48	--	
44. Night Vision	69	58	62	58	60	69	59	25	71	63	--
45. Peripheral Vision	69	63	66	61	66	76	59	15	72	52	87
46. Depth Perception	71	61	67	66	60	69	63	39	77	61	91
47. Glare Sensitivity	55	51	44	52	47	57	45	52	74	66	87
48. Hearing Sensitivity	61	52	51	59	58	59	51	35	60	58	73
49. Auditory Attention	59	54	49	53	50	59	40	27	28	34	59
50. Sound Localization	57	56	54	61	55	72	58	31	66	64	80
51. Speech Recognition	-03	06	08	08	11	20	01	08	03	71	10
52. Speech Clarity	-13	-11	02	-09	-05	-01	-11	12	02	08	-03

Table 9-9b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	45	46	47	48	49	50	51	42
45. Peripheral Vision	--							
46. Depth Perception	80	--						
47. Glare Sensitivity	75	90	--					
48. Hearing Sensitivity	80	79	71	--				
49. Auditory Attention	72	52	48	71	--			
50. Sound Localization	86	75	74	88	72	--		
51. Speech Recognition	16	-06	-04	09	38	30	--	
52. Speech Clarity	04	-14	-17	-06	26	09	82	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 9-10a

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Oral Comprehension	--										
2. Written Comprehension	49	--									
3. Oral Expression	65	53	--								
4. Written Expression	59	67	67	--							
5. Fluency of Ideas	51	45	55	62	--						
6. Originality	41	51	53	64	65	--					
7. Problem Sensitivity	49	53	53	52	51	49	--				
8. Deductive Reasoning	49	66	58	67	56	65	62	--			
9. Inductive Reasoning	40	47	47	52	53	54	56	65	--		
10. Information Ordering	54	56	48	51	37	44	56	71	56	--	
11. Category Flexibility	31	38	42	48	53	61	36	54	52	46	--
12. Math Reasoning	36	33	32	39	51	48	30	50	48	45	48
13. Number Facility	34	35	29	34	39	30	38	41	38	36	30
14. Memorization	49	52	53	49	38	42	53	55	52	68	39
15. Speed of Closure	44	45	47	58	61	66	53	69	60	56	54
16. Flexibility of Closure	24	28	34	37	55	48	37	47	46	36	51
17. Perceptual Speed	20	29	31	32	41	34	41	44	43	43	41
18. Spatial Orientation	18	32	26	29	36	41	37	37	34	35	32
19. Visualization	30	29	35	30	50	44	28	36	40	34	47
20. Selective Attention	26	38	32	36	29	39	49	51	48	53	31
21. Time Sharing	33	41	41	41	30	39	41	51	40	50	33
22. Arm-hand Steadiness	25	19	23	13	28	26	29	34	30	28	20
23. Manual Dexterity	18	15	19	14	26	31	33	31	25	24	18
24. Finger Dexterity	26	24	13	23	34	27	33	36	27	26	18
25. Control Precision	11	09	02	08	12	11	25	20	25	25	06
26. Multi-limb Coordination	04	13	06	04	13	08	19	16	16	18	11
27. Response Orientation	18	19	09	12	23	12	33	25	26	21	06
28. Rate Control	-01	09	04	08	13	13	13	11	26	11	05

Table 9-10a (continued)
Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Reaction Time	02	09	02	03	17	10	23	18	20	14	02
30. Wrist-finger Speed	19	20	11	10	16	10	26	20	16	32	08
31. Speed of Limb Movement	09	05	04	08	22	01	26	07	13	13	03
32. Static Strength	05	-09	04	-03	12	10	16	04	07	09	00
33. Explosive Strength	03	-03	04	06	20	14	20	13	15	18	21
34. Dynamic Strength	06	-06	-00	00	17	07	20	09	10	15	08
35. Trunk Strength	08	-16	02	-11	16	-01	15	03	10	11	12
36. Stamina	05	-03	03	-04	17	09	20	09	12	15	14
37. Extent of Flexibility	05	-07	-00	-05	11	05	15	05	06	08	05
38. Dynamic Flexibility	06	-05	04	02	20	04	23	12	05	12	11
39. Gross Body Coordination	09	-00	05	01	21	02	20	09	03	10	08
40. Gross Body Equilibrium	05	-03	01	01	15	07	17	12	11	10	18
41. Near Vision	36	24	24	19	26	16	30	31	28	26	15
42. Far Vision	06	23	17	19	27	22	31	26	22	16	16
43. Visual Color Discrimin	16	20	19	17	30	17	38	29	24	25	13
44. Night Vision	08	11	10	13	30	13	21	16	29	11	09
45. Peripheral Vision	09	24	17	18	23	22	36	31	26	28	13
46. Depth Perception	04	21	06	14	21	16	19	17	23	15	09
47. Glare Sensitivity	12	14	06	22	23	18	22	20	15	17	18
48. Hearing Sensitivity	03	17	18	13	21	18	22	26	26	24	16
49. Auditory Attention	21	27	32	26	35	26	33	32	36	29	22
50. Sound Localization	07	12	05	06	24	13	24	11	20	08	05
51. Speech Recognition	37	13	38	27	35	24	32	23	25	26	24
52. Speech Clarity	46	41	58	50	43	35	54	44	45	44	36

Table 9-10a (continued)
Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Math Reasoning	--										
13. Number Facility	65	--									
14. Memorization	34	38	--								
15. Speed of Closure	50	33	54	--							
16. Flexibility of Closure	46	21	34	61	--						
17. Perceptual Speed	45	35	39	46	62	--					
18. Spatial Orientation	22	10	32	34	55	48	--				
19. Visualization	45	33	37	40	63	56	53	--			
20. Selective Attention	25	23	47	39	46	51	54	47	--		
21. Time Sharing	23	27	38	44	48	38	44	39	57	--	
22. Arm-hand Steadiness	19	19	29	25	34	45	56	47	41	42	--
23. Manual Dexterity	09	03	24	22	39	40	58	45	46	38	72
24. Finger Dexterity	29	22	18	31	44	52	45	46	38	31	66
25. Control Precision	25	14	14	12	32	41	50	36	38	28	58
26. Multi-limb Coordination	11	-03	15	06	31	41	55	33	39	28	59
27. Response Orientation	11	-02	20	10	33	32	54	31	38	30	54
28. Rate Control	16	00	14	11	33	34	55	35	32	22	49
29. Reaction Time	09	02	11	04	29	33	53	34	39	28	52
30. Wrist-finger Speed	20	21	26	23	22	29	11	11	21	20	32
31. Speed of Limb Movement	01	-06	16	04	278	27	53	21	31	14	47
32. Static Strength	01	-03	16	-01	21	27	52	29	23	18	57
33. Explosive Strength	14	04	15	10	31	31	51	33	24	22	45
34. Dynamic Strength	08	00	14	-01	21	29	53	32	30	11	48
35. Trunk Strength	05	01	16	-01	20	32	38	26	15	10	49
36. Stamina	10	03	22	04	26	32	47	31	25	17	53
37. Extent of Flexibility	09	04	08	02	029	37	50	34	24	15	53
38. Dynamic Flexibility	13	05	18	03	30	36	50	30	27	16	50
39. Gross Body Coordinatio..	05	-00	14	00	25	27	46	33	22	14	47

Table 9-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
40. Gross Body Equilibrium	16	05	06	05	30	32	51	34	21	17	47
41. Near Vision	19	25	25	27	40	42	35	31	44	29	34
42. Far Vision	10	07	30	16	34	22	57	29	41	34	40
43. Visual Color Discrimin	16	13	19	19	40	44	49	34	40	30	55
44. Night Vision	10	-05	15	15	39	24	53	29	28	24	47
45. Peripheral Vision	10	03	30	20	36	33	63	29	43	39	57
46. Depth Perception	10	-01	14	13	28	29	57	32	31	21	53
47. Glare Sensitivity	18	05	12	17	33	23	51	24	36	24	51
48. Hearing Sensitivity	19	16	23	21	37	38	41	36	29	40	40
49. Auditory Attention	14	08	28	25	41	42	45	35	38	44	42
50. Sound Localization	13	03	12	11	33	31	43	33	30	31	46
51. Speech Recognition	20	18	23	26	28	17	26	19	18	35	23
52. Speech Clarity	33	24	52	40	33	33	24	19	26	28	14

Table 9-10a (continued)
Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Manual Dexterity	--										
24. Finger Dexterity	72	--									
25. Control Precision	65	58	--								
26. Multi-limb Coordination	65	58	62	--							
27. Response Orientation	60	57	65	71	--						
28. Rate Control	55	49	72	70	74	--					
29. Reaction Time	64	56	75	72	81	75	--				
30. Wrist-finger Speed	31	49	30	30	32	28	25	--			
31. Speed of Limb Movement	60	54	56	67	72	64	69	36	--		
32. Static Strength	62	47	58	61	58	52	64	14	64	--	
33. Explosive Strength	43	43	45	49	55	47	58	20	59	71	--
34. Dynamic Strength	55	55	53	63	64	54	66	26	68	78	75
35. Trunk Strength	54	49	42	52	52	37	54	30	67	74	69
36. Stamina	53	52	47	58	61	51	58	27	66	78	76
37. Extent of Flexibility	58	59	57	65	57	53	64	26	69	78	63
38. Dynamic Flexibility	48	51	46	63	60	49	60	26	70	74	78
39. Gross Body Coordination	59	56	47	63	61	44	60	29	70	66	61
40. Gross Body Equilibrium	48	55	47	65	55	49	58	20	61	68	76
41. Near Vision	35	47	27	31	41	23	40	27	42	31	37
42. Far Vision	45	38	41	50	63	53	57	20	59	50	46
43. Visual Color Discrimin	55	57	50	53	63	45	61	30	66	53	55
44. Night Vision	45	42	46	47	61	60	60	17	68	54	57
45. Peripheral Vision	64	51	56	64	68	62	65	32	65	54	47
46. Depth Perception	52	51	51	65	64	73	64	24	66	48	48
47. Glare Sensitivity	47	47	54	59	67	61	64	26	62	47	46
48. Hearing Sensitivity	48	44	46	52	54	53	59	20	47	47	46
49. Auditory Attention	51	42	37	44	55	47	52	27	51	43	47
50. Sound Localization	55	53	55	56	71	63	68	26	63	54	55

Table 9-10a (continued)
Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
51. Speech Recognition	22	21	16	12	26	10	14	21	24	17	22
52. Speech Clarity	08	10	03	04	15	04	-01	22	19	00	17

Table 9-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Abilities

Descriptor	34	35	36	37	38	39	40	41	42	43	44
34. Dynamic Strength	--										
35. Trunk Strength	79	--									
36. Stamina	83	80	--								
37. Extent of Flexibility	73	75	75	--							
38. Dynamic Flexibility	80	76	82	82	--						
39. Gross Body Coordination	77	75	72	77	82	--					
40. Gross Body Equilibrium	79	71	79	75	83	78	--				
41. Near Vision	38	42	41	47	48	45	42	--			
42. Far Vision	46	36	47	47	53	46	44	42	--		
43. Visual Color Discrimin	55	57	58	62	61	57	56	58	59	--	
44. Night Vision	56	50	60	51	59	52	56	42	61	69	--
45. Peripheral Vision	54	47	54	54	58	59	56	38	71	66	67
46. Depth Perception	56	43	55	52	55	52	58	35	60	59	73
47. Glare Sensitivity	52	41	48	47	53	48	51	32	64	57	61
48. Hearing Sensitivity	38	42	44	46	41	40	42	34	53	58	49
49. Auditory Attention	43	44	48	43	43	43	40	47	49	53	53
50. Sound Localization	52	48	57	55	51	48	48	36	60	66	62
51. Speech Recognition	17	17	21	18	22	26	19	29	30	32	24
52. Speech Clarity	07	10	11	06	20	19	12	38	26	26	18

Table 9-10a (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Abilities

Descriptor	45	46	47	48	49	50	51	42
45. Peripheral Vision	--							
46. Depth Perception	71	--						
47. Glare Sensitivity	63	72	--					
48. Hearing Sensitivity	59	57	50	--				
49. Auditory Attention	57	48	40	70	--			
50. Sound Localization	65	62	62	75	71	--		
51. Speech Recognition	34	13	28	29	45	37	--	
52. Speech Clarity	31	11	14	20	42	19	63	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 9-10b

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
1. Oral Comprehension	--										
2. Written Comprehension	48	--									
3. Oral Expression	69	59	--								
4. Written Expression	57	59	62	--							
5. Fluency of Ideas	57	43	49	66	--						
6. Originality	44	52	47	66	70	--					
7. Problem Sensitivity	54	45	57	49	51	43	--				
8. Deductive Reasoning	48	56	55	62	53	66	57	--			
9. Inductive Reasoning	46	46	41	44	54	55	60	64	--		
10. Information Ordering	48	41	49	41	30	39	47	56	40	--	
11. Category Flexibility	39	35	36	47	50	56	31	47	50	48	--
12. Math Reasoning	33	35	22	36	44	39	29	44	45	28	44
13. Number Facility	45	28	25	30	35	35	31	32	37	24	29
14. Memorization	41	33	44	32	25	28	43	36	36	47	34
15. Speed of Closure	39	41	41	53	51	58	47	65	55	39	45
16. Flexibility of Closure	30	27	37	36	49	47	49	45	51	38	45
17. Perceptual Speed	23	22	23	22	30	32	36	34	39	37	33
18. Spatial Orientation	24	23	24	29	29	31	35	34	27	36	29
19. Visualization	20	24	23	29	42	40	28	29	35	23	38
20. Selective Attention	26	24	25	25	26	35	39	38	38	37	25
21. Time Sharing	43	36	42	50	31	38	41	42	29	49	35
22. Arm-hand Steadiness	22	19	22	15	17	22	28	26	23	22	14
23. Manual Dexterity	24	12	22	154	14	24	34	30	24	24	10
24. Finger Dexterity	26	27	15	25	29	27	36	36	27	24	18
25. Control Precision	12	03	-04	03	05	06	20	11	19	11	03
26. Multi-limb Coordination	08	03	05	-04	05	02	19	10	14	10	03
27. Response Orientation	17	11	01	10	13	09	29	15	14	16	05
28. Rate Control	05	03	-04	00	04	07	11	09	19	04	-01

Table 9-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	1	2	3	4	5	6	7	8	9	10	11
29. Reaction Time	13	08	03	06	10	08	26	17	17	12	00
30. Wrist-finger Speed	18	11	07	11	12	04	23	13	09	26	07
31. Speed of Limb Movement	21	-00	06	02	11	-05	23	04	08	10	-05
32. Static Strength	09	-10	09	-02	00	10	13	04	-01	15	00
33. Explosive Strength	04	-00	01	04	11	11	22	11	15	17	14
34. Dynamic Strength	08	-07	-00	04	11	10	25	08	09	19	12
35. Trunk Strength	12	-10	07	-06	06	06	15	06	11	21	13
36. Stamina	11	-06	03	02	13	09	23	07	10	13	10
37. Extent of Flexibility	09	-12	02	-02	02	-01	16	04	04	09	00
38. Dynamic Flexibility	07	-09	04	01	08	05	20	08	11	16	06
39. Gross Body Coordination	10	-10	07	03	12	05	21	01	04	17	04
40. Gross Body Equilibrium	07	-04	-04	-05	13	05	18	06	15	08	09
41. Near Vision	26	11	13	14	18	16	23	19	16	15	13
42. Far Vision	18	18	16	28	22	24	25	21	12	13	15
43. Visual Color Discrimin	19	07	10	14	21	08	31	20	13	11	03
44. Night Vision	20	15	08	16	21	09	24	11	24	08	09
45. Peripheral Vision	12	19	14	17	17	14	31	22	20	20	13
46. Depth Perception	08	16	00	12	11	13	15	15	18	07	10
47. Glare Sensitivity	12	07	04	25	13	12	13	12	06	11	14
48. Hearing Sensitivity	13	23	20	20	11	16	24	25	22	19	18
49. Auditory Attention	28	31	32	26	28	30	34	28	30	27	27
50. Sound Localization	13	13	08	08	18	10	17	10	13	01	02
51. Speech Recognition	40	22	38	25	26	17	21	16	17	23	19
52. Speech Clarity	37	32	43	36	36	16	40	25	30	30	26

Table 9-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
12. Math Reasoning	--										
13. Number Facility	59	--									
14. Memorization	25	38	--								
15. Speed of Closure	50	32	40	--							
16. Flexibility of Closure	43	22	33	54	--						
17. Perceptual Speed	38	26	39	37	59	--					
18. Spatial Orientation	08	07	34	25	50	45	--				
19. Visualization	37	26	31	28	54	51	44	--			
20. Selective Attention	16	19	45	32	46	51	51	37	--		
21. Time Sharing	19	21	38	37	41	36	42	27	46	--	
22. Arm-hand Steadiness	06	19	31	19	36	42	55	33	38	37	--
23. Manual Dexterity	00	11	26	19	43	42	58	31	41	35	75
24. Finger Dexterity	25	26	24	32	40	48	45	43	32	25	64
25. Control Precision	14	09	11	02	31	44	46	29	39	24	58
26. Multi-limb Coordination	-05	-07	19	-02	30	35	57	25	37	25	62
27. Response Orientation	00	04	18	-02	26	27	50	23	32	24	52
28. Rate Control	00	00	13	-01	26	34	52	25	33	24	48
29. Reaction Time	-03	-00	10	-02	26	32	56	28	41	22	56
30. Wrist-finger Speed	20	22	24	20	20	25	19	03	23	13	31
31. Speed of Limb Movement	-10	-01	18	-06	22	25	48	12	34	16	45
32. Static Strength	-12	-02	18	-07	21	34	52	18	26	13	56
33. Explosive Strength	-03	-03	12	00	24	26	42	27	24	10	39
34. Dynamic Strength	-07	-02	16	-03	22	23	54	28	30	14	48
35. Trunk Strength	-02	07	21	-05	21	30	45	23	22	09	48
36. Stamina	-04	-00	20	-02	23	24	50	23	24	14	51
37. Extent of Flexibility	-09	-02	17	-01	24	34	54	27	25	15	49
38. Dynamic Flexibility	-06	-03	23	-04	24	34	52	24	29	15	48
39. Gross Body Coordination	-10	-06	22	-07	23	30	49	23	23	14	54

Table 9-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	12	13	14	15	16	17	18	19	20	21	22
40. Gross Body Equilibrium	02	-01	04	-06	27	30	48	34	18	08	44
41. Near Vision	21	24	19	21	34	36	30	24	34	25	27
42. Far Vision	08	15	30	14	25	17	48	21	38	38	35
43. Visual Color Discrimin	07	13	14	10	31	35	41	27	27	24	48
44. Night Vision	03	02	21	05	33	19	57	22	32	26	50
45. Peripheral Vision	03	02	26	10	37	33	63	24	41	37	59
46. Depth Perception	-02	-00	15	06	28	29	59	28	31	29	57
47. Glare Sensitivity	03	00	07	08	029	23	46	20	29	35	53
48. Hearing Sensitivity	11	08	18	18	35	38	42	35	26	39	40
49. Auditory Attention	11	09	27	22	39	41	42	30	40	40	45
50. Sound Localization	-00	-03	07	03	28	26	40	27	26	29	46
51. Speech Recognition	16	14	22	21	17	16	29	16	22	31	23
52. Speech Clarity	24	20	34	28	23	25	31	16	23	33	22

Table 9-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
23. Manual Dexterity	--										
24. Finger Dexterity	71	--									
25. Control Precision	63	52	--								
26. Multi-limb Coordination	67	51	63	--							
27. Response Orientation	60	51	64	69	--						
28. Rate Control	55	37	74	70	68	--					
29. Reaction Time	62	52	73	73	84	75	--				
30. Wrist-finger Speed	33	48	29	29	28	20	24	--			
31. Speed of Limb Movement	61	47	55	71	66	56	71	38	--		
32. Static Strength	59	46	56	61	53	43	61	22	61	--	
33. Explosive Strength	38	44	47	53	53	39	55	24	54	68	--
34. Dynamic Strength	55	51	45	61	66	43	66	27	62	74	75
35. Trunk Strength	55	49	40	57	50	36	51	40	59	71	69
36. Stamina	50	49	46	57	58	41	60	31	61	74	76
37. Extent of Flexibility	62	54	51	69	51	47	59	30	69	77	62
38. Dynamic Flexibility	52	48	46	70	61	49	62	30	70	75	73
39. Gross Body Coordination	63	50	47	67	62	44	57	35	73	73	63
40. Gross Body Equilibrium	46	53	45	64	48	43	57	27	56	64	74
41. Near Vision	30	45	21	25	33	15	34	35	37	26	32
42. Far Vision	34	34	35	46	51	43	53	25	53	45	42
43. Visual Color Discrimin	55	59	44	51	56	39	56	32	60	51	47
44. Night Vision	45	39	51	54	63	60	64	25	63	46	49
45. Peripheral Vision	61	51	52	65	65	60	65	33	59	51	40
46. Depth Perception	57	48	57	64	60	71	67	21	60	43	42
47. Glare Sensitivity	48	46	50	53	56	53	59	27	53	42	40
48. Hearing Sensitivity	50	41	44	47	43	43	44	10	34	32	31
49. Auditory Attention	51	39	33	40	47	41	44	26	38	37	40
50. Sound Localization	54	48	47	56	62	55	59	20	55	38	46

Table 9-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	23	24	25	26	27	28	29	30	31	32	33
51. Speech Recognition	22	19	10	19	21	09	15	14	23	17	11
52. Speech Clarity	19	16	04	11	11	03	09	19	23	07	15

Table 9-10b (continued)

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Abilities

Descriptor	34	35	36	37	38	39	40	41	42	43	44
34. Dynamic Strength	--										
35. Trunk Strength	74	--									
36. Stamina	80	80	--								
37. Extent of Flexibility	72	73	71	--							
38. Dynamic Flexibility	78	71	80	81	--						
39. Gross Body Coordination	76	73	77	76	81	--					
40. Gross Body Equilibrium	74	71	74	72	76	70	--				
41. Near Vision	36	45	39	36	32	29	36	--			
42. Far Vision	45	42	50	43	48	42	40	46	--		
43. Visual Color Discrimin	54	52	56	58	56	55	57	51	54	--	
44. Night Vision	52	49	60	44	56	51	49	32	55	60	--
45. Peripheral Vision	54	47	55	51	59	55	49	31	64	57	69
46. Depth Perception	50	43	53	48	52	45	48	33	54	52	72
47. Glare Sensitivity	40	40	44	44	45	44	39	35	58	51	65
48. Hearing Sensitivity	29	33	32	41	29	33	30	30	41	46	45
49. Auditory Attention	36	40	42	39	37	42	37	33	39	42	50
50. Sound Localization	42	41	49	46	47	50	46	35	49	57	62
51. Speech Recognition	18	17	20	30	24	26	17	25	30	26	23
52. Speech Clarity	16	16	21	22	26	22	21	31	29	23	21

Table 9-10b (continued)

Intercorrelations of Descriptors for the Level Scale (Individual-Level Data): Abilities

Descriptor	45	46	47	48	49	50	51	42
45. Peripheral Vision	--							
46. Depth Perception	72	--						
47. Glare Sensitivity	60	69	--					
48. Hearing Sensitivity	56	57	45	--				
49. Auditory Attention	57	45	42	61	--			
50. Sound Localization	67	62	55	68	71	--		
51. Speech Recognition	35	15	22	29	44	38	--	
52. Speech Clarity	31	19	14	27	41	28	61	--

Note. N = 35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

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Table 9-11
Principal Components Analysis Pattern Matrix for the Level Scale: Abilities (loadings over .30)

Descriptor	Factor F1	F2	F3	F4	F5	F6	F7	Communality
1. Oral Comp.	-.10	.80	.10	-.30	.27	.08	-.14	.85
2. Written Comp.	-.13	.89	-.06	.18	-.05	-.00	-.09	.86
3. Oral Expression	-.07	.78	.06	.31	.25	-.17	.06	.80
4. Written Expression	-.14	.93	-.18	.09	.06	-.05	-.06	.93
5. Fluency of Ideas	-.14	.79	.11	-.12	.35	-.22	.16	.86
6. Originality	.03	.86	.09	.04	.02	-.27	.23	.87
7. Problem Sensitivity	.16	.79	.09	-.01	.41	-.00	-.10	.83
8. Deductive Reason.	-.06	.95	.03	.12	-.11	-.01	-.08	.94
9. Inductive Reasoning	.15	.89	-.00	.07	.09	.06	.04	.84
10. Information Ord.	-.10	.87	.15	.14	-.15	.23	.12	.89
11. Category Flex.	-.17	.58	.18	.04	.06	-.02	.58	.73
12. Math Reasoning	-.22	.76	.30	-.31	-.21	-.00	-.14	.87
13. Number Facility	-.32	.66	.35	-.28	-.13	.11	-.27	.83
14. Memorization	-.06	.63	.10	.52	.20	-.08	-.16	.75
15. Speed of Closure	-.17	.87	-.04	.02	.13	.24	-.02	.85
16. Flexibility of Clo.	.21	.64	.40	.12	.18	.12	.31	.77
17. Perceptual Speed	.23	.37	.60	.29	-.13	.48	.23	.93
18. Spatial Orientation	.86	.09	-.13	.12	-.07	-.01	.24	.83
19. Visualization	.24	.38	.71	.06	-.11	-.17	.10	.77
20. Selective Attention	.16	.54	.14	.52	-.16	.38	.13	.79
21. Time Sharing	.03	.68	.05	.57	.08	.15	.06	.82
22. Arm-hand Stead.	.76	.02	.32	.15	.16	.22	-.08	.78
23. Manual Dexterity	.81	-.03	.41	.04	-.02	.26	-.03	.89
24. Finger Dexterity	.60	.04	.60	-.26	-.00	.29	-.14	.89
25. Control Precision	.79	.15	.22	-.10	-.29	.19	-.27	.90
26. Multi-limb Coord.	.88	-.15	.03	-.01	-.09	.18	.11	.85
27. Response Orient	.94	.08	.05	.02	.09	.11	-.11	.91
28. Rate Control	.92	.04	-.02	.02	-.16	.02	-.16	.90
29. Reaction Time	.92	.05	.04	.02	-.20	.11	-.15	.93
30. Wrist-finger Spd.	.06	-.13	-.04	-.02	.01	.84	.01	.73
31. Speed of Limb Mv.	.86	-.27	.01	-.12	.20	.20	-.05	.90
32. Static Strength	.88	-.22	.04	-.05	-.16	-.06	.16	.89
33. Explosive Strength	.86	-.09	-.16	-.15	-.04	-.07	.30	.88
34. Dynamic Strength	.88	-.09	.10	-.13	-.17	-.07	.31	.94
35. Trunk Strength	.83	-.29	.17	-.23	.01	.10	.31	.95
36. Stamina	.83	-.23	.14	-.25	.02	-.06	.28	.90
37. Extent Flexibility	.82	-.38	.26	-.18	-.05	.13	.09	.93
38. Dynamic Flex.	.84	-.40	.11	-.18	.04	.00	.17	.93
39. Gross Body Coord..	.85	-.32	.24	-.17	.10	-.02	.17	.95
40. Gross-body Equilib.	.83	-.22	.10	-.42	-.06	-.14	.13	.95
41. Near Vision	.40	.36	.31	.14	.05	.59	-.15	.79
42. Far Vision	.75	.11	-.17	.35	.13	-.12	-.15	.78
43. Visual Color Disc.	.66	.12	.18	.23	.21	.26	-.04	.64
44. Night Vision	.91	-.02	-.12	.19	.09	.03	-.04	.89

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Table 9-11 (continued)
Principal Components Analysis Pattern Matrix for the Level Scale: Abilities (loadings over .30)

Descriptor	Factor F1	F2	F3	F4	F5	F6	F7	Communality
45. Peripheral Vision	.90	-.08	-.03	.28	.08	-.08	-.02	.90
46. Depth Perception	.95	.10	-.01	.03	-.14	-.02	-.11	.94
47. Glare Sensitivity	.85	.10	-.22	.09	-.04	.18	-.31	.92
48. Hearing Sensitivity	.84	.05	.23	.25	-.09	-.07	-.24	.90
49. Auditory Attention	.74	.13	.28	.29	.11	.04	.06	.74
50. Sound Localization	.89	-.03	.17	.08	.19	-.01	-.20	.89
51. Speech Recog.	-.03	.21	-.03	.02	.87	.03	-.03	.80
52. Speech Clarity	-.10	.56	-.15	.08	.73	-.04	.13	.89
Percent of Variance	41	25	6	5	4	3	2	
Eigenvalue	21.41	13.20	2.95	2.45	2.01	1.69	1.19	

Note. N = 33. The correlation matrix was based on means calculated at the occupation level. F1 = Psychomotor/ Perceptual, F2 = Cognitive, F3 = Visualization, F4 = Time Sharing, F5 = Speech, F6 = Wrist-Finger Speed, F7 = Non-interpretable. These loadings are based on an orthogonal varimax rotation.

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Table 9-12a

Descriptor Means and Standard Deviations on the Level Scale on Six Example Jobs: Abilities

Descriptor	Jobs: General Managers & Top Executives (n=6) M	SD	Computer Programmers (n=30) M	SD	Registered Nurses (n=23) M	SD	Police Patrol Officers (n=27) M	SD	Janitors & Cleaners[a] (n=38) M	SD	Maintenance Repairers, General Utility (n=43) M	SD
1. Oral Comprehension	5.10	1.13	5.67	.82	5.03	1.85	4.57	1.44	2.67	2.29	4.29	1.71
2. Written Comprehension	5.21	1.39	6.00	.89	5.33	1.56	4.70	1.11	2.74	2.43	4.26	1.84
3. Oral Expression	5.35	1.45	5.83	.98	5.23	1.79	5.30	.76	3.00	2.47	4.68	1.58
4. Written Expression	5.36	.78	6.17	.98	5.23	1.17	4.91	1.31	2.48	2.34	4.00	1.83
5. Fluency of Ideas	4.62	1.21	4.33	1.97	3.67	1.73	2.70	2.10	1.63	1.92	2.92	2.08
6. Originality	5.07	.80	5.17	1.47	4.13	1.76	3.61	1.53	2.22	2.42	3.71	2.08
7. Problem Sensitivity	5.49	1.16	4.33	2.42	6.23	.94	4.83	1.37	2.48	2.14	4.32	1.76
8. Deductive Reasoning	4.95	1.53	5.50	1.22	4.67	1.77	4.09	1.70	1.81	2.27	3.92	1.71
9. Inductive Reasoning	4.95	1.15	4.50	2.43	5.27	1.62	4.65	1.15	2.22	2.24	3.54	1.84
10. Information Ordering	4.44	1.67	5.17	1.60	4.52	2.06	4.13	1.39	2.37	2.20	3.89	1.77
11. Category Flexibility	4.21	1.85	3.50	2.26	2.55	2.42	.87	1.58	1.59	2.22	2.58	2.16
12. Math Reasoning	3.90	1.57	4.83	1.17	3.57	1.76	1.65	1.53	1.70	1.96	3.08	2.08
13. Number Facility	4.45	1.52	4.50	1.38	3.90	2.09	2.61	1.59	1.88	1.80	4.00	1.68
14. Memorization	4.72	1.32	5.17	1.72	4.70	1.86	4.27	1.39	2.63	2.44	4.11	1.61
15. Speed of Closure	4.35	1.43	4.17	2.48	4.30	1.29	4.22	1.00	1.78	1.89	3.65	1.71
16. Flexibility of Closure	3.63	2.17	3.50	2.74	3.30	2.38	2.96	2.12	1.33	2.02	3.32	2.27
17. Perceptual Speed	3.44	1.98	2.50	2.95	2.70	2.37	2.57	2.09	2.22	2.42	3.11	2.05
18. Spatial Orientation	2.86	2.17	1.00	2.45	2.97	2.31	4.73	1.86	2.54	2.41	3.50	2.20
19. Visualization	3.67	2.20	1.50	2.81	2.47	2.26	2.68	2.12	2.30	2.15	4.11	1.77
20. Selective Attention	4.47	1.55	3.50	2.88	4.53	1.94	4.22	1.44	3.11	2.56	4.53	1.74
21. Time Sharing	4.74	1.65	4.00	2.83	5.03	1.65	4.57	.79	2.11	2.17	4.16	1.98
22. Arm-hand Steadiness	1.36	2.01	1.17	1.94	4.17	2.42	4.04	2.25	1.81	2.37	3.53	2.41
23. Manual Dexterity	1.98	2.18	1.33	1.97	4.03	2.46	3.70	1.72	2.26	2.14	4.00	2.00
24. Finger Dexterity	1.74	1.99	1.50	1.52	3.60	2.40	2.61	2.13	2.11	2.17	3.52	2.41
25. Control Precision	1.81	2.01	1.00	1.26	2.37	2.19	3.09	1.86	2.44	2.47	4.26	1.94

Table 9-12a (continued)
Descriptor Means and Standard Deviations on the Level Scale on Six Example Jobs: Abilities

Descriptor	General Managers & Top Executives (n=6) M	SD	Computer Programmers (n=30) M	SD	Registered Nurses (n=23) M	SD	Police Patrol Officers (n=27) M	SD	Janitors & Cleaners (n=38) M	SD	Maintenance Repairers, General Utility (n=43) M	SD
26. Multi-limb Coordination	1.91	2.21	.83	1.17	2.57	2.19	3.17	1.80	2.04	2.10	3.76	2.14
27. Response Orientation	2.26	2.33	1.00	2.00	3.33	2.23	5.00	1.24	2.30	2.55	3.58	2.27
28. Rate Control	1.37	1.99	.67	1.21	1.43	2.01	4.39	1.16	2.33	2.57	3.71	2.13
29. Reaction Time	2.37	2.65	.50	.84	3.40	2.49	6.00	1.17	3.07	2.85	3.74	2.30
30. Wrist-finger Speed	2.19	2.14	2.83	2.23	2.83	2.21	3.91	1.86	2.33	2.25	3.45	1.97
31. Speed of Limb Movmnt.	1.65	2.25	.67	1.21	3.37	2.43	4.74	2.09	2.93	2.60	3.63	1.88
32. Static Strength	1.56	2.07	.67	1.03	3.53	2.26	4.65	2.17	3.33	2.53	4.87	2.15
33. Explosive Strength	1.05	1.89	.33	.82	1.70	2.15	4.83	1.59	2.93	2.64	2.82	2.37
34. Dynamic Strength	1.02	1.81	.33	.82	1.80	2.06	3.91	1.86	2.96	2.46	3.18	2.39
35. Trunk Strength	1.23	1.86	.33	.82	2.80	2.07	3.61	1.78	3.35	2.25	3.55	2.13
36. Stamina	1.23	1.80	.17	.41	2.66	2.02	3.96	1.43	3.22	2.21	3.13	2.23
37. Extent Flexibility	1.72	2.07	.50	.84	3.17	1.89	3.74	1.51	3.19	2.20	4.29	2.09
38. Dynamic Flexibility	1.12	1.79	.17	.41	2.13	2.06	3.17	1.67	2.59	2.04	3.34	2.22
39. Gross Body Coord.	1.74	2.22	.17	.41	2.37	1.90	3.61	1.67	2.85	2.27	3.39	1.92
40. Gross-body Equilib.	1.40	2.09	.50	.84	1.97	2.28	3.48	1.65	3.11	2.06	3.71	2.07
41. Near Vision	3.81	2.04	2.83	2.56	4.27	2.08	4.57	.84	2.56	2.21	4.37	1.76
42. Far Vision	2.91	2.17	1.00	1.67	2.76	2.27	4.74	1.48	2.30	2.27	3.97	2.11
43. Visual Color Discrim.	2.12	2.26	1.67	1.86	3.24	2.70	3.82	1.75	2.22	2.17	3.84	2.07
44. Night Vision	1.95	2.16	.33	.52	2.13	2.18	5.09	1.31	2.22	2.52	3.24	2.20
45. Peripheral Vision	1.77	2.13	.33	.52	2.00	2.08	5.04	1.61	1.81	2.43	3.50	1.87
46. Depth Perception	1.58	2.05	.50	.84	2.37	2.19	4.43	1.47	1.88	2.29	3.63	1.95
47. Glare Sensitivity	1.42	1.94	.67	.82	1.73	2.12	3.83	1.23	1.38	2.02	3.50	2.14
48. Hearing Sensitivity	2.02	1.97	.83	.98	3.27	2.35	3.52	1.50	2.22	2.45	3.53	2.04
49. Auditory Attention	3.19	2.10	1.83	1.94	3.87	2.27	4.57	1.83	2.30	2.45	3.47	2.17
50. Sound Localization	1.98	2.18	.50	1.22	3.45	2.14	4.70	1.46	2.63	2.68	3.87	1.98

Table 9-12a (continued)

Descriptor Means and Standard Deviations on the Level Scale on Six Example Jobs: Abilities

	Jobs											
	General Managers & Top Executives (n=6)		Computer Programmers (n=30)		Registered Nurses (n=23)		Police Patrol Officers (n=27)		Janitors & Cleaners (n=38)		Maintenance Repairers, General Utility (n=43)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
51. Speech Recognition	4.12	2.14	3.33	2.94	5.79	1.13	3.78	1.51	2.74	2.35	4.16	2.11
52. Speech Clarity	5.35	1.17	5.00	1.55	5.40	1.87	4.61	1.78	3.04	2.39	4.16	1.87

[a]The full title for this occupation is "Janitors and Cleaners, Except Maids and Housekeeping."

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Table 9-12b

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Jobs: Abilities

	Jobs											
	General Managers & Top Executives (n=6)		Computer Programmers (n=30)		Registered Nurses (n=23)		Police Patrol Officers (n=27)		Janitors & Cleaners[a] (n=38)		Maintenance Repairers, General Utility (n=43)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Oral Comprehension	4.00	.79	3.83	.75	4.23	1.07	3.91	.90	2.67	1.33	3.66	1.07
2. Written Comprehension	4.02	.94	4.17	.75	4.27	.94	3.78	.74	2.59	1.37	3.55	1.06
3. Oral Expression	4.23	.95	3.83	.75	4.13	1.11	4.09	.60	2.74	1.35	3.76	1.02
4. Written Expression	4.02	.71	4.33	.52	4.07	.94	4.04	.93	2.22	1.12	3.45	1.16
5. Fluency of Ideas	3.42	.88	3.33	1.03	3.03	1.03	2.35	1.11	1.85	1.10	2.71	1.31
6. Originality	3.57	.66	3.67	1.37	3.20	1.19	2.78	.85	2.15	1.26	3.05	1.33
7. Problem Sensitivity	3.93	.88	3.33	1.37	4.43	.82	4.04	1.07	2.48	1.34	3.61	1.05
8. Deductive Reasoning	3.70	.99	3.67	1.21	3.47	1.07	3.30	1.02	2.07	1.36	3.14	1.04
9. Inductive Reasoning	3.67	.94	3.50	1.38	3.87	1.07	3.83	.98	2.11	1.25	2.87	1.14
10. Information Ordering	3.43	1.12	3.83	1.17	3.45	1.38	3.26	.96	2.44	1.42	3.26	1.13
11. Category Flexibility	3.00	1.15	2.83	1.33	2.41	1.40	1.35	.71	1.89	1.28	2.42	1.39
12. Math Reasoning	3.12	1.07	3.50	.84	3.17	1.12	1.87	.92	1.85	1.10	2.65	1.28
13. Number Facility	3.24	1.06	3.00	1.10	3.43	1.36	2.39	.99	2.22	1.22	3.16	1.03
14. Memorization	3.44	.96	3.33	1.21	3.50	1.11	3.27	.86	2.26	1.20	3.19	.98
15. Speed of Closure	3.09	.92	2.83	1.47	3.37	.81	3.13	.63	1.78	1.01	2.95	1.09
16. Flexibility of Closure	2.63	1.22	2.67	1.37	2.70	1.39	2.65	1.19	1.70	1.14	2.84	1.31
17. Perceptual Speed	2.44	1.22	2.00	1.55	2.47	1.36	2.43	1.16	2.11	1.28	2.63	1.28
18. Spatial Orientation	2.21	1.25	1.50	1.22	2.37	1.22	3.64	1.11	2.19	1.21	2.92	1.24
19. Visualization	2.88	1.31	1.83	1.60	2.23	1.17	2.36	1.23	2.33	1.33	3.13	1.04
20. Selective Attention	3.14	.99	3.00	1.90	3.47	1.07	3.13	.92	2.52	1.22	3.34	1.05
21. Time Sharing	3.30	1.10	3.17	1.60	3.67	1.03	3.22	.80	2.07	1.17	3.11	1.09
22. Arm-hand Steadiness	1.57	1.12	1.33	.82	3.23	1.36	3.17	1.34	1.81	1.14	2.82	1.35
23. Manual Dexterity	1.81	1.20	1.33	.82	3.27	1.39	2.74	1.05	2.19	1.18	3.16	1.24
24. Finger Dexterity	1.71	.93	1.67	1.03	2.97	1.35	2.09	1.08	1.96	1.06	2.93	1.38

Table 9-12b (continued)

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Jobs: Abilities

	Jobs											
	General Managers & Top Executives (n=6)		Computer Programmers (n=30)		Registered Nurses (n=23)		Police Patrol Officers (n=27)		Janitors & Cleaners (n=38)		Maintenance Repairers, General Utility (n=43)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
25. Control Precision	1.71	.98	1.17	.41	2.17	1.12	2.70	1.11	2.22	1.25	3.37	1.20
26. Multi-limb Coordination	1.60	.98	1.17	.41	2.27	1.23	2.52	1.12	2.00	1.11	3.10	1.25
27. Response Orientation	1.79	1.17	1.17	.41	2.83	1.32	3.70	.93	2.19	1.33	2.87	1.38
28. Rate Control	1.53	.98	1.17	.41	1.63	.93	3.39	.66	2.04	1.22	2.87	1.23
29. Reaction Time	2.05	1.31	1.17	.41	2.77	1.45	4.26	.96	2.56	1.50	2.95	1.37
30. Wrist-finger Speed	1.79	.91	2.67	1.97	2.27	1.28	2.91	1.20	2.11	1.12	2.72	1.24
31. Speed of Limb Movmnt.	1.53	.96	1.17	.41	2.60	1.40	3.30	1.18	2.33	1.30	2.87	1.26
32. Static Strength	1.60	1.03	1.33	.52	2.63	1.19	3.17	1.15	2.70	1.30	3.26	1.33
33. Explosive Strength	1.37	.87	1.17	.41	1.80	1.16	3.35	1.07	2.44	1.34	2.45	1.43
34. Dynamic Strength	1.45	.91	1.17	.41	2.00	1.23	3.00	1.13	2.38	1.27	2.68	1.40
35. Trunk Strength	1.56	.98	1.17	.41	2.37	1.25	3.00	1.09	2.73	1.23	2.87	1.26
36. Stamina	1.63	.98	1.17	.41	2.41	1.30	3.35	.93	2.59	1.15	2.61	1.39
37. Extent Flexibility	1.60	.93	1.33	.52	2.52	1.07	3.13	.97	2.54	1.15	3.16	1.26
38. Dynamic Flexibility	1.42	.85	1.17	.41	2.13	1.25	2.61	1.08	2.33	1.11	2.66	1.30
39. Gross Body Coord.	1.65	1.15	1.17	.41	2.23	1.10	3.09	1.08	2.48	1.22	2.68	1.25
40. Gross-body Equilib.	1.53	1.01	1.33	.52	1.87	1.25	2.70	.88	2.74	1.32	3.08	1.22
41. Near Vision	2.67	1.08	2.50	1.38	3.03	1.19	3.26	.75	2.37	1.21	3.29	1.09
42. Far Vision	2.14	1.04	1.67	1.21	2.45	1.19	3.39	.78	2.19	1.14	2.89	1.29
43. Visual Color Discrim.	1.91	1.15	1.67	1.21	2.72	1.41	2.86	1.10	2.26	1.13	3.21	1.14
44. Night Vision	1.67	.94	1.17	.41	2.00	1.11	3.87	.81	2.00	1.21	2.61	1.22
45. Peripheral Vision	1.70	1.01	1.17	.41	1.90	1.09	3.86	1.01	1.96	1.32	2.71	1.14
46. Depth Perception	1.67	1.02	1.17	.41	2.10	1.16	3.52	.90	1.92	1.21	2.89	1.11
47. Glare Sensitivity	1.56	.83	1.33	.52	1.83	1.05	2.96	.77	1.69	.99	2.63	1.15
48. Hearing Sensitivity	1.86	.91	1.17	.41	2.67	1.37	2.65	1.07	2.04	1.19	2.92	1.30

Table 9-12b (continued)

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Jobs: Abilities

	Jobs											
	General Managers & Top Executives (n=6)		Computer Programmers (n=30)		Registered Nurses (n=23)		Police Patrol Officers (n=27)		Janitors & Cleaners (n=38)		Maintenance Repairers, General Utility (n=43)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
49. Auditory Attention	2.35	.92	1.67	1.21	2.97	1.33	3.13	1.10	2.11	1.25	2.74	1.27
50. Sound Localization	1.77	.95	1.17	.41	2.76	1.28	3.04	1.07	2.26	1.38	2.89	1.16
51. Speech Recognition	2.93	1.20	2.17	1.60	4.00	.98	2.96	.93	2.44	1.19	3.00	1.14
52. Speech Clarity	3.63	.93	2.67	1.21	3.93	1.11	3.74	1.14	2.77	1.28	3.24	1.13

[a]The full title for this occupation is "Janitors and Cleaners, Except Maids and Housekeeping."

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Table 9-13
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for Level Scale: Abilities

	Functions						
Descriptor	F1	F2	F3	F4	F5	ΣF^2	η^2
1. Oral Comprehension	.03	.39	.14	.00	.12	.19	.31
2. Written Comprehension	-.09	.55	.05	-.02	.03	.31	.14
3. Oral Expression	.01	.52	.05	.00	.00	.27	.24
4. Written Expression	.00	.62	.05	.06	.12	.40	.09
5. Fluency of Ideas	.10	.54	-.09	.05	.01	.31	.15
6. Originality	.04	.53	-.05	-.08	.22	.34	.12
7. Problem Sensitivity	.13	.50	-.09	.04	.18	.31	.23
8. Deductive Reasoning	-.03	.52	-.03	.12	.17	.32	.14
9. Inductive Reasoning	.06	.48	-.05	.22	.20	.32	.14
10. Information Ordering	.08	.28	.12	-.00	.33	.21	.30
11. Category Flexibility	.11	.29	-.00	-.01	.15	.12	.25
12. Math Reasoning	.08	.26	-.02	.05	.59	.43	.34
13. Number Facility	.04	.21	.05	.02	.65	.47	.37
14. Memorization	-.05	.23	.04	.02	.14	.10	.26
15. Speed of Closure	.06	.38	.06	-.03	.16	.18	.28
16. Flexibility of Closure	.24	.30	.06	.01	.17	.18	.11
17. Perceptual Speed	.16	.09	.08	.16	.15	.10	.09
18. Spatial Orientation	.24	.05	-.04	.08	.04	.10	.23
19. Visualization	.24	.20	.02	.07	.17	.13	.24
20. Selective Attention	.01	.14	.03	.01	.05	.01	.12
21. Time Sharing	-.00	.31	.13	.07	.14	.14	.26
22. Arm-hand Steadiness	.41	.13	.05	.14	.06	.21	.26
23. Manual Dexterity	.42	.05	.08	.24	.04	.24	.10
24. Finger Dexterity	.41	.06	.16	.23	.14	.27	.19
25. Control Precision	.36	-.02	.05	.46	.24	.40	.26
26. Multi-limb Coordination	.55	.09	.17	.19	.13	.39	.15
27. Response Orientation	.43	.12	.16	.48	-.02	.46	.21
28. Rate Control	.43	.08	.02	.49	.04	.43	.30
29. Reaction Time	.37	.05	.09	.50	.00	.40	.36
30. Wrist-finger Speed	.18	-.00	.69	.10	.03	.52	.28
31. Speed of Limb Movement	.46	.01	.12	.22	-.00	.27	.23
32. Static Strength	.73	.05	.00	.03	.01	.54	.18
33. Explosive Strength	.70	.10	.09	.09	.02	.52	.24
34. Dynamic Strength	.66	.04	.00	.13	.05	.46	.16
35. Trunk Strength	.63	-.00	.09	.07	-.04	.41	.25
36. Stamina	.60	-.02	-.00	.10	.06	.37	.24
37. Extent Flexibility	.62	-.06	.05	.01	.06	.39	.27
38. Dynamic Flexibility	.62	-.02	.09	.02	.09	.40	.24

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Table 9-13 (continued)
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for Level Scale: Abilities

	Functions						
Descriptor	F1	F2	F3	F4	F5	ΣF^2	η^2
39. Gross Body Coordination	.60	.00	.03	.15	-.04	.39	.30
40. Gross-body Equilibrium	.64	-.03	-.06	.05	.06	.42	.30
41. Near Vision	.29	.25	.31	.15	.06	.27	.28
42. Far Vision	.28	.15	-.00	.14	.03	.12	.30
43. Visual Color Discrimination	.31	.10	-.04	.14	.06	.13	.14
44. Night Vision	.35	.08	-.01	.29	-.03	.21	.15
45. Peripheral Vision	.47	.10	.01	.15	.05	.26	.23
46. Depth Perception	.48	.20	.01	.24	.00	.33	.17
47. Glare Sensitivity	.29	.13	.08	.28	.02	.19	.23
48. Hearing Sensitivity	.30	.06	.04	.22	.11	.16	.29
49. Auditory Attention	.23	.15	.08	.12	-.00	.10	.23
50. Sound Localization	.32	.02	.06	.27	-.03	.18	.27
51. Speech Recognition	.03	.10	.08	-.00	.02	.01	.36
52. Speech Clarity	.02	.24	-.03	.00	.10	.10	.35
R_c	.82	.73	.68	.62	.57		
Percent of Variance	24	13	10	7	6		
Eigenvalue	2.05	1.14	.87	.63	.50		

Note. Statistics are based on 33 occupations with Abilities questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 13.0, harmonic mean = 9.65). F1 = Physical, F2 = Cognitive, F3 = Wrist-Finger Speed, F4 = Psychomotor-Speed, F5 = Mathematics. Percent of "grouped" cases correctly classified: 62.32%.
ΣF^2 = Sum of squared rotated correlations across five functions.
η^2 = Variance in Ability Level Scale ratings accounted for by occupations.

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Table 9-14a

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Level Scale: Abilities

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
1. Oral Comprehension	4.31	1.66	.75	3.94	1.12	.94	4.13*	2.20*	.67	.75
2. Written Comprehen.	4.29	1.73	.83	3.72	1.32	.94	5.71*	1.72	.76	.94
3. Oral Expression	4.58	1.69	.73	4.08	1.20	.95	5.33*	1.99	.70	.90
4. Written Expression	3.98	1.85	.87	3.52	1.46	.95	4.30*	1.60	.80	.79
5. Fluency of Ideas	2.77	1.97	.84	2.88	1.44	.93	-1.06	1.89	.82	.43
6. Originality	3.34	1.99	.83	2.73	1.42	.93	5.50*	1.98	.69	1.39
7. Problem Sensitivity	4.21	1.86	.85	3.20	1.28	.88	9.89*	2.09*	.76	1.83
8. Deductive Reasoning	3.64	1.96	.83	3.25	1.49	.91	3.48*	1.73	.83	.85
9. Inductive Reasoning	3.37	2.08	.88	3.02	1.48	.93	2.97*	1.96	.77	.97
10. Information Ordering	3.75	1.87	.70	3.55	1.09	.82	2.14*	2.97*	.62	.56
11. Category Flexibility	2.46	2.17	.74	2.95	1.27	.73	-4.47*	2.93*	.37	1.18
12. Math Reasoning	2.74	2.01	.82	2.99	1.36	.92	-2.30*	2.19*	.67	.76
13. Number Facility	3.61	1.86	.82	3.33	1.26	.93	2.73*	2.17*	.67	.83
14. Memorization	4.06	1.66	.52	3.49	.99	.85	6.72*	2.81*	.59	.67
15. Speed of Closure	3.27	1.92	.77	2.75	1.50	.82	4.60*	1.62	.80	.62
16. Flexibility of Closure	2.45	2.22	.69	2.28	1.54	.71	1.45	2.08*	.58	.81
17. Perceptual Speed	2.76	2.08	.45	2.78	1.33	.69	-.21	2.44*	.36	.71
18. Spatial Orientation	2.68	2.25	.68	2.44	1.14	.89	2.24*	3.90*	.78	.53
19. Visualization	2.79	2.11	.69	2.84	1.42	.91	-.43	2.20*	.68	.67
20. Selective Attention	3.98	1.88	.63	2.67	.99	.73	14.18*	3.64*	.41	2.15
21. Time Sharing	4.10	1.95	.66	2.74	1.08	.83	13.86*	3.26*	.50	2.25
22. Arm-hand Steadiness	2.26	2.32	.83	2.50	1.04	.86	-2.25*	4.95*	.58	.91
23. Manual Dexterity	2.63	2.29	.82	2.47	1.10	.87	1.47	4.28*	.59	1.26
24. Finger Dexterity	2.41	2.20	.66	2.40	1.20	.80	.09	3.38*	.50	.92
25. Control Precision	2.13	2.18	.86	2.23	1.53	.92	-.83	2.04*	.85	.62
26. Multi-limb Coord.	2.14	2.25	.85	1.97	1.40	.89	1.43	2.59*	.75	.86
27. Response Orientation	2.50	2.28	.86	2.34	1.39	.93	1.36	2.71*	.86	.69
28. Rate Control	1.75	2.26	.90	1.27	1.54	.93	3.89*	2.15*	.88	1.15
29. Reaction Time	2.63	2.63	.88	2.29	1.69	.94	2.48*	2.44*	.87	1.13
30. Wrist-finger Speed	3.50	2.25	.80	2.84	1.11	.80	6.08*	4.11*	.52	.87
31. Speed of Limb Mvmt.	2.45	2.43	.84	1.75	1.30	.85	5.80*	3.47*	.74	1.57
32. Static Strength	2.38	2.32	.91	2.58	1.60	.95	-1.57	2.10*	.80	.79
33. Explosive Strength	1.52	2.15	.90	1.51	1.37	.94	.06	2.46*	.80	.63
34. Dynamic Strength	1.61	2.13	.87	1.37	1.35	.92	2.08*	2.49*	.81	.76
35. Trunk Strength	2.14	2.05	.82	2.50	.84	.91	-3.76*	5.97*	.82	.48
36. Stamina	1.90	2.03	.85	1.31	1.12	.89	5.88*	3.27*	.79	1.04
37. Extent Flexibility	2.52	2.10	.85	2.61	1.23	.92	-.78	2.92*	.70	.74
38. Dynamic Flexibility	1.80	2.01	.83	1.16	1.10	.81	6.33*	3.32*	.76	1.07

Table 9-14a (continued)
Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Level Scale: Abilities

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
39. Gross Body Coord.	2.01	2.03	.86	1.41	1.03	.86	6.14*	3.90*	.77	1.36
40. Gross-body Equilib.	1.68	2.09	.87	1.23	.96	.90	4.55*	4.79*	.80	1.06
41. Near Vision	3.63	1.92	.66	3.87	.90	.82	-2.68*	4.53*	.37	.73
42. Far Vision	2.52	2.16	.82	2.47	1.60	.79	.47	1.83	.75	.53
43. Visual Color Discrim.	2.21	2.20	.84	2.43	1.43	.85	-1.81	2.37*	.62	.83
44. Night Vision	1.88	2.23	.88	1.60	1.39	.86	2.39*	2.56*	.84	.69
45. Peripheral Vision	2.02	2.24	.90	1.73	1.25	.90	2.58*	3.19*	.87	.91
46. Depth Perception	1.73	2.13	.90	1.69	1.30	.93	.36	2.67*	.87	.50
47. Glare Sensitivity	1.72	2.07	.87	1.26	1.06	.85	4.51*	3.81*	.74	1.14
48. Hearing Sensitivity	2.25	2.14	.82	2.17	1.23	.87	.71	3.03*	.71	.80
49. Auditory Attention	3.17	2.20	.60	2.42	.92	.81	7.38*	5.77*	.55	1.54
50. Sound Localization	2.56	2.34	.86	1.83	1.28	.87	6.28*	3.36*	.80	1.82
51. Speech Recognition	4.10	2.04	.49	2.95	1.03	.89	11.61*	3.95*	.48	1.68
52. Speech Clarity	4.34	1.86	.57	3.23	1.13	.94	11.46*	2.72*	.69	1.75

Note. Incumbent statistics based on 33 occupations with Ability questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 11, harmonic mean = 9.65). Analyst statistics are based on the same 33 occupations with Ability questionnaire responses from at least 6 analysts (mean number of analysts = 10.51, median = 12, harmonic mean = 8.76). The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
The t statistic tests for differences in the incumbent and analyst group means.
The F statistic tests for differences in the incumbent and analyst group standard deviations.
The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.
The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.
*$p < .05$

Table 9-14b

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Importance Scale: Abilities

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
1. Oral Comprehension	3.70	1.06	.66	3.95	.96	.86	-3.85*	1.22	.52	.36
2. Written Comprehen.	3.59	1.06	.75	3.70	1.11	.86	-1.51	1.11	.72	.26
3. Oral Expression	3.71	1.06	.71	4.04	1.05	.93	-4.64*	1.02	.63	.56
4. Written Expression	3.40	1.11	.85	3.51	1.21	.91	-1.39	1.19	.71	.39
5. Fluency of Ideas	2.51	1.18	.81	2.68	1.10	.92	-2.20*	1.15	.78	.26
6. Originality	2.72	1.18	.81	2.48	1.15	.90	3.04*	1.05	.70	.50
7. Problem Sensitivity	3.41	1.16	.81	3.28	1.04	.87	1.69	1.23	.65	.35
8. Deductive Reasoning	3.01	1.17	.78	3.06	1.06	.89	-.66	1.22	.75	.24
9. Inductive Reasoning	2.79	1.23	.87	2.96	1.19	.90	-2.11*	1.06	.78	.28
10. Information Ordering	3.19	1.17	.50	3.72	.80	.73	-8.24*	2.10*	.41	.47
11. Category Flexibility	2.28	1.23	.68	2.82	.98	.73	-7.53*	1.56	.14	.79
12. Math Reasoning	2.57	1.23	.78	2.97	1.12	.92	-5.06*	1.20	.66	.43
13. Number Facility	3.08	1.19	.74	3.34	1.09	.92	-3.47*	1.20	.66	.45
14. Memorization	3.25	1.05	.33	3.18	.87	.73	1.04	1.45	.55	.16
15. Speed of Closure	2.71	1.15	.73	2.52	1.03	.81	2.66*	1.25	.76	.20
16. Flexibility of Closure	2.25	1.25	.61	2.27	1.09	.73	-.30	1.32	.60	.23
17. Perceptual Speed	2.46	1.22	.34	2.76	1.04	.77	-4.04*	1.36	.34	.45
18. Spatial Orientation	2.36	1.27	.71	2.56	1.08	.88	-2.60*	1.37	.70	.29
19. Visualization	2.42	1.22	.58	2.78	1.21	.89	-4.33*	1.02	.64	.48
20. Selective Attention	3.23	1.13	.62	2.86	.84	.64	5.70*	1.79	.27	.40
21. Time Sharing	3.16	1.17	.57	2.71	1.04	.81	6.13*	1.27	.46	.53
22. Arm-hand Steadiness	2.12	1.28	.86	2.68	1.11	.88	-7.15*	1.34	.55	.65
23. Manual Dexterity	2.31	1.33	.83	2.86	1.08	.92	-6.97*	1.50	.49	.83
24. Finger Dexterity	2.21	1.22	.67	2.67	1.07	.84	-6.09*	1.28	.31	.70
25. Control Precision	2.07	1.21	.86	2.46	1.32	.92	-4.46*	1.18	.80	.41
26. Multi-limb Coord.	2.05	1.23	.86	2.30	1.20	.90	-3.09*	1.06	.72	.39
27. Response Orientation	2.29	1.32	.86	2.39	1.15	.91	-1.24	1.32	.84	.22
28. Rate Control	1.83	1.19	.92	1.76	1.16	.95	.95	1.05	.88	.27
29. Reaction Time	2.37	1.48	.87	2.27	1.26	.95	1.06	1.37	.84	.35
30. Wrist-finger Speed	2.78	1.34	.83	2.84	.97	.82	-.80	1.92	.57	.37
31. Speed of Limb Mvmt.	2.17	1.31	.85	1.99	1.03	.88	2.33*	1.63	.80	.28
32. Static Strength	2.14	1.25	.91	2.47	1.23	.95	-3.88*	1.03	.81	.43
33. Explosive Strength	1.70	1.13	.89	1.81	1.04	.93	-1.47	1.16	.74	.29
34. Dynamic Strength	1.81	1.16	.86	1.77	1.01	.93	.62	1.33	.76	.28
35. Trunk Strength	2.15	1.20	.77	2.76	.90	.74	-9.03*	1.75	.57	.66
36. Stamina	2.01	1.19	.85	1.85	1.05	.86	2.25*	1.29	.77	.26
37. Extent Flexibility	2.25	1.20	.85	2.62	1.08	.90	-4.90*	1.25	.79	.31
38. Dynamic Flexibility	1.90	1.13	.82	1.59	.84	.86	4.82*	1.83	.68	.34
39. Gross Body Coord.	2.04	1.17	.84	1.80	.92	.87	3.54*	1.62	.72	.34

Table 9-14b (continued)

Comparison Between Incumbent and Analyst Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations for the Importance Scale: Abilities

	Incumbent			Analyst						
Descriptor	M	SD	r_k	M	SD	r_k	t	F	r_{ia}	d^2
40. Gross Body Equilib.	1.89	1.19	.87	1.65	.87	.89	3.52*	1.87	.79	.31
41. Near Vision	2.90	1.16	.51	3.80	.94	.58	-13.12*	1.51	.29	1.08
42. Far Vision	2.26	1.19	.81	2.46	1.16	.88	-2.48*	1.04	.77	.27
43. Visual Color Discrim.	2.16	1.26	.84	2.45	1.26	.82	-3.52*	1.00	.68	.36
44. Night Vision	1.93	1.22	.92	1.84	1.09	.91	1.18	1.25	.88	.20
45. Peripheral Vision	2.03	1.28	.91	2.01	1.15	.88	.27	1.24	.87	.21
46. Depth Perception	1.91	1.21	.90	2.04	1.13	.94	-1.62	1.16	.85	.23
47. Glare Sensitivity	1.87	1.13	.86	1.60	.97	.90	3.91*	1.35	.84	.26
48. Hearing Sensitivity	2.14	1.21	.78	2.29	1.13	.85	-1.98*	1.16	.70	.27
49. Auditory Attention	2.63	1.24	.57	2.58	.89	.75	.73	1.92	.21	.51
50. Sound Localization	2.26	1.25	.85	2.01	1.05	.85	3.30*	1.42	.66	.53
51. Speech Recognition	3.12	1.21	.47	3.06	1.01	.78	.77	1.43	.46	.29
52. Speech Clarity	3.45	1.12	.46	3.59	1.05	.91	-1.93	1.14	.51	.49

Note. Incumbent statistics based on 33 occupations with Ability questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.57, median = 11, harmonic mean = 9.65). Analyst statistics are based on the same 33 occupations with Ability questionnaire responses from at least 6 analysts (mean number of analysts = 10.51, median = 12, harmonic mean = 8.76). The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

The t statistic tests for differences in the incumbent and analyst group means.

The F statistic tests for differences in the incumbent and analyst group standard deviations.

The r_{ia} correlation indicates the degree of relationship between incumbent and analyst mean occupations ratings.

The d^2 statistic indicates the squared differences between incumbent and analyst mean occupations ratings.

*$p < .05$

Table 9-15

Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Abilities

Descriptor	Incumbent M	Incumbent SD	Incumbent r_k	Analyst M	Analyst SD	Analyst r_k	t
1. Oral Comprehension	.93	.26	.60	1.00	.00	--	-5.17*
2. Written Comprehension	.93	.26	.59	1.00	.05	--	-4.91*
3. Oral Expression	.93	.25	.55	1.00	.00	--	-4.98*
4. Written Expression	.92	.27	.67	.99	.08	--	-5.05*
5. Fluency of Ideas	.76	.43	.69	.95	.23	.42	-7.59*
6. Originality	.82	.38	.58	.95	.22	.44	-5.77*
7. Problem Sensitivity	.92	.27	.50	1.00	.05	--	-5.10*
8. Deductive Reasoning	.85	.36	.70	.97	.16	.56	-6.08*
9. Inductive Reasoning	.82	.39	.71	.98	.15	.58	-7.43*
10. Information Ordering	.89	.31	.62	.99	.08	.14	-5.96*
11. Category Flexibility	.63	.48	.63	.95	.23	--	-11.36*
12. Math Reasoning	.75	.43	.70	.96	.19	.02	-8.71*
13. Number Facility	.89	.31	.61	1.00	.05	--	-6.18*
14. Memorization	.93	.26	.56	1.00	.05	--	-5.17*
15. Speed of Closure	.81	.39	.73	.87	.34	.27	-2.20*
16. Flexibility of Closure	.63	.48	.53	.81	.40	.37	-5.92
17. Perceptual Speed	.72	.45	.31	.95	.23	.22	-8.79*
18. Spatial Orientation	.68	.47	.47	.95	.21	.66	-10.29*
19. Visualization	.74	.44	.56	.94	.24	.39	-7.71*
20. Selective Attention	.92	.27	.65	.99	.08	--	-4.85*
21. Time Sharing	.89	.31	.60	.99	.11	--	-5.71*
22. Arm-hand Steadiness	.57	.49	.67	.99	.12	--	-15.23*
23. Manual Dexterity	.66	.47	.69	.99	.12	--	-12.55*
24. Finger Dexterity	.64	.48	.41	.93	.25	.73	-10.44*
25. Control Precision	.59	.49	.72	.84	.37	.57	-8.12*
26. Multi-limb Coordination	.57	.50	.74	.83	.38	.65	-8.40*
27. Response Orientation	.65	.48	.69	.93	.26	.58	-9.83*
28. Rate Control	.44	.50	.86	.52	.50	.80	-2.40*
29. Reaction Time	.59	.49	.76	.86	.35	.62	-8.80*
30. Wrist-finger Speed	.80	.40	.63	.97	.16	.12	-7.63*
31. Speed of Limb Movement	.60	.49	.76	.79	.41	.61	-6.24*
32. Static Strength	.63	.48	.79	.95	.21	.60	-11.73*
33. Explosive Strength	.42	.49	.86	.69	.46	.80	-8.31*
34. Dynamic Strength	.45	.50	.81	.66	.48	.72	-6.33*
35. Trunk Strength	.66	.47	.65	.99	.12	.22	-12.60*
36. Stamina	.59	.49	.75	.77	.42	.70	-5.84*
37. Extent Flexibility	.73	.45	.72	.97	.18	.28	-9.70*
38. Dynamix Flexibility	.56	.50	.78	.63	.48	.58	-2.25*
39. Gross Body Coordination	.64	.48	.80	.76	.43	.69	-4.01*

Table 9-15 (continued)
Comparison of Incumbent and Analyst Descriptive Statistics Across All Occupations for the Level Scale Rescored Dichotomously: Abilities

Descriptor	Incumbent			Analyst			
	M	SD	r_k	M	SD	r_k	t
40. Gross Body Equilibrium	.49	.50	.85	.74	.44	.76	-7.56*
41. Near Vision	.85	.35	.56	1.00	.00	--	-7.72*
42. Far Vision	.68	.47	.60	.83	.37	.62	-5.22*
43. Visual Color Discrimination	.62	.49	.74	.88	.32	.53	-9.20*
44. Night Vision	.49	.50	.81	.73	.45	.66	-7.27*
45. Peripheral Vision	.55	.50	.81	.84	.37	.71	-9.40*
46. Depth Perception	.49	.50	.84	.80	.40	.78	-10.16*
47. Glare Sensitivity	.51	.50	.78	.79	.41	.50	-8.96*
48. Hearing Sensitivity	.62	.49	.71	.91	.28	.23	-10.27*
49. Auditory Attention	.79	.41	.45	.99	.11	.01	-8.96*
50. Sound Localization	.66	.47	.78	.85	.36	.46	-6.47*
51. Speech Recognition	.90	.30	.41	1.00	.05	--	-5.84*
52. Speech Clarity	.94	.24	.42	1.00	.00	--	-4.65*

Note. Incumbent statistics are based on 35 occupations with Skills questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.51, median = 12, harmonic mean = 9.01). Analyst statistics are based on the same 35 occupations with Skills questionnaire responses from at least 6 analysts (mean number of analysts = 10.29, median = 12.0, harmonic mean = 8.66).
The estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.
The t statistic tests for differences in the incumbent and analyst group means.
*$p < .05$

Table 9-16

Principal Components Analysis Pattern Matrix for the Analyst Level Scale: Abilities

Descriptor	Factor F1	F2	F3	F4	F5	F6	Communality
1. Oral Comp.	.93	-.08	-.20	-.06	-.01	-.18	.95
2. Written Comp.	.92	-.16	-.26	-.14	.05	-.02	.96
3. Oral Expression	.88	-.13	-.27	-.12	-.12	-.24	.95
4. Written Expression	.90	-.18	-.33	-.17	.01	-.02	.97
5. Fluency of Ideas	.93	-.05	-.02	.07	-.28	-.00	.94
6. Originality	.91	-.02	.01	.06	-.29	.01	.92
7. Problem Sensitivity	.91	.19	-.04	.14	-.02	-.03	.89
8. Deductive Reason.	.95	-.02	-.14	.03	.07	.17	.95
9. Inductive Reasoning	.95	.12	-.06	.04	-.03	.06	.93
10. Inductive Reasoning	.77	-.07	.30	.19	.40	.15	.91
11. Information Ord.	.84	-.25	-.00	.13	-.08	-.09	.79
12. Category Flex.	.86	-.28	-.24	-.04	.18	.13	.92
13. Math Reasoning	.77	-.35	-.26	-.12	.19	.08	.84
14. Number Facility	.80	.01	-.14	.01	-.24	-.40	.87
15. Memorization	.86	.11	-.17	.10	.26	-.16	.88
16. Speed of Closure	.67	.51	.21	.05	.04	.23	.80
17. Perceptual Speed	.34	-.00	-.04	.29	.74	.09	.76
18. Perceptual Speed	-.10	.79	.40	.17	-.17	-.08	.86
19. Visualization	.45	.18	-.56	.47	-.01	.27	.93
20. Selective Attention	.61	.57	-.10	.35	.17	-.05	.87
21. Time Sharing	.47	.65	-.11	-.04	-.28	-.17	.76
22. Arm-Hand Stead.	.09	.28	.60	.62	.24	-.15	.91
23. Manual Dexterity	-.19	.25	.76	.43	.30	.05	.95
24. Finger Dexterity	.01	.13	.35	.63	.60	.10	.91
25. Control Precision	-.06	.61	.30	.52	.34	.27	.93
26. Multi-limb Coord.	-.28	.69	.55	.19	.11	.11	.91
27. Response Orient.	-.17	.92	.18	.08	.11	.03	.93
28. Rate Control	-.13	.91	.22	.01	.04	.17	.91
29. Reaction Time	-.14	.87	.31	.27	.12	.01	.95
30. Wrist-Finger Speed	.23	-.07	.07	-.04	.81	.01	.72
31. Speed of Limb Mv.	-.20	.71	.57	.04	.16	-.09	.90
32. Static Strength	-.23	.48	.75	.19	.06	-.05	.89
33. Explosive Strength	-.09	.70	.65	.07	-.02	.17	.95
34. Dynamic Strength	-.24	.51	.77	.14	.09	.07	.94
35. Trunk Strength	-.37	.35	.80	.21	.03	.11	.96
36. Stamina	-.11	.55	.73	-.17	-.14	.00	.90
37. Extent of Flexibility	-.28	.30	.83	.28	.03	.11	.95
38. Dynamic Flexibility	-.37	.34	.77	.16	-.04	.10	.88
39. Gross Body Coord.	-.26	.65	.59	-.01	-.19	-.04	.89
40. Gross Body Equil.	-.18	.45	.82	.10	-.06	.04	.90

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Table 9-16 (continued)
Principal Components Analysis Pattern Matrix for the Analyst Level Scale: Abilities

Descriptor	F1	F2	F3	F4	F5	F6	Communality
	Factor						
41. Near Vision	.74	-.16	-.36	.02	.43	-.11	.90
42. Far Vision	.24	.74	.17	-.01	-.45	.03	.86
43. Visual Color Discrim.	.09	.32	.40	.76	-.04	.11	.86
44. Night Vision	.11	.82	.37	.00	-.16	-.25	.91
45. Peripheral Vision	-.15	.88	.27	.10	-.18	-.06	.91
46. Depth Perception	-.15	.74	.52	.16	.01	.26	.93
47. Glare Sensitivity	.04	.86	.21	-.05	.09	.20	.83
48. Hearing Sensitivity	-.03	.57	.42	.50	.16	.23	.84
49. Auditory Attention	.14	.64	.18	.44	.03	-.04	.66
50. Sound Localization	-.07	.85	.18	.36	.05	-.05	.89
51. Speech Recognition	.46	-.14	-.33	-.31	-.11	-.65	.87
52. Speech Clarity	.75	-.00	-.34	-.26	-.26	-.36	.93
Percent of Variance	44	26	9	5	2	2	
Eigenvalue	23.07	13.72	4.80	2.47	1.23	1.12	

Note. The correlation matrix was based on means calculated at the occupation level. F1 = Cognitive, F2 = Psychomotor/Perceptual, F3 = Physical, F4 = Sensory-Dexterity, F5 = Wrist-Finger Speed, F6 = Speech. These loadings are based on an orthogonal varimax rotation.

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Figure 9-1
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
COGNITIVE ABILITIES		
Verbal Abilities		
1. Oral Comprehension	The ability to listen to and understand information and ideas presented through spoken words and sentences.	High - Understanding a lecture on advanced physics. Low - Understanding a television commercial.
2. Written Comprehension	The ability to read and understand information and ideas presented in writing.	High - Understanding an instruction book on repairing a missile guidance system. Low - Understanding signs on the highway.
3. Oral Expression	The ability to communicate information and ideas in speaking so others will understand.	High - Explaining advanced principles of genetics to college freshmen. Low - Canceling newspaper delivery by phone.
4. Written Expression	The ability to communicate information and ideas in writing so others will understand.	High - Writing an advanced economics textbook. Low - Writing a note to remind someone to take something out of the freezer to thaw.

Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
Idea Generation and Reasoning Abilities		
5. Fluency of Ideas	The ability to come up with a number of ideas about a given topic. It concerns the number of ideas produced and not the quality, correctness, or creativity of the ideas.	High - Naming all the possible strategies for a particular military battle. Low - Naming four different uses for a screwdriver.
6. Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.	High - Inventing a new type of man-made fiber. Low - Using a credit card to open a locked door.
8. Problem Sensitivity	The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.	High - Recognizing an illness at an early stage of a disease when there are only a few symptoms. Low - Recognizing that an unplugged lamp doesn't work.
11. Deductive Reasoning	The ability to apply general rules to specific problems to come up with logical answers. It involves deciding if an answer makes sense.	High - Designing an aircraft wing using the principles of aerodynamics. Low - Knowing that, due to the law of gravity, a stalled car can coast down the hill.

Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
12. Inductive Reasoning	The ability to combine separate pieces of information, or specific answers to problems, to form general rules or conclusions. It includes coming up with a logical explanation for why a series of seemingly unrelated events occur together.	High - Diagnosing a disease using the results of many different lab tests. Low - Determining clothing to wear based on the weather report.
13. Information Ordering	The ability to correctly follow a given rule or set of rules in order to arrange things or actions in a certain order. The things or actions can include numbers, letters, words, pictures, procedures, sentences, and mathematical or logical operations.	High - Assembling a nuclear warhead. Low - Putting things in numerical order.
14. Category Flexibility	The ability to produce many rules so that each rule tells how to group (or combine) a set of things in a different way.	High - Classifying man-made fibers in terms of their strength, cost, flexibility, melting points, etc. Low - Sorting nails in a toolbox on the basis of length.
Quantitative Abilities		
9. Mathematical Reasoning	The ability to understand and organize a problem and then to select a mathematical method or formula to solve the problem.	High - Determining the mathematics required to simulate a space craft landing on the moon. Low - Determining how much 10 oranges will cost when they are priced at 2 for 29 cents.

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Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
10. Number Facility	The ability to add, subtract, multiply, or divide quickly and correctly.	High - Manually calculating the flight path of an aircraft, taking into account speed, fuel, wind, and altitude. Low - Adding 2 and 7.
Memory		
7. Memorization	The ability to remember information such as words, numbers, pictures, and procedures.	High - Reciting the Gettysburg Address after studying it for 15 minutes. Low - Remembering the number on your bus to be sure you get back on the right one.
Perceptual Abilities		
15. Speed of Closure	The ability to quickly make sense of information that seems to be without meaning or organization. It involves quickly combining and organizing different pieces of information into a meaningful pattern.	High - Interpreting the patterns on a weather radarscape to decide if the weather is changing. Low - Recognizing a song after hearing only the first few notes.
16. Flexibility of Closure	The ability to identify or detect a known pattern (a figure, object, word, or sound) that is hidden in other distracting material.	High - Identifying camouflaged tanks while flying in a high speed airplane. Low - Tuning in a radio weather station in a noisy truck.

Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
19. Perceptual Speed	The ability to quickly and accurately compare letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.	High - Inspecting electrical parts for defects as they flow by on a fast-moving assembly line. Low - Sorting mail according to zip codes with no time pressure.
Spatial Abilities		
17. Spatial Organization	The ability to know one's location in relation to the environment, or to know whether other objects are in relation to one's self.	High - Navigating an ocean voyage using only the positions of the sun and stars. Low - Using the floor plan to locate a store in a shopping mall.
18. Visualization	The ability to imagine how something will look after it is moved around or when its parts are moved or rearranged.	High - Anticipating opponent's as well as your own future moves in a chess game. Low - Imagining how to put paper in the typewriter so the letterhead comes out at the top.
Attentiveness		
20. Selective Attention	The ability to concentrate and not be distracted while performing a task over a period of time.	High - Studying a technical manual in a noisy boiler room. Low - Answering a business call with coworkers talking nearby.

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Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
21. Time Sharing	The ability to efficiently shift back and forth between two or more activities or sources of information (such as speech, sounds, touch, or other sources.)	High - Monitoring radar and radio transmissions to keep track of aircraft during periods of heavy traffic. Low - Listening to music while filing papers.
PSYCHOMOTOR ABILITIES		
Fine Manipulative Abilities		
27. Arm-Hand Steadiness	The ability to keep the hand and arm steady while making an arm movement or while holding the arm and hand in one position.	High - Cutting facets in diamonds. Low - Lighting a candle.
28. Manual Dexterity	The ability to quickly make coordinated movements of one hand, a hand together with the arm, or two hands to grasp, manipulate, or assemble objects.	High - Performing open-heart surgery using surgical instruments. Low - Screwing a light bulb into a lamp socket.
29. Finger Dexterity	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.	High - Putting together the inner workings of a small wrist watch. Low - Putting coins in a parking meter.
Control Movement Abilities		
22. Control Precision	The ability to quickly and repeatedly make precise adjustments in moving the controls of a machine or vehicle to exact positions.	High - Drilling a tooth. Low - Adjusting a room light with a dimmer switch.

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Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
23. Multilimb Coordination	The ability to coordinate movements of two or more limbs together (for example, two arms, two legs, or one leg and one arm) while sitting, standing, or lying down. It does not involve performing the activities while the body is in motion.	High - Playing the drum set in a jazz band. Low - Rowing a boat.
24. Response Orientation	The ability to choose quickly and correctly between *two or more movements* in response to *two or more different signals* (lights, sounds, pictures, etc.). It includes the *speed* with which the correct response is *started* with the hand, foot, or other body parts.	High - In a spacecraft which is out of control, reacting quickly to each malfunction with the correct control movements. Low - When the doorbell and telephone ring at the same time, quickly selecting which to answer first.
25. Rate Control	The ability to time the adjustments of a movement or equipment control in anticipation of changes in the speed and/or direction of a continuously moving object or scene.	High - Operating aircraft controls used to land a jet on an aircraft carrier in rough weather. Low - Riding a bicycle alongside a jogger.
Reaction Time and Speed Abilities		
26. Reaction Time	The ability to quickly respond (with the hand, finger, or foot) to one signal (sound, light, picture, etc.) when it appears.	High - Hitting the brake when a pedestrian steps in front of the car. Low - Starting to slow down the car when a traffic light turns yellow.

Figure 9-1 (continued)
<u>Descriptions and Definitions of Abilities</u>

Construct Label	Operational Definition	Level Scale
30. Wrist-Finger Speed	The ability to make *fast, simple*, repeated *movements* of the *fingers, hands, and wrists*.	High - Typing a document at the speed of 90 words per minute. Low - Using a manual pencil sharpener.
31. Speed of Limb Movement	The ability to *quickly* move the arms or legs.	High - Throwing punches in a boxing match. Low - Sawing through a thin piece of wood.
PHYSICAL ABILITIES		
Physical Strength Abilities		
32. Static Strength	The ability to exert maximum muscle force to lift, push, pull, or carry objects.	High - Lifting 75-pound bags of cement onto a truck. Low - Pushing an empty shopping cart.
33. Explosive Strength	The ability to use short bursts of muscle force to propel oneself (as in jumping or sprinting), or to throw an object.	High - Propelling (throwing) a shot-put in a track meet. Low - Hitting a nail with a hammer.
34. Dynamic Strength	The ability to exert muscle force repeatedly or continuously over time. This involves muscular endurance and resistance to muscle fatigue.	High - Performing a gymnastics routine using the rings. Low - Using pruning shears to trim a bush.

Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
35. Trunk Strength	The ability to use one's abdominal and lower back muscles to support part of the body repeatedly or continuously over time without "giving out" or fatiguing.	High - Doing 100 sit-ups. Low - Sitting up in an office chair.
Endurance		
40. Stamina	The ability to exert one's self physically over long periods of time without getting winded or out of breath.	High - Running a 10 mile race. Low - Walking a quarter of a mile to deliver a letter.
Flexibility, Balance and Coordination		
36. Extent Flexibility	The ability to bend, stretch, twist, or reach out with the body, arms, and/or legs.	High - Working under a car dashboard to repair the heater. Low - Reaching for a microphone in a patrol car.
37. Dynamic Flexibility	The ability to quickly and repeatedly bend, stretch, twist, or reach out with the body, arms, and/or legs.	High - Maneuvering a kayak through swift rapids. Low - Hand picking a bushel of apples from a tree.
38. Gross Body Coordination	The ability to coordinate the *movement of the arms, legs, and torso together* in activities where the whole body is in motion.	High - Performing a ballet dance. Low - Getting in and out of a truck.

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Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
39. Gross Body Equilibrium	The ability to keep or regain one's body balance to stay upright when in an unstable position.	High - Walking on narrow beams in high-rise construction. Low - Standing on a ladder.
SENSORY ABILITIES		
Visual Abilities		
41. Near Vision	The ability to see details of objects at a close range (within a few feet of the observer).	High - Detecting minor defects in a diamond. Low - Reading dials on the car dashboard.
42. Far Vision	The ability to see details at a distance.	High - Detecting differences in ocean vessels on the horizon. Low - Reading a roadside billboard.
43. Visual Color Discrimination	The ability to match or detect differences between colors, including shades of color and brightness.	High - Painting a color portrait from a living subject. Low - Separating laundry into colors and whites.
44. Night Vision	The ability to see under low light conditions.	High - Finding your way through the woods on a moonless night. Low - Reading street signs when driving at dusk (just after the sun sets).

Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
45. Peripheral Vision	The ability to see objects or movement of objects to one's side when the eyes are focused forward.	High - When piloting a plane in air combat, distinguishing friendly and enemy aircraft. Low - Keeping in step while marching in a military formation.
46. Depth Perception	The ability to judge which of several objects is closer or farther away from the observer, or to judge the distance between an object and the observer.	High - Throwing a long pass to a teammate who is surrounded by opponents. Low - Merging a car into traffic on a city street.
47. Glare Sensitivity	The ability to see objects in the presence of glare or bright lighting.	High - Snow skiing in bright sunlight. Low - Driving on a familiar roadway on a cloudy day.
Auditory and Speech Abilities		
48. Hearing Sensitivity	The ability to detect or tell the difference between sounds that vary over broad ranges of pitch and loudness.	High - Tuning an orchestra. Low - Noticing when the hourly watch alarm goes off.
49. Auditory Attention	The ability to focus on a single source of auditory (hearing) information in the presence of other distracting sounds.	High - Listening to instructions from a coworker in a noisy saw mill. Low - Listening to a lecture while people are whispering nearby.

Figure 9-1 (continued)
Descriptions and Definitions of Abilities

Construct Label	Operational Definition	Level Scale
50. Sound Localization	The ability to tell the direction from which a sound originated.	High - Determining the direction of an emergency vehicle from the sound of its siren. Low - Listening to a stereo to determine which speaker is working.
51. Speech Recognition	The ability to identify and understand the speech of another person.	High - Understanding a speech presented by someone with a strong foreign accent. Low - Recognizing the voice of a coworker.
52. Speech Clarity	The ability to speak clearly so that it is understandable to a listener.	High - Giving a lecture to a large audience. Low - Calling the numbers in a bingo game.

Figure 9-2
Example Page from Abilities Questionnaire

1. Oral Comprehension The ability to listen to and understand information and ideas presented through spoken words and sentences.

Level

What level of this ability is needed to perform this job?

Requires understanding complex or detailed spoken sentences that contain unusual words and phrases.

7

6 ← *Understanding a lecture on advanced physics.*

5

4 ← *Understanding a coach's oral instructions for a sport.*

3

2 ← *Understanding a television commercial.*

1

Requires understanding short or simple spoken sentences that contain common words and phrases.

NR Not relevant at all for performance on this job

Importance

How important is this ability to performance on this job?

Not Important	Somewhat Important	Important	Very Important	Extremely Important
1	2	3	4	5

1

Figure 9-3

Thirty-Three Occupations With Four or More Incumbents Completing the Abilities Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	8
19005	General Managers & Top Executives	43
21108	Loan Officers & Counselors	5
22135	Mechanical Engineers	13
25105	Computer Programmers	6
27311	Recreation Workers	4
31303	Teachers, Preschool	6
31305	Teachers, Elementary School	13
32502	Registered Nurses	30
32902	Medical & Clinical Laboratory Technologists	8
49008	Salespersons, Except Scientific & Retail	7
49011	Salespersons, Retail	21
49021	Stock Clerks, Sales Floor	8
49023	Cashiers	16
51002	First Line Supervisors, Clerical/Administrative	47
53311	Insurance Claims Clerks	7
55108	Secretaries,	63
55305	Receptionists & Information Clerks	5
55338	Bookkeeping, Accounting, & Auditing Clerks	28
55347	General Office Clerks	76
61005	Police & Detective Supervisors	13
63014	Police Patrol Officers	23
65008	Waiters & Waitresses	19
65038	Food Preparation Workers	16
66008	Nursing Aides, Orderlies, & Attendants	12
67005	Janitors & Cleaners	27
85132	Maintenance Repairers, General Utility	38
87902	Earth Drillers	4
89108	Machinists	4
92974	Packaging & Filling Machine Operators	11
97102	Truck Drivers	16
97111	Bus Drivers, Schools	12

Chapter 10

Occupational Interests and Values: Evidence for the Reliability and Validity of the Occupational Interest Codes and the Values Measures

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The primary motivation for describing people and occupations in terms of vocational interests and values is to facilitate the match between the two. As Sager (1995) states:

> It is an enduring proposition that performance is a function of ability and motivation. As pointed out by Hakel (1986) and Dawis (1991), understanding interests and values is part of understanding motivation. The idea is that individuals who are motivated will perform well, and that interests and values are important parts of motivation. Maximizing performance, however, is not the only reason for trying to achieve good matches between people and jobs. Borgen, Weiss, Tinsley, Dawis, and Lofquist (1968) point to the theory that satisfaction is

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> dependent on the extent to which the job matches a person's interests and values. Therefore, if the goals of O*NET include the description of occupations for the purpose of person-job matching, then occupational interests and values are potentially an important part of the content model. (p. 11-1).

This chapter first briefly reviews the taxonomies of the occupational interests and values descriptors that are part of the O*NET content model, second, discusses the reliability and validity evidence related to the measures of these descriptors used in the initial O*NET data collection effort, and, finally, discusses the implications of the reliability and validity evidence for potential revisions to the content model and measures.

The O*NET occupational interests and values measures and their development are discussed in Sager (1995). In the occupational domain interests and values are defined as relatively stable dispositions, developed over time, that are based on affective evaluations of life's experiences (Dawis, 1991). Interests are generally viewed as the relative like or dislike of particular activities while occupational values are viewed as judgments about the importance of activities or other characteristics of the work environment. For example, the Strong Interest Inventory (SII) is an interest measure; some of its items ask people to indicate whether they like, are indifferent towards, or dislike particular work and leisure activities (Hansen & Campbell, 1985). The Minnesota Information Questionnaire (MIQ) is a values measure; its items require people to evaluate the relative importance of different characteristics of their "ideal" job, such as Security (Descriptor #14) and Variety (Descriptor #19) (Dawis & Lofquist, 1984).

In addition to the conceptual distinction between occupational interests and values, the empirical evidence suggests that individual difference measures of these constructs have complimentary strengths and weaknesses (Dawis, 1991). Research shows that values

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discriminate among occupations; however, there is relatively more research supporting the hypothesis that interest measures predict later occupational membership. While values appear to be relatively strong predictors of future job satisfaction the evidence for the influence of interests on future job satisfaction is mixed. Because occupational interests and values are theoretically different and their measures show different patterns of relationships with external variables (e.g., future occupational membership and job satisfaction), it was determined that the prototype of the O*NET content model would include occupation descriptors in both domains (Sager, 1995).

Interests

Taxonomy

Holland's six factor taxonomy of occupational interests was chosen to define interests within the O*NET content model (Sager, 1995). Holland's six factor taxonomy is used to describe people and occupations (Gottfredson & Holland, 1989; Holland, 1976). Figure 10-1 contains the titles and descriptions of the Strong Interest Inventory General Occupational Themes (i.e., Holland's six types) that are used to describe people. Here, Holland codes describe an occupation in terms of the three Holland types that best fit the occupation (i.e., High-point codes). An occupation's code consists of the first letter of each of the three relevant types (i.e., R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; and C = Conventional) presented in order of importance. For example, the Holland code for the O*NET occupation Education Administrators is ESA, meaning that this occupation is primarily described as an Enterprising occupation, secondarily as a Social occupation, and as having some Artistic elements (Gottfredson & Holland, in press).

Procedures

The Holland codes for 6 of the occupations that are part of the O*NET prototype are presented in Figure 10-2 with their O*NET occupation codes and titles: (1) General Managers and Top Executives, (2) Computer Programmers, (3) Registered Nurses, (4) Police Patrol Officers, (5) Janitors and Cleaners, Except Maids and Housekeeping, and (6) Maintenance Repairers, General Utility.

The codes are reproduced here with permission from Psychological Assessment Resources, Incorporated from the Dictionary of Holland Occupational Codes (DHOC), Third Edition (Gottfredson & Holland, in press). The Holland codes for 80 of the O*NET occupations were derived from Holland codes generated for their related Dictionary of Occupational Titles (DOT) occupations.[1] The process is briefly summarized here.

First, multiple discriminant analysis was used to develop classification functions based on 193 DOT occupations for which there was confidence regarding their Holland codes. These functions used DOT job analysis data to estimate the probability of assignment of each occupation to each Holland type. Each occupation was assigned a three-letter code such that the letters represented the most probably types in descending order. The functions were then used to generate codes for 12,741 DOT occupations. The new codes for these occupations were reviewed for consistency with other job analysis information including their associated codes from the second edition of the DHOC (Gottfredson & Holland, 1989). This review resulted in some adjustments; however, there were very few changes in Holland codes for DOT occupations between the second and third editions of the DHOC (i.e., only 3% of these DOT occupations were affected).

In the third edition of the DHOC (Gottfredson & Holland, in press) the Holland codes for the O*NET occupations are derived from the codes for their associated DOT occupations. As indicated earlier the O*NET occupational structure is based on the Occupational Employment Statistics (OES) structure, and the DOT occupations have been linked to OES occupations (National Crosswalk Services Center, 1993). Because there are many more occupations in the DOT structure than the OES/O*NET structure, the linkages are generally multiple DOT occupations to one OES/O*NET occupation. Within each OES/O*NET occupation scores were assigned to the Holland types for each DOT occupation; a score of 3 was assigned to the type if it was the first in the occupation's code, 2 if it was the second, 1 if it was the third, and 0 if it was not in the top three. The scores for each type were summed across the DOT occupations linked to each OES/O*NET occupation. The three Holland types which scored highest on the associated DOT occupations, taken in descending order, were combined to generate the Holland code for each OES/O*NET occupation. The Holland codes for the OES/O*NET codes were reviewed along with the codes for their associated DOT occupations. In some instances, this review suggested that a DOT occupation had been linked to the wrong OES/O*NET occupation. In these cases OES/O*NET Holland codes were recalculated across the corrected set of DOT occupations.

Sager (1995), in summarizing the evidence presented by Gottfredson and Holland (1989; in press), presents an example supporting the validity of the DOT Holland codes, as follows:

> One example is a comparison between their High-point codes [Holland codes] and the Guide for Occupational Exploration (GOE; U.S. Department of Labor, 1979) categories. Employment Service occupational analysts assigned the DOT

[1] Codes were derived for the 80 occupations included in the initial O*NET occupational sample. See Chapter 2 for

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> occupations to 12 GOE categories. These categories represent 11 interest dimensions and 1 category for occupations that require physical performance. The U.S. Department of Labor also mapped the 12 GOE categories onto the six Holland types. This allowed an examination of the extent to which occupations assigned by classificatory function to a particular Holland category were assigned by occupational analysts to the associated GOE category. The occupational analysts assigned 76.8 percent of the DOT occupations into the predicted categories. (p. 11-12)

This comparison was based on Holland codes from the first edition of the DHOC (Gottfredson, Holland, & Ogawa, 1982).

Finally, it is important to note that while Gottfredson and Holland (in press) support the validity of the Holland codes associated with O*NET occupations, they indicate that users should consider these codes in the context of other available information, perhaps including direct assessments of occupations, "For large applications or important individual decisions…"(p. 5-9).

Results

The Holland codes that are part of the O*NET prototype were not collected via incumbent/supervisor or analyst questionnaires; therefore, the reliability and validity analyses associated with the other domains are not possible. However, the Holland codes shown in Figure 10-2 provide information that allows profile comparisons across occupations in a manner similar to the information presented for the Occupational Values Questionnaire and for the other domain questionnaires in other chapters.

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the rationale for the selection of the 80 occupations.

Examination of the Holland codes for the six occupations in Figure 10-2 provides preliminary evidence that the codes do reflect differences and similarities among occupations. For example, Janitors and Cleaners, Except Maids and Housekeeping, and Maintenance Repairers, General Utility are the most "blue collar" of the six occupations, and the first letter of their code is R for Realistic. This makes sense because occupations classified as primarily this type "... tend to involve concrete and practical activity involving machines, tools, and materials" (Gottfredson & Holland, 1989, p. 6).

However, the second and third letters in the codes for these two occupations do not match, distinguishing these two primarily Realistic occupations in a way that makes sense. The remaining part of the code for Janitors and Cleaners, Expect Maids and Housekeeping is E for Enterprising and then C for Conventional. Enterprising occupations, "... tend to involve working with people in a supervisory or persuasive way to achieve some organizational goal." (Gottfredson & Holland, 1989, p. 6). Members of this occupation often need to persuade people to comply with standard rules associated with the orderly functioning of a facility like walking around barriers that indicate a wet floor or keeping food and drink out of some parts of a building. Conventional occupations, "... tend to involve working with things, numbers, or machines in an orderly way to meet the regular and predictable needs of an organization or to meet specified standards" (Gottfredson & Holland, 1989, p. 6). Janitors and Cleaners, Except Maids and Housekeeping generally have a relatively fixed set of tools and responsibilities.

The second and third letters of the Holland code for Maintenance Repairers, General Utility are I for Investigative and S for Social. Occupations in the investigative category, "... tend to involve analytical or intellectual activity aimed at problem-solving, trouble-shooting, or the creation and use of knowledge" (Gottfredson & Holland, 1989, p. 6). Repair involves finding and

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correcting the causes of equipment malfunctions. Social occupations, "... typically involve working with people in a helpful or facilitative way" (Gottfredson & Holland, 1989, p. 6). This occupation often involves direct interaction with the individuals who use the equipment being repaired.

The Holland codes for the other occupations are also logically consistent. The first letter of the code for General Managers and Top Executives is E for Enterprising. Supervising people is part of the definition of this Holland type. The code for Computer Programmers indicates that it is primarily an Investigative occupation. Debugging programs and the application of knowledge of computer languages are central parts of this occupation. Finally, the first letter of codes for Registered Nurses and Police Patrol officers is S for Social, correctly reflecting the fact that working with and helping people are important activities in these occupations.

Occupational Values

Measure

The Occupational Values Questionnaire was included in the O*NET incumbent/supervisor data collection. However, this questionnaire was not included in the occupational analyst data collection effort.[2]

The Occupational Values Questionnaire is based on the Minnesota Job Description Questionnaire (MJDQ; Borgen, et al., 1968; Dawis, 1991; Dawis & Lofquist, 1984). The MJDQ describes occupations according to their occupational reinforcer patterns (ORPs) on 21 need-reinforcers. Respondents are required to evaluate the relative extent to which statements representing each of these need-reinforcers describe their occupation. Each statement begins, "Workers on this job ...." For example, "Workers on this job are busy all the time," is the

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statement representing the need reinforcer "Activity." There are two forms of the MJDQ. In one form the statements are presented to respondents five at a time, in a multiple rank-order format; the other form follows a paired comparison format. Sager (1995) reviews some of the MJDQ's favorable reliability and validity evidence (e.g., Borgen, et al., 1968).

As described in Sager (1995), because of the large number of questionnaires and items included in the O*NET data collection the judgment was made that there was not enough time or space available to use the paired comparison or multiple rank-order formats. Based on this judgment and the results of a try-out study, an O*NET questionnaire was developed that differs from the MJDQ in three significant ways:

1. Respondents are required to rate each statement on a 5-point amount of agreement scale. The scale anchors are strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree, respectively.
2. The statements from the MJDQ for the reinforcers Authority (Descriptor #5), Company Policies (Descriptor #6), Co-workers (Descriptor #8), Moral Values (Descriptor #11), Social Status (Descriptor #16), Supervision-Human Relations (Descriptor #17), and Supervision-Technical (Descriptor #18) were modified to modernize and simplify language.
3. The title of the questionnaire is the Occupational Values Questionnaire.

The MJDQ's 21 reinforcers and the statements used in the Occupational Values Questionnaire are presented in Figure 10-3. The complete Occupational Values Questionnaire is presented in the Development of Prototype Occupational Information Network (O*NET) Content Model report (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1995).

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[2] Occupational analysts completed ratings using a modified version of the Occupational Values Questionnaire as part

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Taxonomy

The 21 reinforcers represent the first level of O*NET's occupational values taxonomy. The titles and definitions of the dimensions representing the hypothesized second level of the taxonomy and the reinforcers (i.e., descriptors) associated with each of these higher-level dimensions are presented in Figure 10-4. This structure came from Dawis's (1991) review of studies that factor analyzed responses to the Minnesota Importance Questionnaire (MIQ; Dawis & Lofquist, 1984). The MIQ is designed to measure people, not occupations. As indicated previously, it consists of the same need-reinforcer statements as the MJDQ; however, respondents are required to rank order sets of the five statements in terms of their relative importance in an "ideal" job. The results of these factor analyses represent the higher level of the taxonomy for the importance of reinforcers in people's ideal occupations. Therefore, it is a working hypothesis that this structure applies equally well as the higher level of the taxonomy for ratings of the presence of reinforcers in actual occupations.

Sample

Of the 80 occupations targeted in the O*NET prototype incumbent/supervisor sample, only 36 yielded four or more completed Occupational Values Questionnaire. Only these respondents in those 36 occupations were included in the analyses, for a total of 682 respondents. For each occupation, Figure 10-5 lists the O*NET occupation code, occupation title, and the number of respondents per occupation. The 36 occupations represent a broad range of occupations in terms of level and industry.

of another project, but those results are not discussed here.

Results

Descriptive Statistics

Table 10-1 presents some descriptive statistics for each of the items on the Occupational Values Questionnaire. Consistent with the description above, each item is a statement that carries the descriptor label of its associated need-reinforcer, and responses to the items were ratings on a 5-point agreement scale. The second column of Table 10-1 shows the mean of the mean ratings for each occupation on each descriptor. These means show that overall the ratings are concentrated in the top half of the scale. However, the standard deviations of the mean ratings across occupations in Table 10-1 show that there is some variation across occupations in terms of agreement about the presence of reinforcers. The fourth and fifth columns of Table 10-1 show the standard error of estimate and reliability of the mean occupation rating for each descriptor.

Reliability

The standard deviations in Table 10-1 suggest that occupations do vary on the reinforcers and that they might be useful for discriminating among occupations. To what extent does this variation represent reliable differences among occupations? The results presented in Tables 1 through 7 address the reliability of the mean occupation ratings on the Occupational Values Questionnaire.

The standard error of measurement (SEM) and reliability estimates in Table 10-1 provide a mixed picture. The SEMs are generally not small relative to the standard deviations, indicating that a substantial part of the variation in mean ratings across occupations is due to unreliability. The reliabilities, based on a harmonic mean of $k = 9.69$ raters per occupation, are also not generally high; the reliabilities for eight descriptors are below $r_k = .50$. However, the reliabilities for five of the descriptors are above $r_k = .70$. The mean reliability is .53, the median is .55. It is relevant to note that reliabilities depend on the number of raters per occupation. Table 10-2 provides estimates of what the reliabilities for the mean occupations ratings would be if they were based on 1 and 30 raters per occupation. The single rater reliabilities are all low; the highest is $r_1 = .28$. Predictably, the 30-rater reliabilities are substantially higher than the k rater reliabilities. For 14 of the descriptors they are $r_{30} = .75$ or greater; however, some are low. For example, the 30-rater reliability for Moral Values (Descriptor #11) is still only $r_{30} = .26$. These results indicate that reliable occupation mean ratings on individual Occupational Values Questionnaire descriptors depend on at least 30 raters per occupation.

Analyses of Variance

Tables 10-4 through 10-7 show another way to address the reliability issue. Analysis of variance was used to separately calculate the effects of occupations, raters within occupations, descriptors, descriptor by occupation interactions, and descriptor by raters within occupations interactions on the variation in ratings. Table 10-4 shows that ratings differ significantly across occupations. This result supports the hypothesis that the overall presence of reinforcers varies from one occupation to the next. Table 10-4 also shows that ratings differ significantly across descriptors. This result supports the hypothesis that across all occupations, some reinforcers are more likely to be present than others. Finally, Table 10-4 indicates a significant interaction between the effect of descriptors on ratings and the effect of occupations on ratings. This result supports the hypothesis that generally the presence of particular reinforcers varies across occupations, suggesting that the occupational values instrument can discriminate among occupations.

Table 10-5 shows the interrater agreement coefficients based on the results presented in Table 10-4 for k raters per occupation, one rater per occupation, and 30 raters per occupation.

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The overall interrater agreement for the questionnaire, based on a harmonic mean of $\underline{k} = 9.69$ raters per occupation is not high ($\underline{r}_k = .60$), and the interrater agreement for one rater per occupation is low ($\underline{r}_1 = .13$), however, the overall interrater agree for 30 raters per occupation is fairly strong ($\underline{r}_{30} = .82$). This result suggests that, with 30 raters per occupation, the pattern of scores on the descriptors in the Occupational Values Questionnaire could reliably discriminate among occupations.

As shown in Figure 10-4, a higher level was hypothesized for the taxonomy of reinforcers in the Occupational Values Questionnaire. The mean first-order ratings for each occupation were aggregated to create scores for each occupation on the six dimensions described in Figure 10-4. The analysis of variance and overall interrater agreement results for the six aggregate scores are presented in Tables 10-6 and 10-7. Table 10-6 shows that aggregate scores vary significantly across occupations, aggregates, and that the interaction between occupations and aggregates is significant. However, a comparison between the results in Tables 10-5 and 10-7 indicates that the level of interrater agreement is virtually the same for the 6 aggregates as it is for 21 reinforcer scores.

Descriptor and Scale Relationships

Table 10-9 presents the correlations among the ratings at the occupation level, and Table 10-10 presents these correlations at the individual level based on four randomly selected raters per occupation. Examination of correlations among the ratings at the occupational level is emphasized here for two reasons: (1) the primary concern here is the study of occupations and (2) the reliabilities of the ratings underlying the correlations among ratings at the individual level are so low that attempts to discern patterns are not likely to be fruitful.

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Examination of the correlations in Table 10-9 indicates that the relationships among the reinforcer ratings are generally positive with two notable exceptions: (1) Independence (Descriptor #10) is negatively correlated with almost all of the other ratings, and (2) there is a relatively high negative correlation between Social Service (Descriptor #15) and Compensation (Descriptor #7) (r = -.48). Examination of the correlations relative to the hypothesized higher level structure shown in Figure 10-4 shows that the correlations are not particularly consistent with this structure with the exception of the first hypothesized aggregate "Achievement;" its two constituent reinforcers (i.e., Ability Utilization [Descriptor #1] and Achievement [Descriptor #2]) show a relatively high correlation (r = .77). The highest mean correlation for any of the other aggregates is .45 for Safety. Comfort is a mixture of positive and negative correlations, with a mean of .04.

Factor Structure

Table 10-11 presents the pattern matrix from a principal components analysis of the occupation level correlation matrix in Table 10-9, after an orthogonal varimax rotation. Examination of eigenvalues and interpretability of the solutions favors a five factor solution that accounts for 71% of the variance in mean ratings. The communalities indicate that five factors generally account for a substantial amount of the variance in mean occupation ratings with the exception of Working Conditions (Descriptor #20) whose communality is only .39.

Factor 1 is labeled individual accomplishment and accounts for 25% of the variance in mean occupation ratings. This factor subsumes the hypothesized aggregates Achievement and Autonomy, shown in Figure 10-4, because the highest loadings for the reinforcers Ability Utilization (Descriptor #1) (.87), Achievement (Descriptor #2) (.87), Creativity (Descriptor #9) (.88), Responsibility (Descriptor #13) (.77), and Autonomy (Descriptor #21) (.71) are on this

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factor. The highest loadings for Authority (Descriptor #5) (.79) and Variety (Descriptor #19) (.78) are also on Factor 1.

Factor 2 accounts for 12% of the variance in mean occupation ratings and is labeled <u>structure</u>. This factor shares some of the reinforcers associated with the hypothesized aggregates comfort and safety. The highest loadings for four reinforcers are on this factor: (1) Activity (Descriptor #3) (.61), (2) Independence (Descriptor #10) (-.78), (3) Supervision - Human Relations (Descriptor #17) (.71), and (4) Supervision - Technical (Descriptor #18) (.60). Company Policies (Descriptor #6) (.46) also shows a relatively high loading on this factor.

Factor 3 is labeled <u>social comfort</u> and accounts for 12% of the variance in mean occupation ratings. This factor shares some of the reinforcers associated with the hypothesized aggregates Altruism and Safety. However, the reinforcers with high loadings on Factor 3 together appear to describe the extent to which occupations are socially comfortable. Reinforcers with high loadings on this factor include Company Policies (Descriptor #6) (.48), Co-workers (Descriptor #8) (.76), Moral Values (Descriptor #11) (.66), Recognition (Descriptor #12) (.62), Supervision - Human Relations (Descriptor #17) (.41), and Working Conditions (Descriptor #20) (.61).

Factor 4 accounts for 12% of the variance in mean occupation ratings and is labeled <u>career advancement</u>. This factor is not strongly related to any of the hypothesized aggregates in terms of shared reinforcers. The reinforcers Advancement (Descriptor #4) (.73) and Compensation (Descriptor #7) (.83) show the highest loadings on this factor. Company Policies (Descriptor #6) (.40) and Recognition (Descriptor #12) (.41) also show high loadings on this factor. Social Service (Descriptor #15) (-.69) loads negatively on Factor 4 suggesting that, in this sample, occupations that pay well and provide opportunities for Advancement (Descriptor #4) do not emphasize Social Service (Descriptor #15) and vice versa.

Factor 5, labeled stability, accounts for 11% of the variance in mean occupation ratings. This factor is also not strongly related to any of the hypothesized aggregates. Loadings for two reinforcers are highest on this factor: Security (Descriptor #14) (.77) and Social Status (Descriptor #16) (.77). Social Service (Descriptor #15) (.45) also has a high loading on Factor 5. This factor seems to capture the degree of stability in the organization and community that the occupation offers.

Overall the results of the principal components analysis are interpretable. They suggest that meaningful constructs are being assessed by the Occupational Values Questionnaire and that the mean ratings on the reinforcers can discriminate among occupations in meaningful ways. However, the empirically discovered structure of the occupation mean ratings is different from the hypothesized structure. There are three salient, possible reasons for this difference. First, the hypothesized structure is based on factor analyses of the MIQ, an instrument designed to measure the importance of reinforcers in people's ideal occupations, not the presence of reinforcers in actual occupations. Second, as previously stated in this chapter and discussed in detail in Sager (1995), some of the statements (i.e., items) in the Occupational Values Questionnaire are modifications of those in the MJDQ; changes in wordings may have affected the relationships among some of the reinforcers. Finally, the sample of 682 respondents in 36 occupations may be somewhat idiosyncratic.

Another method of examining the factor structure of the Occupational Values Questionnaire is confirmatory factor analysis. Two competing models were hypothesized to underlie the occupation level correlations among the reinforcers in Table 10-9. Windows

LISREL 8.03 was used to test these models (Joreskog & Sorbom, 1993). The first model is derived from the hypothesized higher level of the Occupational Values Questionnaire that is summarized in Figure 10-4. As indicated previously, six factors were hypothesized based on factor analyses of the MIQ. After 1,000 iterations LISREL was not able to produce final maximum-likelihood parameter estimates for this model. The second model is derived from the results of the exploratory principal components analysis (see Table 10-11). LISREL was able to generate maximum-likelihood estimates of the parameters for this model; however, the fit was poor ($\chi^2(184, N = 36) = 334.06, p < .001$). The pattern matrices and factor correlation matrices for these models are not presented here because they fit the data so poorly.

However, it is important to note that the principal components analysis and the two confirmatory factor analyses do not represent the best possible examination of the factor structures underlying the relationships among the reinforcers. First, the occupation mean ratings are not uniformly reliable; some are based on as few as four raters per occupation. The results of the reliability analysis make it clear that more than four raters per occupation are needed to obtain reliable reinforcer occupation means. Second, only 36 occupations underlie the correlations in the matrix that was analyzed; this means that all three analyses were estimating more parameters than there were cases. In consideration of these two points, the results of these analyses should be considered preliminary.

Occupation Differences

Table 10-12 offers a demonstration of the extent to which ratings on the Occupational Values Questionnaire can capture the similarities and differences among occupations according to its 21 reinforcers. This table presents the mean ratings and standard deviations for six distinct occupations: (1) General Managers and Top Executives, (2) Computer Programmers, (3)

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Registered Nurses, (4) Police Patrol Officers, (5) Janitors and Cleaners, Except Maids and Housekeeping, and (6) Maintenance Repairers, General Utility.

Table 10-12 shows that mean ratings of a number of the reinforcers vary little across the six occupations. For example, the range of mean ratings for four reinforcers on the 5-point agreement scale is .50 or less across these occupations: Ability Utilization (Descriptor #1), Co-workers (Descriptor #8), Supervision - Human Relations (Descriptor #17), and Autonomy (Descriptor #21). This result suggests that these six occupations are generally similar with regard to the presence of these reinforcers and that they do not discriminate well among these occupations.

However, some of the reinforcers do vary across these six occupations. For example, the range of mean ratings of Social Service (Descriptor #15) across the six occupations is 1.83. The mean Social Service (Descriptor #15) rating is near M = 4.00 for five of the occupations; however, it is relatively low for Computer Programmers (M = 2.86, SD = .90). Likewise, the range of mean ratings on Social Status (Descriptor #16) is 1.39. The mean ratings on this reinforcer were lower for Computer Programmers (M = 2.86, SD = .90) and Janitors and Cleaners, Except Maids and Housekeeping (M = 2.93, SD = 1.07) than for Police Patrol Officers (M = 4.25, SD = .68), General Mangers and Top Executives (M = 3.93, SD = .70). Finally, the range of mean ratings on Activity (Descriptor #3) is 1.19. General Managers and Top Executives showed the highest mean rating on Activity (Descriptor #3) (M = 4.44, SD = .70), while Police Patrol Officers showed the lowest (M = 3.25, SD = .90). On Advancement (Descriptor #4), there is a difference of 1.27 between the mean ratings for Computer Programmers (higher) [illegible] Janitors and Cleaners. These example comparisons of mean ratings on occupation reinforcers are consistent with expected similarities and differences among the six occupations included in

Table 10-12. And, the reinforcers discussed in this paragraph are among those identified in the discriminant analyses as differentiating among occupations.

Discriminant Analysis

Discriminant analysis is another method to ask the question, "Does the Occupational Values Questionnaire differentiate among occupations?" Table 10-13 presents the results of a discriminant analysis based on k raters from each of the 36 occupations included in the analyses for this chapter. Table 10-13 shows (1) the correlation between each reinforcer and the first six rotated discriminant functions, (2) the sum of the squared rotated correlations between the discriminating variables (i.e., reinforcers) across six discriminant functions (ΣF^2), (3) the proportion of variance in the ratings of each reinforcer accounted for by occupations (η^2), (4) the canonical correlation for each function (R_c), (5) the percent of variance accounted for by each function, and (6) the eigenvalue for each function.

The first six functions account for 71% of the between occupations variance in ratings. All 21 classification functions correctly reassigned 35% of the raters into the occupations from which they were drawn. This correct assignment rate is substantially above chance, which would be about 3% for 36 occupations, if all the occupations were of equal size.

The correlations between the reinforcers and the first six functions, ΣF^2 values, and η^2 coefficients show that these discriminant functions are dominated by six reinforcers. The correlation between Function 1 and Activity (Descriptor #3) is $r = .98$. The correlation between Function 2 and Social Status (Descriptor #16) is $r = .93$. The correlation between Function 3 and Authority (Descriptor #5) is $r = .96$. The correlation between Function 4 and Advancement (Descriptor #4) is $r = .94$. The correlation between Function 5 and Social Service (Descriptor #15) is $r = .98$. And finally, the correlation between Function 6 and Security (Descriptor #14) is r

= .97. None of the other correlations between reinforcers and functions are greater than r = .15. These results suggest that these are the six best reinforcers in terms of differentiating among the occupations in this sample.

Additional Validity Evidence

As noted previously, the Occupational Values Questionnaire is a modification of the MJDQ. There are two important characteristics of the MJDQ to note: (1) occupations are primarily compared by occupational reinforcer profile, not by individual reinforcers (e.g., Borgen et al., 1968; Dawis & Lofquist, 1984) and (2) researchers suggest that stable results depend on a minimum of 20 raters per occupation (e.g., Borgen et al., 1968). As indicated previously, the results presented in this chapter are based on N = 36 occupations, with a median of only 12 raters per occupation. This small sample does not provide strong evidence in support of the reliability of the Occupational Values Questionnaire. However, Table 10-5 shows that the estimated overall reliability of the questionnaire would be $r_{30} = .82$ if there were 30 raters per occupation. This estimated reliability considered along with these two characteristics of the MJDQ suggests an alternative method of examining the reliability and validity of the Occupational Values Questionnaire.

Table 10-17 summarizes the results of an alternative method of examining the reliability and validity of the Occupational Values Questionnaire that compares mean group profiles within and across occupations. Three of the 36 occupations included in the sample were rated by close to or more than 60 raters. The occupations are (1) First Line Supervisors, Clerical/Administrative (n = 59), (2) Secretaries, Except Legal and Medical (n = 67), and (3) General Office Clerks (n = 92). Within each occupation respondents were randomly assigned to two groups of 30 each, except that the first group of First Line Supervisors, Clerical/Administrative contained only 29 raters. Profiles were calculated for each of the six groups (i.e., two groups for each of three occupations). Each profile consists of the mean ratings for that group on each of the 21 reinforcers. A matrix containing the correlations among the six group profiles was then calculated.

To achieve more stable estimates of these correlations, the process of assigning raters randomly to one of two groups within each occupation was performed 10 times resulting in 10 different randomly assigned sets of 6 groups. A correlation matrix was calculated for each set of six group profiles. Table 10-17 presents the median correlations across the 10 correlation matrices.

The within occupation median correlations between group profiles are $r_{30} = .86$, $r_{30} = .87$, and $r_{30} = .91$, respectively. These correlations are estimates of the overall reliability of the Occupational Values Questionnaire for these occupations when there are 30 raters per occupation. These reliabilities are good and similar to the projected reliability presented in Table 10-5 ($r_{30} = .82$).

The question remains, however, "Can profiles on this questionnaire capture similarities and differences between occupations?" The remaining off-diagonal median correlations in Table 10-17 address this question. They are correlations between group profiles across occupations. There are four such correlations for each pair of occupations. For example, the between group and across occupation median profile correlations for Occupations 1 and 2 (i.e., First Line Supervisors, Clerical/Administrative and Secretaries Except Legal and Medical, respectively) are $r = .69$, $r = .64$, $r = .74$, and $r = .70$. These values are lower than the within occupation median correlations for these two occupations ($r_{30} = .86$ and $r_{30} = .87$, respectively). This result is evidence that this questionnaire recognizes differences between these two occupations, even

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though they tend to occur in the same environment and involve many of the same tasks. The between occupation median correlations comparing Occupation 1 profiles to Occupation 3 (i.e., General Office Clerks) profiles are also somewhat lower than the relevant within occupation median correlations, suggesting that this questionnaire can differentiate between these two occupations.

However, the median correlations comparing Occupation 2 profiles to Occupation 3 profiles are high relative to their respective within occupation median correlations. This result suggests that this questionnaire does not differentiate Occupation 2 from Occupation 3 in terms of reinforcers. This is not surprising given the similarities in these occupations; Occupation 2 is regular Secretaries and Occupation 3 is Office Clerks.

Taken as a whole, the results presented in Table 10-17 provide evidence that the Occupational Values Questionnaire can reliably describe occupations in terms of reinforcers if it is supported by 30 raters per occupation. It is also interesting that the questionnaire was able to partially differentiate among three occupations that take place in same environment and involve very similar tasks; all three are clerical office occupations. Smaller between occupation profile correlations would be likely if less similar occupations were considered.

As described in Sager (1995), Borgen et al. (1968) used this method to examine the reliability and validity of the ranked version of the MJDQ.

> Their study included 81 occupations. For each occupation, two ORPs were created, each based on half of the respondents completing the questionnaire for that particular occupation. The within occupation correlations between groups ranged from $r = .78$ to $r = .98$ with a median of $r = .91$ (p. 11-10).

The median correlation between profiles from different occupations was $\underline{r} = .55$ (Borgen et al., 1968). This result provided evidence that the MJDQ could reliably differentiate among occupations because the correlations between profiles were on average higher within occupations than between occupations. It also provides additional promise for the Occupational Values Questionnaire in future samples that will include a wider variety of occupations with more raters per occupation.

Conclusions

The primary motivation for describing occupations in terms of interests and occupational values is to facilitate the match between the interests and values and occupations. That is, occupations vary according to the activities they involve and the potential reinforcers that they offer incumbents. Two taxonomies and their associated indicators were discussed in this chapter: (1) Holland codes that denote the three Holland types most closely associated with each occupation and (2) mean occupation ratings on the 21 need-reinforcers presented in the Occupational Values Questionnaire. The goal was to assess the feasibility of including these constructs and their indicators in O*NET's content model. In this context there are three parts to the feasibility question:

1. Do research and theory support the selected occupational interest and values taxonomies?
2. Are the procedures for assessing occupations according to the selected interest and values taxonomies practically useable in the context of O*NET?
3. Are the assessments of the occupations according to the selected interest and values taxonomies reliable and valid?

The rest of this chapter summarizes the feasibility evidence and discusses its implications for potential revisions to the content model and measures.

Interests

As described in Sager (1995), the six Holland types are a significant part of the vocational and career counseling literature and there is evidence supporting the reliability and validity of various assessments of occupations according to the Holland types. Sager (1995) also indicates that a good deal of this research depends on large numbers of individuals completing long instruments for each occupation in question. The alternative procedure that Gottfredson and Holland (in press) used for developing Holland codes for OES/O*NET occupations is relatively efficient and has already generated Holland codes for every occupation in this structure.

Sager (1995) summarizes an example of the evidence supporting the validity of the Holland codes for DOT occupations (Holland & Gottfredson 1989; in press). This chapter examines the validity of the Holland codes for O*NET occupations by reviewing the codes for six occupations that vary across industry and level (see Figure 10-2). The codes describe and differentiate among the occupations in a manner that is logically consistent with definitions of each of the Holland types and with what is known about these occupations.

Recommendations

The evidence supporting the validity of the Holland codes developed by Gottfredson and Holland (in press) is positive, yet preliminary. There is a fair amount of evidence supporting the validity of the these codes for DOT occupations, but more evidence is needed to support their validity for the O*NET occupations. Analyses comparing these Holland codes with other parts of the O*NET content model could substantially increase confidence in the validity of the Holland codes. However, given the positive preliminary evidence, the substantial literature behind the

Holland types, and the wide use of Holland taxonomy in vocational and career counseling it is recommended that the Holland codes remain part of O*NET's content model.

Occupational Values

Sager (1995) summarizes the literature supporting the need to describe occupations in terms of the values (i.e., the importance of particular work activities and other characteristics of the work environments; Dawis, 1991). Sager also reviews the MJDQ, an instrument designed to describe occupations according to the relative presence of 21 need-reinforcers (i.e., work values). Dawis (1991) provides evidence that these 21 reinforcers address the work values assessed by other instruments. Borgen et al. (1968), Dawis and Lofquist (1984), and (Dawis, 1991) describe and summarize evidence supporting the reliability and validity of the MJDQ. Finally, Weiss, Dawis, England, and Lofquist (1964) and Gay, Weiss, Hendel, Dawis, and Lofquist (1971) provide evidence that the statements presented in the MJDQ to assess the reinforcers are easy to read and understand. Clearly, then, the Occupational Values Questionnaire is based on sound theoretical ground and a very practical and useable occupation assessment instrument (i.e., the MJDQ).

There are, however, some concerns about the Occupational Values Questionnaire and the nature of the sample of occupations and respondents included in the O*NET prototype data collection effort. First, as mentioned previously, the Occupational Values Questionnaire is based on the MJDQ with two substantial modifications:

1. The MJDQ requires forced choices between or among statements that represent each of the 21 reinforcers, while the Occupational Values Questionnaire requires that each statement be individually rated.

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2. In the Occupational Values Questionnaire the wording of some of the 21 MJDQ statements was modified.

These modifications have implications for consideration of the results of the analyses. As discussed in Sager (1995), if respondents are not forced to make choices about reinforcers relative to each other they may display (a) a positive bias and rate every reinforcer as present in their occupation or (b) a job satisfaction bias and rate every reinforcer according to their overall level of job satisfaction. The concern was that this would result in mean occupation ratings that were uniformly high and/or showed little variation across occupations and reinforcers. Such a result could reduce the effectiveness of the ratings on the Occupational Values Questionnaire in terms of its ability to differentiate among occupations. Additionally, there is some concern that modifications to the wording of the reinforcer statements may affect the construct that each assesses and thus change the structure of the taxonomy.

There are two concerns about the data available for these analyses. The first is that, while the targeted sample in the initial O*NET data collection included 80 of the more populous occupations, unfortunately, for only 36 of the occupations were the minimum of four Occupational Values Questionnaires returned. These occupations represent a broad range of occupations in terms of level and industry; however, it is difficult to infer that this small non-random sample of occupations represents the full variety of occupations in terms of interests or occupational values. Another difficulty is the small number of respondents per occupation. The literature indicates that the MJDQ needs 20 raters per occupations to generate reliable descriptions of occupations. The median number of respondents per occupation across the 36 occupations was only 12, and for some occupations, as few as four incumbents responded.

Unfortunately, these data do not allow for an optimal test of the reliability and validity of the Occupational Values Questionnaire.

It is in the context of these strengths and weaknesses that the evidence regarding the reliability and the validity of the Occupational Values Questionnaire should be considered. The tables in this chapter present evidence regarding the extent to which the occupation mean ratings on the questionnaire can reliably differentiate among occupations. Tables 1 through 5 present reliability evidence in terms of the extent to which there is more variation in respondent ratings across occupations compared to within ratings. This method of considering reliability, referred to as interrater agreement, assumes that occupations vary on the constructs being assessed. Therefore, these indices of interrater agreement provide relatively direct evidence about the extent to which the reinforcers assessed by the Occupational Values Questionnaire can differentiate among occupations. The results suggest that in the current sample the reliability of occupation mean ratings of individual reinforcers is low, and that reasonably reliable ratings at the level of individual reinforcers would require at least 30 respondents per occupation. However, the evidence considering the reliability of the questionnaire as a whole is more optimistic. Table 10-5 presents an interrater agreement of $\underline{r}_k = .60$ for the questionnaire as a whole with a harmonic mean of $\underline{k} = 9.69$ respondents per occupation. This table also shows a very respectable estimate of what the interrater agreement would be if there were 30 respondents per occupation ($\underline{r}_{30} = .82$). This, by itself, is evidence that if the Occupational Values Questionnaire were supported by 30 respondents per occupation, it could reliably differentiate among occupations.

Some of the analyses address the validity of the Occupational Values Questionnaire in terms of the similarities and differences among occupations. Examination of the occupation

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means on the 21 reinforcers across six varied occupations (see Table 10-12) indicates that some reinforcers show little variation across the six occupations; however, others do. Social Service (Descriptor #15), Social Status (Descriptor #16), and Activity (Descriptor #3) are examples of reinforcers that vary in manner consistent with expected similarities and differences among the examined occupations. The results of the discriminant analysis indicate that for this sample the Occupational Values Questionnaire is not strong in terms of differentiating among occupations. However, the six reinforcers that appear to be the best at discriminating among the 36 occupations are (1) Activity (Descriptor #3), (2) Social Status (Descriptor #16), (3) Authority (Descriptor #5), (4) Advancement (Descriptor #4), (5) Social Service (Descriptor #15) and (6) Security (Descriptor #14), respectively.

Another group of analyses address the validity of the Occupational Values Questionnaire in terms of the observed relationships among the ratings. Tables 10-6 and 10-7 show that aggregate scores based on the six hypothesized dimensions presented in Figure 10-4 do not fit the current data. The reliability of the aggregate scores is slightly lower than the reliability of the occupation mean ratings on the 21 reinforcers (see Tables 10-5 and 10-7). Examination of the correlations among reinforcer ratings and the results of an attempted confirmatory analysis also suggest that the reinforcers, as rated by the Occupational Values Questionnaire, do not fit the hypothesized structure. As discussed previously, these results are not surprising for a number of reasons not the least of which is that the hypothesized structure is not based on analyses of an occupation assessment, but on analyses of a person measure (i.e., the MIQ). However, despite the failure of the hypothesized structure, the exploratory principal components analysis suggests a structure that is interpretable and reasonably consistent with theory (see Table 10-11).

Table 10-17 represents an alternative method of examining the reliability and validity of the Occupational Values Questionnaire. Reliability in this context is defined as the extent to which the mean ratings for one group of respondents from a particular occupation are related to the mean ratings for another group of respondents from the same occupation. Here the reliability of the Occupational Values Questionnaire, supported by 30 respondents per occupation, is strong. The results presented in Table 10-17 also support the hypothesis that when this questionnaire is completed by 30 respondents per occupation, it can recognize differences and similarities in occupational reinforcer profiles across occupations.

Summary

Research and theory support the hypothesis that the constructs measured by the Occupational Values Questionnaire are relevant to the description of occupations. Further, this questionnaire is practical and useable in the context of O*NET. It is simple and short relative to the other questionnaires. The results of this study also provide favorable evidence regarding the ability of the questionnaire as a whole to reliably differentiate among occupations when there are 30 respondents per occupation. This successful differentiation among occupations minimizes the concern that not using a forced choice rating format would result in too little variation in ratings across occupations.

However, a concern remains. What is the structure underlying the relationships among the reinforcers as they are measured by the Occupational Values Questionnaire, and does it make sense? However, the observed factor structure, as describe by the exploratory principal components analysis, is interpretable by itself and in the context of the hypothesized structure.

Recommendations

As was true for the measurement of interests using the Holland codes, the current evidence supports the inclusion of the Occupational Values Questionnaire in the O*NET content model. If the subsequent data collection plans include approximately 30 raters per occupation, this questionnaire should be maintained as part of the system. However, additional studies with larger numbers of occupations and respondents per occupation would allow a more definitive evaluation of the extent to which the questionnaire can reliably differentiate among occupations. Additionally, comparison of these ratings to ratings in other domains of the content model would enhance the evaluation of the Occupational Values Questionnaire.

The results suggest that some of the individual items (i.e., reinforcer statements) could not reliably differentiate among occupations, even if there were 30 respondents per occupation. This could be interpreted as suggesting that individual items showing low reliabilities should be eliminated from the questionnaire. However, it is recommended that, for now, all 21 items be retained in the questionnaire because further studies including more occupations and more respondents per occupation may provide more favorable item level reliability evidence. Additionally, the Occupational Values Questionnaire would no longer represent a complete taxonomy of vocational values if items were removed.

Final Comments

The evidence for the Holland codes and the Occupational Values Questionnaire as assessments of interests and values is favorable, and information in these domains is an important part of occupation description. "The primary use of vocational interest and value information has been and will likely continue to be helping people make vocational choices (Dawis, 1991; Holland, 1976)" (Sager, 1995, p. 11-16). After all, matching people to occupations is one of O*NET's primary goals. It is also relevant to note that vocational and career counselors have been frequent purchasers of the DOT in the past (Miller, Treiman, Cain, & Roos, 1980). Including interest and values information in the O*NET content model would provide substantial support for the work of vocational and career counselors.

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Figure 10-1
Titles And Descriptions of the Strong Interest Inventory General Occupational Themes (i.e., Holland Taxonomy of Interests)

Theme	Description
Realistic	People scoring high here usually are rugged, robust, practical, physically strong; they usually have good physical skills, but sometimes have trouble expressing themselves or in communicating their feelings to others.
Investigative	This theme centers around science and scientific activities. Extremes of this type are task-oriented; they are not particularly interested in working around other people.
Artistic	The extreme type here is artistically oriented, and likes to work in artistic settings that offer many opportunities for self-expression.
Social	The pure type here is sociable, responsible, humanistic, and concerned with the welfare of others.
Enterprising	The extreme type of this theme has a great facility with words, especially in selling, dominating, and leading; frequently these people are in sales work.
Conventional	Extremes of this type prefer the highly ordered activities, both verbal and numerical, that characterize office work.

Note: This table contains the titles of the General Themes from the SII that are based on Holland's taxonomy and a brief description of each; the descriptions contain only a part of language used to describe them on pages 14 and 15 of the Manual for the Strong Interest Inventory (Hansen & Campbell, 1985).

Figure 10-2

O*NET Codes, Titles, and Holland Codes for Six Occupations

O*NET Occupation Code	Occupation Title	Holland Code[a]
19005	General Managers & Top Executives	ESR
25105	Computer Programmers	IRE
32502	Registered Nurses,	SIE
63014	Police Patrol Officers	SER
67005	Janitors and Cleaners[b]	REC
85132	Maintenance Repairers, General Utility	RIS

Note. The Holland Occupational Codes and explanatory text included in this document are adapted and reproduced by special permission of the Publisher, Psychological Assessment Resources, Inc., Odessa, FL 33556, from the Dictionary of Holland Occupational Codes, Second Edition by Gary D. Gottfredson, Ph.D., and John L. Holland, Ph.D., Copyright, 1982, 1989. Further reproduction for any purpose or by any means is prohibited without the prior written permission of the Publisher.

[a]R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional.

[b]The full title for this job is "Janitors and Cleaners, Except Maids and Housekeeping."

Figure 10-3
Minnesota Job Description Questionnaire's Twenty-One Reinforcers and Their Associated Statements in the Occupational Values Questionnaire

Reinforcer	Reinforcer Statement Each statement begins with "Workers on this job ..."
1. Ability Utilization	make use of their individual abilities.
2. Achievement	get a feeling of accomplishment.
3. Activity	are busy all the time.
4. Advancement	have opportunities for advancement.
5. Authority	give directions and instructions to others.
6. Company Policies	are treated fairly by the company.
7. Compensation	are well paid in comparison with other workers.
8. Co-workers	have co-workers who are easy to get along with.
9. Creativity	try out their own ideas.
10. Independence	do their work alone.
11. Moral Values	are never pressured to do things that go against their sense of right and wrong.
12. Recognition	receive recognition for the work they do.
13. Responsibility	make decisions on their own.
14. Security	have steady employment.
15. Social Service	have work where they do things for other people.
16. Social Status	are looked up to by others in their company and their community.
17. Supervision - Human Relations	have supervisors who back up their workers with management.
18. Supervision - Technical	have supervisors who train their workers well.
19. Variety	have something different to do every day.
20. Working Conditions	have good working conditions.
21. Autonomy	plan their work with little supervision.

Note. The reinforcers are from page 41 and most of the statements are from the Minnesota Job Description Questionnaire (MJDQ) in Appendix A of A Psychological Theory of Work Adjustment by Dawis and Lofquist (1984). However, statements 5, 6, 8, 11, 16, 17, and 18 were modified in the Occupational Values Questionnaire to modernize the language.

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Figure 10-4

The Twenty-One Reinforcers From the Minnesota Information Questionnaire and Their Associated Higher Order Dimensions

Higher Order Dimension	Reinforcer
Achievement	Ability Utilization
	Achievement
Comfort	Activity
	Independence
	Variety
	Compensation
	Security
	Working Conditions
Status	Advancement
	Recognition
	Authority
	Social Status
Altruism	Co-workers
	Social Service
	Moral Values
Safety	Company Policies
	Supervision, Human Relations
	Supervision, Technical
Autonomy	Creativity
	Responsibility
	Autonomy

Note: The information in this table is abstracted from a table on page 849 of Dawis (1991).

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Figure 10-5
Thirty-Six Occupations With Four or More Incumbents Completing the Occupational Values Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	11
19005	General Managers & Top Executives	43
21108	Loan Officers & Counselors	6
22135	Mechanical Engineers	11
25105	Computer Programmers	7
31303	Teachers, Preschool	6
31305	Teachers, Elementary School	13
32502	Registered Nurses	26
32902	Medical & Clinical Laboratory Technologists	7
49008	Salespersons, Except Scientific & Retail	14
49011	Salespersons, Retail	21
49021	Stock Clerks, Sales Floor	13
49023	Cashiers	20
51002	First Line Supervisors, Clerical/Administrative	59
53102	Tellers	4
53311	Insurance Claims Clerks	7
53905	Teachers' Aides & Assistants, Clerical	9
55108	Secretaries, Except Legal & Medical	67
55305	Receptionists & Information Clerks	6
55338	Bookkeeping, Accounting, & Auditing Clerks	27
55347	General Office Clerks	92
61005	Police & Detective Supervisors	13
63014	Police Patrol Officers	24
65008	Waiters & Waitresses	11
65026	Cooks, Restaurant	5
65038	Food Preparation Workers	31
66005	Medical Assistants	4
66008	Nursing Aides, Orderlies, & Attendants	21
67005	Janitors & Cleaners	29
85119	All Other Machinery Maintenance Mechanics	4
85132	Maintenance Repairers, General Utility	26
87902	Earth Drillers, Except Oil & Gas	5
89108	Machinists	4
92974	Packaging & Filing Machine Operators	15
97102	Truck Drivers, Heavy or Tractor-Trailer	9
97111	Bus Drivers, Schools	11

Table 10-1

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Occupational Values Agreement Ratings

	Agreement Ratings			
Descriptor	M	SD	SEM[a]	r_k[b]
1. Ability Utilization	4.04	0.35	0.20	0.67
2. Achievement	3.81	0.34	0.24	0.49
3. Activity	4.00	0.54	0.25	0.79
4. Advancement	3.17	0.54	0.33	0.63
5. Authority	3.86	0.52	0.24	0.78
6. Company Policies	3.47	0.37	0.29	0.38
7. Compensation	3.11	0.47	0.31	0.55
8. Co-workers	3.76	0.31	0.26	0.31
9. Creativity	3.53	0.47	0.24	0.73
10. Independence	3.10	0.47	0.28	0.65
11. Moral Values	3.32	0.34	0.32	0.10
12. Recognition	3.18	0.33	0.28	0.28
13. Responsibility	3.62	0.36	0.24	0.55
14. Security	4.03	0.33	0.21	0.59
15. Social Service	4.12	0.37	0.21	0.67
16. Social Status	3.23	0.44	0.21	0.77
17. Supervision - Human Relations	4.48	0.37	0.31	0.31
18. Supervision - Technical	3.17	0.32	0.29	0.19
19. Variety	3.46	0.50	0.27	0.72
20. Working Conditions	3.71	0.31	0.22	0.48
21. Autonomy	3.81	0.38	0.25	0.55

Note. Statistics are based on 36 occupations with Occupational Values Questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.92, median = 12, harmonic mean = 9.69).

[a]This estimate of the standard error of measurement was calculated as $SEM = SD * \sqrt{(1 - r_k)}$.

[b]This estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

Table 10-2
Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Occupational Values

Descriptor	Numbers of Raters on Each Descriptor r_1[a]	r_{30}[b]
1. Ability Utilization	18	86
2. Achievement	09	75
3. Activity	28	92
4. Advancement	15	84
5. Authority	27	92
6. Company Policies	06	65
7. Compensation	11	79
8. Co-workers	04	59
9. Creativity	22	89
1 Independence	16	85
11. Moral Values	01	26
12. Recognition	04	54
13. Responsibility	11	79
14. Security	13	82
15. Social Service	17	86
16. Status	25	91
17. Supervision - Human Relations	04	58
18. Supervision - Technical	02	42
19. Variety	21	89
20. Working Conditions	09	74
21. Autonomy	11	79

Note. Statistics are based on 36 occupations with Occupational Values questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.92, median = 12, harmonic mean = 9.69). Decimals are omitted.

[a]Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judge ratings across occupations: ICC(1,1) = [BMS-WMS]/[BMS+(k-1)WMS] (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

[b]Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

Table 10-4
Analysis of Variance of Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Agreement Scale: Occupational Values

Source of Variation	SS	df	MS	F
Occupations	332.05	35	9.49	2.37*
S(Occupations)	2584.07	645	4.01	
Descriptor	801.08	20	40.05	58.90*
Descriptor x Occupations	1189.01	700	1.70	2.50*
Descriptor x S(Occupations)	8772.19	12900	0.68	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.
* $p < .05$

Table 10-5
Interrater Agreement Coefficients for Each Scale Type: Occupational Values

Scale Type	Number of Raters on Each Variable r_k	r_1	r_{30}
Agreement	.60	.13	.82

Note. Interrater agreement coefficient estimates are based on 36 occupations with Occupational Values questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.92, median = 12, harmonic mean = 9.69). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Descriptor x Occupations" terms from Table 10-4 as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation.

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Table 10-6

Analysis of Variance of Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on Agreement Scale: Occupational Values

Source of Variation	SS	df	MS	F
Occupations	103.00	35	2.94	2.42*
S(Occupations)	785.75	645	1.22	
Aggregate	82.38	5	16.48	65.53*
Aggregate x Occupations	103.45	175	0.59	2.53*
Aggregate x S(Occupations)	810.90	3225	0.25	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.

*p<.05

Table 10-7

Interrater Agreement Coefficients for Aggregate Descriptors for Agreement Ratings: Occupational Values

Scale Type	Number of Raters on Each Variable r_k	r_1	r_{30}
Agreement	57	12	81

Note. Interrater agreement coefficient estimates are based on 36 occupations with Occupational Values Questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.92, median = 12, harmonic mean = 9.69). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Aggregate x Occupations" terms from Table 10-6 as true variance. Error variance was defined as the "Aggregate x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

ble 10-9

Intercorrelations of Descriptors for the Agreement Scale (Occupational-Level Data): Occupational Values

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Ability Utilization	--																				
2. Achievement	77	--																			
3. Activity	24	36	--																		
4. Advancement	09	27	-02	--																	
5. Authority	65	71	19	14	--																
6. Company Policies	38	46	35	47	42	--															
7. Compensation	06	29	-16	48	00	35	--														
8. Co-workers	17	09	26	02	15	40	05	--													
9. Creativity	78	69	11	16	69	31	-02	-11	--												
10. Independence	-11	-28	-25	-39	-31	-29	-05	07	-32	--											
11. Moral Values	05	05	02	-25	12	14	-14	30	06	05	--										
12. Recognition	35	37	06	37	41	66	29	39	43	-17	28	--									
13. Responsibility	50	53	02	03	72	11	02	-05	59	-02	02	30	--								
14. Security	15	05	-17	04	31	14	-22	04	24	11	-26	01	38	--							
15. Social Service	13	11	14	-19	30	-04	-48	16	26	-13	24	-06	12	29	--						
16. Social Status	28	34	00	55	49	34	06	12	38	-18	-18	42	44	46	39	--					
17. Supervision - Human Relations	30	38	43	42	49	65	13	39	28	-50	17	61	19	-12	02	32	--				
18. Supervision - Technical	-28	-15	10	15	12	27	-05	22	-23	-27	11	10	-15	06	37	23	44	--			
19. Variety	73	62	15	22	72	34	-08	08	73	-22	03	36	59	32	43	59	33	-01	--		
20. Working Conditions	36	09	14	26	-02	26	02	31	26	-10	24	34	-15	-08	18	26	19	-06	21	--	
21. Autonomy	59	65	11	31	56	35	23	11	54	-06	18	57	61	-10	00	39	49	-08	53	21	--

Note. N = 36. All correlations calculated based on the mean of ratings assigned on a given occupation and descriptor. Decimals are omitted.

Table 10-10

Intercorrelations of Descriptors for the Agreement Scale (Incumbent-Level Data): Occupational Values

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Ability Utilization	--																				
2. Achievement	48	--																			
3. Activity	32	24	--																		
4. Advancement	13	18	15	--																	
5. Authority	27	30	18	18	--																
6. Company Policies	17	27	02	29	18	--															
7. Compensation	10	20	-07	30	07	39	--														
8. Co-workers	16	20	03	01	00	33	21	--													
9. Creativity	41	24	00	11	40	22	-01	06	--												
10. Independence	00	-06	04	-05	-24	-02	-02	08	-18	--											
11. Moral Values	10	20	-02	02	07	29	27	37	08	10	--										
12. Recognition	18	37	-08	37	19	48	42	26	18	-08	26	--									
13. Responsibility	47	35	16	12	29	18	14	05	33	04	11	15	--								
14. Security	08	09	08	-01	21	18	07	12	-07	19	-04	06	23	--							
15. Social Service	05	06	06	05	27	08	-10	03	15	-15	-03	01	23	13	--						
16. Social Status	15	28	-07	16	16	24	16	09	13	-05	-14	23	22	24	19	--					
17. Supervision - Human Relations	21	34	02	37	17	56	35	19	15	-10	23	48	17	05	07	35	--				
18. Supervision - Technical	17	28	11	33	06	36	34	21	-07	11	23	38	10	14	10	31	51	--			
19. Variety	36	37	16	17	29	21	-06	06	28	-14	02	11	14	08	10	21	15	21	--		
20. Working Conditions	10	15	-02	14	01	40	28	30	10	-13	33	30	05	06	15	23	32	24	25	--	
21. Autonomy	24	22	08	02	29	15	03	01	31	00	12	02	40	10	11	28	13	05	13	20	--

Note. N=144 (4 incumbents selected at random from each of 36 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation and descriptor. Decimals are omitted.

Table 10-11
Principal Components Analysis Pattern Matrix for Agreement Scale: Occupational Values

	Descriptor	Factor F1	F2	F3	F4	F5	Communality
1.	Ability Utilization	.87	.01	.20	.01	-.05	.81
2.	Achievement	.84	.25	.05	.17	-.08	.81
3.	Activity	.20	.61	.13	-.21	-.32	.58
4.	Advancement	.09	.34	.04	.73	.36	.78
5.	Authority	.79	.30	.09	-.08	.26	.79
6.	Company Policies	.28	.46	.48	.40	.15	.70
7.	Compensation	.05	-.02	.05	.83	-.10	.71
8.	Co-workers	-.05	.13	.76	-.04	.07	.61
9.	Creativity	.88	.09	.02	-.02	.11	.79
10.	Independence	-.16	-.78	.16	-.10	-.02	.67
11.	Moral Values	.06	-.03	.66	-.31	-.27	.60
12.	Recognition	.38	.15	.62	.41	.15	.74
13.	Responsibility	.77	-.11	-.08	-.02	.26	.68
14.	Security	.19	-.18	-.11	-.16	.77	.70
15.	Social Service	.15	.21	.19	-.69	.45	.77
16.	Social Status	.37	.17	.14	.17	.77	.81
17.	Supervision - Human Relations	.27	.71	.41	.24	.04	.81
18.	Supervision - Technical	-.35	.60	.22	-.12	.40	.71
19.	Variety	.78	.15	.11	-.11	.36	.79
20.	Working Conditions	.12	.00	.61	.07	.04	.39
21.	Autonomy	.71	.05	.30	.29	-.03	.68
	Percent Variance	25	12	12	12	10	
	Eigenvalue	5.27	2.52	2.48	2.44	2.20	

Note. N = 36. The correlation matrix was based on means calculated at the occupation level. F1 = Individual Accomplishment, F2 = Structure, F3 = Social Comfort, F4 = Career Advancement, F5 = Stability. These loadings are based on an orthogonal varimax rotation.

Table 10-12

Descriptor Means and Standard Deviation on the Agreement Scale on Six Examples Occupations: Occupational Values

		Occupations											
		General Managers & Top Executives (n=43)		Computer Programers (n=7)		Registered Nurses (n=26)		Police Patrol Officers (n-24)		Janitors & Cleaners[a] (n=29)		Maintenance Repairers, General Utility (n=26)	
	Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1	Ability Utilization	4.51	0.55	4.57	0.53	4.08	0.69	4.13	0.68	4.07	0.53	4.08	0.80
2	Achievement	4.23	0.57	4.29	0.49	4.12	0.82	3.83	0.87	3.66	0.97	3.62	0.75
3	Activity	4.44	0.70	4.00	1.41	4.04	0.87	3.25	0.90	3.96	0.78	3.92	0.89
4	Advancement	3.58	1.18	3.86	0.38	3.19	1.06	3.29	1.08	2.59	1.30	3.04	1.28
5	Authority	4.60	0.49	3.86	0.38	4.20	0.80	4.33	0.96	3.78	0.82	3.62	0.98
6	Company Policies	3.98	0.77	3.43	0.53	3.27	1.00	2.96	1.33	3.48	0.95	3.58	1.06
7	Compensation	3.81	1.03	3.71	0.49	3.15	1.26	2.67	1.20	2.72	1.13	3.00	1.17
8	Co-workers	3.60	0.90	3.71	0.76	3.65	0.94	3.75	0.79	3.83	0.71	3.77	0.91
9	Creativity	4.12	0.73	3.71	0.49	3.77	0.82	3.42	0.78	3.46	0.91	3.73	0.83
10	Independence	2.60	0.98	3.00	1.00	3.04	0.92	3.63	0.92	3.45	0.91	3.04	1.04
11	Moral Values	3.16	1.15	3.00	0.82	3.38	1.20	3.42	1.25	3.24	1.21	3.50	1.17
12	Recognition	3.60	0.76	3.14	0.90	2.85	1.22	2.83	0.92	3.34	1.08	3.50	0.81
13	Responsibility	3.84	0.81	3.71	0.76	3.81	0.85	4.33	0.76	3.59	0.95	3.73	0.87
14	Security	3.93	0.77	3.71	0.76	4.35	0.56	4.67	0.48	4.31	0.54	4.08	1.02
15	Social Service	4.12	0.73	2.86	0.90	4.69	0.55	4.42	0.65	4.17	0.47	3.96	0.87
16	Social Status	3.93	0.70	2.86	0.90	3.58	1.06	4.25	0.68	2.93	1.07	3.15	1.05
17	Supervision - Human Relations	3.74	0.88	3.57	1.13	3.31	1.16	3.25	1.11	3.57	0.86	3.58	1.03
18	Supervision - Technical	3.30	0.83	2.57	0.79	3.42	0.86	3.08	1.14	3.79	0.77	3.19	1.10
19	Variety	3.91	0.95	3.14	0.90	3.58	1.10	4.13	0.95	3.31	1.14	4.00	0.57
20	Working Conditions	4.07	0.63	4.00	0.00	3.76	0.86	3.42	0.97	3.69	0.81	3.81	0.98
21	Autonomy	4.12	0.88	4.14	0.69	3.84	0.88	3.92	0.83	3.79	0.82	3.77	1.14

[a]The full title for this occupation is "Janitors and Cleaners, Except Maids and Housekeeping."

Table 10-13

Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for Agreement Scale: Occupational Values

	Functions							
Descriptor	F1	F2	F3	F4	F5	F6	ΣF^2	η^2
1. Ability Utilization	.13	.07	.12	.08	.03	.02	.04	.14
2. Achievement	.08	.12	.10	.10	.04	.04	.04	.10
3. Activity	.98	-.01	.06	.06	.00	.05	.97	.21
4. Advancement	.06	.09	.07	.94	.03	.04	.90	.13
5. Authority	.07	.07	.96	.07	.09	.05	.94	.20
6. Company Policies	.01	.11	.06	.14	.04	.10	.05	.08
7. Compensation	.02	.09	.05	.10	.00	.07	.03	.11
8. Co-workers	.00	.04	.03	.05	.05	.06	.01	.07
9. Creativity	.01	.07	.12	.08	.07	.05	.03	.17
10. Independence	.04	.03	-.07	-.05	-.03	.04	.01	.13
11. Moral Values	.02	.00	.00	.07	.04	.06	.01	.06
12. Recognition	-.01	.14	.02	.16	.04	.07	.05	.07
13. Responsibility	.06	.05	.08	.03	.06	.09	.03	.11
14. Security	.05	.08	.05	.03	.10	.97	.96	.12
15. Social Service	.00	.07	.08	.03	.98	.10	.98	.14
16. Social Status	-.02	.93	.08	.09	.08	.09	.89	.19
17. Supervision - Human Relations	.01	.14	.06	.11	.02	.04	.04	.07
18. Supervision - Technical	.05	.13	.03	.11	-.01	.03	.03	.06
19. Variety	.07	.09	.07	.10	.06	.01	.03	.16
20. Working Conditions	-.02	.08	.01	.06	.07	.06	.02	.09
21. Autonomy	.06	.06	.05	.00	.05	.07	.02	.11
R_c	.58	.57	.50	.46	.39	.37		
Percent of Variance	19	18	12	10	7	6		
Eigenvalue	.50	.47	.34	.27	.18	.16		

Note. Statistics are based on 36 occupations with Occupational Values questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.92, median = 12, harmonic mean = 9.69). F1 = Activity; F2 = Social Status; F3 = Authority; F4 = Advancement; F5 = Social Service; F6 = Security.

ΣF^2 = Sum of squared rotated correlations between the discriminating variable across six discriminant functions.

η^2 = Variance in Level Scale ratings accounted for by occupations.

The statistics "R_c," "Percent of Variance," and "Eigenvalue," were calculated based on the unrotated discriminant functions.

Table 10-17
Correlations Among Group Mean Ratings Profiles Between and Within Three Example Occupations: Occupational Values

	Occ. 1 Group 1[a]	Occ. 1 Group 2	Occ. 2 Group 1	Occ. 2 Group 2	Occ. 3 Group 1	Occ. 3 Group 2
Occ. 1 Group 1	--					
Occ. 1 Group 2	86	--				
Occ. 2 Group 1	69	74	--			
Occ. 2 Group 2	64	70	87	--		
Occ. 3 Group 1	77	84	87	84	--	
Occ. 3 Group 2	74	75	85	86	91	--

Note. Within each occupation, N = 60 raters were randomly divided in half; therefore each group's profile of mean ratings is based on N = 30 raters. This process was performed 10 times resulting in 10 different randomly assigned sets of six groups (i.e., 2 groups per occupation). A correlation matrix was calculated for each set of six group profiles. Each element of this table contains the median of its associated elements across all 10 correlation matrices.

Occ. 1 = First-Line Supervisors and Managers/Supervisors; Clerical and Administrative Support Workers; Occ. 2 = Secretaries Except Legal and Medical; Occ. 3 = General Office Clerks. Decimals are omitted.

[a] The mean profile for this group is based on only n = 29 raters because the sample available for analysis included only n = 59 raters of this occupation.

Chapter 11

Work Style Descriptors:

Evidence for the Reliability and Validity of the Measures

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In this chapter and elsewhere in the O*NET project, we use the term work styles as a label for this domain. The domain is very similar to personality, but to emphasize the intention that the domain contains only occupation-related aspects of personality, the term work styles appears most appropriate.

Work styles requirements in occupations are becoming more important as occupations and organizations undergo what is proving to be considerable change. Changes include organizations increasingly employing teams to do work (e.g., Guzzo & Salas, 1995), organizational citizenship or contextual performance being more often considered as important (e.g., Borman & Motowidlo, 1993; Landy, Shankster, & Kohler, 1994), service jobs becoming more numerous (e.g., Schneider, 1990), and person-organization fit between employees and the values and "personality" of the organization increasingly being a focus of study (e.g., Borman, Hanson, Hedge, in press; Schneider, Goldstein, & Smith, 1996). Each of these trends is associated with increased importance for work styles. To be successful, teams require that their members have certain interpersonal and consensus-building skills. Contextual performance has as antecedents or predictors personality constructs. Most service jobs require strong interpersonal skills. And, person-organization fit generally focuses on the personality, motivational, and values domains. Accordingly, the work styles is an important part of the O*NET content model.

Background

Taxonomy

The Borman, McKee, and Schneider (1995) taxonomy of work styles is intended to provide a comprehensive summary of work style requirements for all occupations in the U.S. economy. The taxonomy is also intended to be efficient. An objective was to represent these occupational requirements with a relatively small number of work style constructs. As with other areas in the content model, the work styles taxonomy is hierarchical, consisting of seven constructs at the first level and 17 constructs at the second level.

Briefly, development of the first level constructs was influenced strongly by certain models and systems in the personality literature. As a point of departure, the five factor model (Goldberg, 1993; Tupes & Christal, 1992) was considered carefully, as were the Hogans' six dimension system for the Hogan Personality Inventory (Hogan & Hogan, 1992), Hough's nine dimension taxonomy (Hough, 1992), constructs from the Occupational Personality Questionnaire (Saville & Holdsworth, 1990), and dimensions from an effort to develop a job analysis questionnaire intended to measure personality requirements of jobs (Guion, 1992). We also reviewed factor analytic research and correlational studies in the area of personality in order to decide upon an appropriate number of first and second level constructs, to assess the relative

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independence of various constructs, and to better understand the nature of constructs in our taxonomy.

The first higher-order construct is Achievement Orientation. This construct involves striving for competence in the work environment and valuing hard work, persisting despite obstacles, setting high standards for performance, and wanting to get ahead. The three subconstructs for the second level taxonomy are Achievement/Effort (Descriptor #1), Persistence (Descriptor #2), and Initiative (Descriptor #3). Achievement/Effort (Descriptor #1) reflects setting difficult self-goals and expending considerable effort toward achieving those objectives. Persistence (Descriptor #2) includes the overcoming obstacles element of Achievement Orientation, and Initiative (Descriptor #3) reflects the notion of willingly taking on additional responsibilities and challenges.

The second higher-order construct, Social Influence, reflects components of interpersonal impact, persuasiveness, and energy. Thus, the lower-order constructs are Energy (Descriptor #4) and Leadership Orientation (Descriptor #5). Energy (Descriptor #4) represents the drive and movement toward having impact in a work setting. Leadership Orientation (Descriptor #5) also has to do with activating the potency and persuasiveness necessary to influence others at work.

Interpersonal Orientation is the third higher-order construct. This reflects aspects of sensitivity to others and generally getting along well with others in the workplace. Accordingly, the subconstruct Cooperation (Descriptor #6) reflects the getting along well component of Interpersonal Orientation. Concern for Others (Descriptor #7) represents the sensitivity element, and Social Orientation (Descriptor #8) is the affiliation, liking to be around other people part of the higher-order construct.

The fourth higher-order construct is Adjustment, being calm, composed, and rational even under stressful circumstances. This also involves being adaptable to changing work situations. Adjustment thus decomposes into the second-level constructs, Self-Control (Descriptor #7), Stress Tolerance (Descriptor #10), and Adaptability/Flexibility (Descriptor #11). The first lower-order construct reflects the evenness of mood, controlling anger aspect of Adjustment. Stress Tolerance (Descriptor #10) brings in the notion of constructively and successfully reacting to stressors. And Adaptability/Flexibility (Descriptor #11) reflects effectively responding to changes in the workplace.

The fifth higher-order construct is Conscientiousness. This is defined as being careful, planful, dependable, disciplined, as well as trustworthy and accepting of authority. The first subconstruct is Dependability (Descriptor #12), being trustworthy and adhering to a strong work ethic. Attention to Detail (Descriptor #13) covers the careful, planful elements of the higher-order construct. Finally, Integrity (Descriptor #14) involves being honest and avoiding unethical behavior.

Independence (Descriptor #15) is the sixth higher-order construct. This has to do with performing effectively with little or no supervision and developing one's own ways of succeeding on the job. This construct has no subconstructs.

Finally, the seventh higher-order construct is Practical Intelligence. We define this construct as generating useful ideas at work and thinking things through logically. Accordingly, the subconstructs are Innovation (Descriptor #16) and Analytical Thinking (Descriptor #17). The Innovation (Descriptor #16) dimension refers to being creative and coming up with new ideas and answers to work-related problems. Analytical Thinking (Descriptor #17) reflects the analyzing information and using logic to address work problems aspect of Practical Intelligence.

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Figure 11-1 describes higher-order constructs and presents the 17 construct lower-order system. See Borman, McKee, and Schneider (1995) provide a complete description of work style construct development and a cross-walk companion of this taxonomy with other personality taxonomies and dimensional systems. We believe that the work styles taxonomy meets the objectives of being comprehensive but at the same time parsimonious. Nonetheless, at this point we had no evidence of reliability or validity for the work styles constructs. The next sections of the chapter begin to address issues of reliability and validity.

Sample and Measures

As mentioned in previous chapters, the target number of occupations for the initial data collection was 80. However, the analyses to be described involve 35 occupations with a minimum of four incumbents per occupation. Figure 11-2 lists these occupations and the N for each. The number of incumbents actually ranged from four to 40, with an harmonic mean of 9.81 per occupation. OAFC analysts did not provide work style ratings.

Regarding the work style survey instrument, level and importance scales were developed. The level scales are 7-point scales (1-7) with an additional not-relevant option. Three behavioral anchors were also developed, at the high, mid-range, and low levels. These anchors were reviewed by the project staff, OAFC staff, and persons in our pilot sample. Revisions were made based on their comments, and the anchors were placed opposite the 6-7, 4, and 1-2 scale points, respectively. The level scales can best be characterized as measuring complexity. The importance scales are 5-point (1-5) scales with the verbal anchors Not Important, Somewhat Important, Important, Very Important, and Extremely Important, respectively, for the 1 to 5 scale points. As with the other domains, for each descriptor, the level question was asked first followed by the importance question. Figure 11-3 provides an example level and importance scale.

Results

Descriptive Statistics

Table 11-1 contains the overall means across the 35 occupations. Also shown are the standard deviations and interrater agreement indices based on 9.81 raters per occupation, and the standard errors of measurement. Focusing on the level ratings, the means are high and the range is quite restricted for some of the descriptors. Dependability (Descriptor #12) is most noteworthy in this regard, with a mean of 6.30 and a standard deviation of only .36. Attention to Detail (Descriptor #13), Cooperation (Descriptor #6), Stress Tolerance (Descriptor #10), and to a lesser extent Adaptability/Flexibility (Descriptor #11) also have high means and standard deviations that are somewhat restricted.

The pattern of means and standard deviations for the importance ratings is similar to that experienced with the level ratings. Means for Dependability (Descriptor #12), Attention to Detail (Descriptor #13), and Cooperation (Descriptor #6) are high and their standard deviations are restricted. The mean for Integrity (Descriptor #14) is also high but its standard deviation is not so restricted.

Reliability

The median $\underline{k}$-rater reliability is, for the level ratings, .66, with Dependability (Descriptor #12) the lowest at .15. The reliability for this descriptor is probably that low because of the serious restriction-in-range. Interrater agreement for the importance ratings are comparable, but slightly lower than those for the level ratings. The median $\underline{k}$-rater reliability is .64. Again, Dependability (Descriptor #12) has the lowest reliability ($\underline{r}$ = .26).

Table 11-2 displays the 1-rater and 30-rater reliabilities, using the Spearman-Brown formula to make the estimates. The 1-rater reliabilities are indeed quite low for both the level and the importance ratings. However, the 30-rater reliabilities are almost all above .75, and many are above .85. If we were to attain our goal of getting 30 incumbents per occupation, the reliabilities for work styles would be very acceptable with the exception of the Dependability (Descriptor #12) descriptor. It may be necessary to have somewhat higher numbers of incumbents completing the work styles scales compared to the scales in some of the other domains such as skills and abilities. Nonetheless, we have demonstrated that it is possible to obtain reasonably reliable incumbents' ratings of the work style requirements for their jobs. To our knowledge, incumbents have not heretofore been asked to make work style requirements judgments about jobs and occupations. This study indicates that it is feasible to gather this kind of information.

Scoring

As mentioned in previous chapters, it might be argued that including not relevant (i.e., zero) scores in the computation of level scale reliabilities is inappropriate. A similar argument could be made for the importance scales in that when not relevant was indicated on the level scale, a 1 (not important) rating was used in computing the interrater agreement of the importance scales. To address this possibility, we recalculated reliabilities, not considering the not relevant responses. Additionally, the level scale reliabilities were recomputed using a simple relevant/not relevant coding scheme.

Interrater agreement coefficients using these recodings are presented in Table 11-3. First, the coefficients are virtually unchanged for the level scales, when ignoring the not relevant response (comparing r_a and r_b). For the importance scales, interrater agreement drops considerably for one scale (Independence [Descriptor #15]), a small amount for eight of the scales, and actually improves for six of the scales. In two cases the coefficients did not change. In summary, reliability suffered only minimally or not at all when the not relevant rescaling was

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employed for the work styles descriptors. Except for one case (Independence [Descriptor #15]), interrater agreement was considerably lower when level scales were scored relevant/not relevant. Accordingly, this simple scoring method does not appear to be prudent.

Overall, the full scale scoring method including not relevant appears preferable and was used for subsequent analyses. Considering not relevant in the level scale scoring adds information that for the most part enhances the reliability of the importance scales. This has intuitive appeal in that a not relevant rating for a work style seems conceptually quite different from a low level requirement for that work style, and, in parallel, being of no importance is different from being of low importance.

Analyses of Variance

A summary, across descriptor approach to examining the reliability of the work styles descriptor scales is to use analysis of variance (ANOVA). Results of these analyses are shown in Tables 11-4a and 11-4b for the level and importance scales, respectively. First, for both types of scales, a significant occupations effect indicates that work styles do in fact discriminate between occupations. A highly significant descriptor effect shows that some work style dimensions are on average required at a higher level and are more important than others. Most relevant, the significant descriptor x occupation interaction provides evidence that different work styles differentiate between different occupations. That is, different patterns of work style requirements are evident for different occupations.

The intraclass correlations summarizing the interrater agreement from the ANOVAs are in Table 11-5. The k-rater coefficients are .70 and .67 for the level and importance scales. The 30-rater coefficients are near .90. Again, this indicates that interrater agreement is quite good, especially if the original target of 30 raters per occupation can be achieved.

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Tables 11-6a and 11-6b present ANOVA results for the aggregate work styles scales, that is, for mean scores computed across the scales combined according to the higher-order 7-dimension system. As with the 17-dimension system, the desirable occupations and descriptor x occupations effects are significant, indicating that work styles can in general differentiate between occupations and that different combinations of work styles provide the differentiation depending on the occupations in the mix. The interrater agreement coefficients of .76 and .73 (Table 11-7) indicate that at the aggregate level, this agreement is reasonably high. When 30 raters can provide ratings, interrater agreement is expected to be in the .90 range. Accordingly, the work style descriptors, whether at the individual scale or aggregate scale level, seem to have adequate reliability.

Descriptor and Scale Relationships

One might question whether data from the two scales, level and importance, are largely redundant. Table 11-8 presents the correlations between the level and importance scales, computed two different ways, for each dimension across the 35 occupations and averaged over the 17 dimensions and for each occupation across the 17 dimensions and averaged over the 35 occupations. The correlations are high (.90 and .93) and the low standard deviations indicate that they are uniformly high, especially by occupation across the 17 dimensions. These results suggest that indeed there is considerable redundancy across the level and importance scales.

Tables 11-9a and 11-9b present the correlations between dimensions for the level and importance scales, respectively. The correlations are at the occupation level; i.e., the N of each correlation is 35. Tables 11-10a and 11-10b present the same correlations but at the individual respondent level. Because our primary concern in the research is to identify differences between occupations, we focus our discussion on the occupation level data. We also focus our discussion on the level scales, although the pattern of relationships for the importance scales is quite similar.

Correlations in Table 11-9a make good intuitive sense. For example, correlations among the three descriptors that comprise the higher level Achievement construct (Achievement/Effort [Descriptor #1], Persistence [Descriptor #2], and Initiative [Descriptor #3]) are .78, .65, and .79. Similarly, the Innovation (Descriptor #16) and Analytical Thinking (Descriptor #17) descriptors that together form the Practical Intelligence higher-order factor correlate .81. In fact, the <u>mean</u> between descriptor, within higher construct correlation is .69; the mean between descriptor, <u>across</u> higher-order construct correlation is .42. The negative correlations are also where they would be expected. Independence (Descriptor #15) correlates -.35 with Social Orientation (Descriptor #8) and -.18 with Cooperation (Descriptor #6), as examples. Thus, the work styles scales seem to provide a meaningful pattern of relationships.

Factor Structure

Another way to evaluate the patterns of relationships between work style dimensions is to factor analyze the correlation matrix shown in Table 11-9a. Accordingly, we conducted a principal components factor analysis with varimax rotation. The 2-7 factor solutions were examined and the pattern of eigenvalues along with interpretability of the solutions suggested that the 3-factor solution best summarized the correlation matrix. This solution is depicted in Table 11-11. The three factors accounted for 75% of the total variance for ratings on the level scale. Also, the communalities suggested that with two exceptions the dimensions were well represented in the solution.

The first factor is a strong one with eight of the 17 dimensions loading substantially on it and 35% of the variance accounted for. We labeled the factor <u>surgency, achievement, high</u>

activity level orientation. Referring to the higher-order 7-dimension set, Factor 1 combines four of these dimensions: Achievement Orientation; Social Influence; Independence; and Practical Intelligence. Factor 2 was called people orientation and accounted for 29% of the total variance. Again, focusing on the higher-order dimension structure to aid in interpretation, this factor includes all of the Interpersonal Orientation descriptors and two of the three Adjustment descriptors. The third factor, accounting for 12% of the variance, has only a single high loading descriptor, Attention to Detail (Descriptor #13). We labeled this factor detail orientation. Two of the Conscientiousness descriptors (Dependability [Descriptor #12] and Integrity [Descriptor #14]) and one of the Adjustment descriptors (Adaptability/Flexibility [Descriptor #11]) are not represented in the 3-factor system. However, at least one descriptor from each of the seven higher-order dimensions loads substantially on one of the factors. So, from that perspective the three factors reflect well the entire scope of the work styles domain.

Of course, it must be remembered that this factor analysis was conducted on data representing 35 occupations. The stability of the solution, therefore, may not be high. Nonetheless, the three factors make reasonably good conceptual sense.

We also attempted to conduct confirmatory factor analyses to test the viability of the 7-dimension higher-order system. Unfortunately, the solution did not converge, probably because of the small N in comparison to the number of variables being analyzed.

Occupation Differences

One of the ways O*NET will be of use in actual practice is to generate profiles of occupational requirements on the O*NET descriptors. To provide an initial idea of the usefulness of profile data in the work styles domain, Tables 11-12a and 11-12b contain the means and standard deviations for each of the 17 work style dimensions on level and importance for six

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different occupations selected to reflect very different types of employment: (1) General Managers and Top Executives; (2) Computer Programmers; (3) Registered Nurses; (4) Police Patrol Officers; (5) Janitors and Cleaners; and (6) Maintenance Repairers, General Utility.

Table 11-12a, depicting the level means, indicates that some descriptors have relatively high means for all of the occupations. For example, Dependability (Descriptor #12) and Attention to Detail (Descriptor #13) show no mean ratings below 5 on the 7-point level scales. This supports the ANOVA finding of a significant descriptor effect. However, even for these descriptors that have relatively restricted ranges of means, there is some differentiation that makes good conceptual sense. For example, the two occupations with the highest Dependability (Descriptor #12) ratings are Patrol Officers and Nurses. These same two occupations plus Computer Programmers have the highest Attention to Detail (Descriptor #13) mean ratings. For the remaining descriptors, the differentiation between occupations is more evident. As examples, Computer Programmers have the highest rating on the Analytical Thinking (Descriptor #17) level descriptor; Janitors have the lowest rating on this descriptor. On the other hand, Janitors have a relatively high mean rating on Energy (Descriptor #4). General Managers have the highest ratings on Initiative (Descriptor #3) and Leadership Orientation (Descriptor #5); Nurses the highest ratings on Cooperation (Descriptor #6), Concern for Others (Descriptor #7), Social Orientation (Descriptor #8), Adaptability, and (as mentioned) Attention to Detail (Descriptor #13); and Computer Programmers the highest ratings on Independence (Descriptor #15) (as well as Analytical Thinking [Descriptor #17]) and the lowest ratings on the Cooperation (Descriptor #6), Concern for Others (Descriptor #7), and Social Orientation (Descriptor #8) descriptors. In summary, the mean level ratings are consistent with the nature of these occupations. The work

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style level scales appear to provide a meaningful description of the similarities and differences between occupations.

Some of the standard deviations are of interest as well. Several of the highest standard deviations are evident with the Janitors and Cleaners. For example, Leadership Orientation (Descriptor #5) and Analytical Thinking (Descriptor #17) have high standard deviations for this group. This may reflect more heterogeneity in the occupations within occupation. Some of the Janitors sampled may have supervisory responsibilities, for example.

We have concentrated on interpreting the level scale data. However, similar conclusions may be drawn from Table 11-12b and the importance rating data.

A very different way to explore occupation differences in work styles is to compare patterns of work style ratings within occupation to the patterns across occupations. In particular, a simple way to address occupation differences in this regard is to identify occupations for which we have a relatively large sample size, split the sample in half within each of the occupations, and correlate the mean incumbents' ratings within and across occupations. The hypothesis is that the within occupation correlations will be higher than the across occupation correlations. This analysis was carried out for three occupations: first-line supervisors; secretaries (except legal and medical); and general office clerks.

Table 11-17 contains these correlations. As hypothesized, in general, the within occupation relationships are higher (M within = .94; M across = .79). However, the clerk-secretary across occupation correlations are also very high. These occupations would be expected to do very similar work, so this result is not surprising.

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Discriminant Analyses

The questions might be asked, how well do the work style descriptors discriminate between the 35 occupations in our total sample? To explore this, we conducted a discriminant function analysis on the level scales. This analysis evaluates the degree of differentiation the work styles provide in general and the variables among them that provide the most (and least) differentiation between the 35 occupations. The one to five function solutions were examined and the four-function solution was selected as most interpretable. Table 11-13 presents the rotated correlations between the discriminating variables and the four canonical discriminant functions. These variables and the vectors of correlations can be interpreted as the loadings on the work style level scales that maximally differentiate between the 35 occupations. Also provided in the table are η^2 coefficients that summarize how much discriminating variance each work style level scale is providing.

The first function, achievement/intelligence, indicates that scales from the higher level Achievement and Practical Intelligence constructs contribute importantly to differentiating these occupations. The two Practical Intelligence descriptors are especially important in differentiating between occupations according to the η^2 results. The second function is primarily an adjustment function, the third can be interpreted as an interpersonal orientation function, and the fourth, energy, is defined by a positive loading on Energy (Descriptor #4) and a negative loading on Attention to Detail (Descriptor #13).

Overall, the work style level scales provided some differentiation of the occupations, classifying 32% of incumbents correctly using all 35 functions and 24% using only the four functions reported in Table 11-13. The η^2 vary from .22 down to .06. As expected, Dependability (Descriptor #12) provided the least differentiation, probably because of its high mean and

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restricted range. It should be noted that the work style scales' η^2 are not in general quite as high as those obtained in some of the other domains, such as skills. Nonetheless, these findings along with the occupation differences data in Table 11-12a, indicate that the work styles can play a role in providing information about job requirements that helps to differentiate between occupations.

Conclusions

We should first remind the reader of two significant limitations to the research conducted to date. The sample of occupations is relatively small at this point, and the number of incumbents per occupation providing ratings was likewise quite small in some cases. Nonetheless, research reported here indicated that job incumbents using the work style descriptor scales can provide reliable data. Interrater agreement was reasonably high for both the level and importance scales. If the target of 30 incumbents per occupation can be accomplished, the reliabilities for the scales should be excellent. It was noteworthy that the level scales were somewhat more reliable than the more traditional importance scales.

Regarding relationships between the two scales, correlations were high, suggesting considerable redundancy in level and importance information. It should be kept in mind, however, that even with a high correlation, there may be some occupations where for certain work style descriptors, legitimate and substantial differences exist between level and importance. Nonetheless, if a scale-type is to be dropped, we would suggest eliminating the importance scale. The level scales are slightly more reliable, and the behavioral anchors attached to the level scales seemed to clarify the definition of each work style.

Overall, this research lends support for the work styles taxonomy developed by Borman, McKee, and Schneider (1995), including the hierarchical structure they proposed. The mean correlation between-descriptor, within-higher-order construct (e.g., Achievement Orientation in

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Figure 11-1) is .69; the mean between-descriptor, across-higher-order construct correlation is .42. Further, other between-descriptor relationships made intuitive sense, and a factor analysis of the correlations between descriptors yielded a readily interpretable 3-factor solution.

Perhaps most important for the purposes of this effort, the work style descriptors successfully differentiated between the 35 occupations. A discriminant function analysis showed that all of the 17 dimension(s) played a role in differentiating at least some of the occupations, although Dependability (Descriptor #12) was marginal in this regard. The taxonomy is primarily designed to describe occupational requirements and how these differ across occupations. The work styles level scales seem useful in this role.

Still, the question might be asked, can we drop any of the 17 work style descriptors based on the findings presented? We would argue that a very important consideration here is the integrity of the taxonomy. Borman et al. (1995) developed this taxonomy with a strong theoretical base. It is comprehensive and yet reasonably parsimonious. Nonetheless, as mentioned, Dependability (Descriptor #12) performed comparatively poorly in the research. Its overall mean was very high for the level scale, and its range across occupations quite restricted. Probably because of this, Dependability (Descriptor #12) played the smallest role in differentiating between occupations in the discriminant function analysis. Thus, this descriptor is a candidate for dropping, or perhaps revising to create more differentiation between occupations. Of course, it must be remembered that it has been tried on only 35 occupations at this point, and Dependability (Descriptor #12) may do better at differentiating between other occupations. It is also reasonable to ask if a work style taxonomy without the Dependability construct is sensible. Because of its perceived required high level and importance, it may not be defensible to drop it.

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In summary, the proposed work styles taxonomy received considerable support from this research. The descriptor scales measuring the taxonomy's constructs yielded reliable, coherent, and useful data. The scales appear to provide an adequate basis for identifying and describing the similarities and differences across occupations in the domain of work style requirements.

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Figure 11-1
Descriptions and Definitions of Work Styles

Construct Label	Operational Definition	Level Scale
Achievement Orientation[a]		
1. Achievement/Effort	Job requires establishing and maintaining personally challenging achievement goals, and exerting effort toward task mastery.	High - Requires continual extensive effort toward achievement of work goals. Medium - Requires sustained effort toward achievement of work goals. Low - Requires only moderate levels of effort toward achievement of work goals.
2. Persistence	Job requires persistence in the face of obstacles on the job.	High - Requires high levels of persistence when work becomes difficult. Medium - Requires moderate levels of persistence on the job. Low - Requires little persistence on the job; few obstacles are encountered.
3. Initiative	Job requires being willing to take on job responsibilities and challenges.	High - Requires volunteering to take on new or additional work responsibilities and challenges. Medium - Requires some willingness to take on new work responsibilities and challenges. Low - Requires little interest in new work responsibilities or challenges; responsibilities are structured and stable.

[a]Higher Order Constructs

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Figure 11-1 (Continued)
Descriptions and Definitions of Work Styles

Construct Label	Operational Definition	Level Scale
Social Influence		
4. Energy	Job requires the energy and stamina to accomplish work tasks.	High - Requires very high levels of energy to get tasks done. Medium - Requires moderate levels of energy to get tasks done. Low - Requires little energy to get tasks done; job is not very physically or mentally demanding.
5. Leadership Orientation	Job requires a willingness to lead, take charge, and offer opinions and direction.	High - Requires a strong preference for making decisions, and leading or directing other organization members. Medium - Requires some preference for making decisions, and leading or directing other organization members. Low - Requires little or no leader decision-making.
Interpersonal Orientation		
6. Cooperation	Job requires being pleasant with others on the job and displaying a good-natured, cooperative attitude encourages people to work together.	High - Requires working very smoothly and cooperatively with others on the job. Medium - Requires generally working smoothly and cooperatively with others on the job. Low - Requires little interaction with others.

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Figure 11-1 (Continued)
Descriptions and Definitions of Work Styles

Construct Label	Operational Definition	Level Scale
7. Concern for Others	Job requires being sensitive to others' needs and feelings, and being understanding and helpful on the job.	High - Requires very high levels of sensitivity to others' needs and feelings, and consistent caring and support for others on the job. Medium - Requires high levels of sensitivity, caring, and support toward others on the job. Low - Requires sensitivity, caring, and support toward others on the job, but this is not a highly important trait for this job.
8. Social Orientation	Job requires preferring to work with others rather than alone and being personally connected with others on the job.	High - Requires a high degree of participation and working closely with other organization members. Medium - Requires a moderate degree of participation and, at times, working closely with other organization members. Low - Requires little participation with other organization members; usually works alone.
Adjustment		
9. Self-Control	Job requires maintaining composure, keeping emotions in check even in very difficult situations, controlling anger, and avoiding aggressive behavior.	High - Requires a very high degree of self-control and behaving in a non-threatening manner. Medium - Requires a high degree of self-control. Low - This job does not usually involve situations that challenge self-control.

Figure 11-1 (Continued)
Descriptions and Definitions of Work Styles

Construct Label	Operational Definition	Level Scale
10. Stress Tolerance	Job requires accepting criticism, and dealing calmly and effectively with high stress situations.	High - Requires being extremely calm and tolerant of stress imposed by other people or by circumstances. Medium - Requires being moderately calm and tolerant of stress imposed by other people or by circumstances. Low - This job does not involve much stress.
11. Adaptability/Flexibility	Job requires being open to change (positive or negative) and to considerable variety in the workplace.	High - Requires being highly flexible and adaptable, even to rapidly changing work situations. Medium - Requires being moderately flexible and adaptable to changing work situations. Low - Rarely requires being flexible to changing work situations; this job and work setting are usually stable.
Conscientiousness		
12. Dependability	Job requires being reliable, responsible, and dependable, and fulfilling obligations.	High - Requires the highest levels of responsibility and dependability in fulfilling job and work obligations. Medium - Requires considerable responsibility and dependability in fulfilling job and work obligations. Low - Requires responsibility and dependability, but if work is not done, it can be transferred to others.

Figure 11-1 (Continued)
Descriptions and Definitions of Work Styles

Construct Label	Operational Definition	Level Scale
13. Attention to Detail	Job requires being careful about detail and thorough in completing work tasks.	High - Requires a very high degree of care and thoroughness in handling details on the job. Medium - Requires a high degree of care and attention to detail in handling job duties. Low - Requires attention to detail in handling job duties, but this is not a highly important trait for this job.
14. Integrity	Job requires being honest and avoiding unethical behavior.	High - Requires the highest levels of integrity and a willingness to abide by a strict code of ethics or behavior. Medium - Requires a great deal of integrity and abiding by a standard code of ethics and behavior. Low - Job does not generally require ethical choices or abiding by a code of ethics.
Independence		
15. Independence	Job requires developing own ways of doing things, guiding oneself with little or no supervision, and depending mainly on oneself to get things done.	High - Requires a very high level of autonomy, with little or no dependence on others, to get job done. Medium - Requires a moderate level of autonomy, with some dependence on others, to get job done. Low - Does not work alone; requires working with others to get the job done.

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Figure 11-1 (Continued)
Descriptions and Definitions of Work Styles

Construct Label	Operational Definition	Level Scale
Practical Intelligence		
16. Innovation	Job requires creativity and alternative thinking to come up with new ideas for and answers to work-related problems.	High - Requires a lot of creative thinking and coming up with new ideas related to work, addressing job and work issues and problems, etc. Medium - Requires moderate levels of creative thinking and coming up with ideas related to work, addressing job and work issues and problems, etc. Low - Work requires little or no creative thinking.
17. Analytical Thinking	Job requires analyzing information, and using logic to address work or job issues and problems.	High - Requires being very good at analyzing complex issues, data, or problems related to work and consistently coming up with high quality, useful information. Medium - Requires being generally good at analyzing complex issues, data, or problems related to work and coming up with high quality, useful information. Low - Job does not require analyzing complex information

Figure 11-2

Thirty-five Occupations With Four or More Incumbents Completing the Work Styles Questionnaire

Occupation Code	Occupation Title	Number of Respondents
15005	Education Administrators	11
19005	General Managers & Top Executives	44
22135	Mechanical Engineers	6
25105	Computer Programmers	8
31305	Teachers, Elementary School	8
31502	Librarians, Professional	4
32502	Registered Nurses	34
32902	Medical & Clinical Laboratory Technologists	9
32905	Medical & Clinical Laboratory Technicians	5
49008	Salespersons, Except Scientific & Retail	7
49011	Salespersons, Retail	24
49017	Counter & Rental Clerks	5
49021	Stock Clerks, Sales Floor	8
49023	Cashiers	29
51002	1st Line Supervisors, Clerical & Administrative	65
53102	Tellers	5
53311	Insurance Claims Clerks	5
53905	Teachers' Aides & Assistants, Clerical	11
55108	Secretaries, Except Legal & Medical	75
55305	Receptionists & Information Clerks	6
55338	Bookkeeping, Accounting & Auditing Clerks	27
55347	General Office Clerks	78
61005	Police & Detective Supervisors	14
63014	Police Patrol Officers	19
65008	Waiters & Waitresses	18
65026	Cooks, Restaurant	6
65038	Food Preparation Workers	18
66008	Nursing Aides, Orderlies & Attendants	17
67005	Janitors & Cleaners	34
85119	Other Machinery Maintenance Mechanics	4
85132	Maintenance Repairers, General Utility	39
87902	Earth Drillers, Except Oil & Gas	8
92974	Packaging & Filling Machine Operators	13
97102	Truck Drivers, Heavy or Tractor Trailer	10
97111	Bus Drivers, Schools	10

Figure 11-3
Example Level, Importance, and Frequency Scales

8. Social Orientation

Job requires preferring to work with others rather than alone and being personally connected with others on the job.

Level

What level of this characteristic is needed to perform this job?

HIGH

7

6 ← *Requires a high degree of participation and working closely with other organization members.*

5

4 ← *Requires a moderate degree of participation and, at times, working closely with other organization members.*

3

2 ← *Requires little participation with other organization members; usually works alone.*

1

LOW

NR Not relevant at all for performance on this job

Importance

How important is this characteristic to performance on this job?

Not Important	Somewhat Important	Important	Very Important	Extremely Important
1	2	3	4	5

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Table 11-1

Descriptive Statistics Across All Occupations and Reliability Estimates for Rated Differences Between Occupations: Work Styles

	Variable							
	Level				Importance			
Descriptor	M	SD	SEM[a]	r_k[b]	M	SD	SEM	r_k
1. Achievement/Effort	4.69	0.88	.52	.64	3.58	0.45	.31	.52
2. Persistence	5.20	0.77	.44	.67	3.68	0.47	.26	.69
3. Initiative	5.32	0.70	.40	.67	3.83	0.41	.26	.59
4. Energy	4.97	0.81	.53	.58	3.56	0.48	.33	.52
5. Leadership Orientation	4.65	1.05	.42	.84	3.42	0.63	.25	.84
6. Cooperation	5.98	0.52	.33	.59	4.16	0.38	.25	.57
7. Concern for Others	5.20	0.85	.51	.64	3.79	0.49	.31	.60
8. Social Orientation	5.05	0.89	.48	.71	3.58	0.53	.32	.63
9. Self-Control	5.62	0.82	.45	.70	4.05	0.45	.26	.66
10. Stress Tolerance	5.61	0.54	.36	.55	3.98	0.38	.23	.64
11. Adaptability/Flexibility	5.43	0.52	.37	.50	3.82	0.34	.24	.51
12. Dependability	6.30	0.36	.33	.15	4.40	0.25	.22	.26
13. Attention to Detail	5.99	0.48	.32	.55	4.18	0.34	.22	.57
14. Integrity	5.74	0.73	.44	.63	4.11	0.47	.27	.66
15. Independence	5.25	0.69	.49	.50	3.77	0.40	.29	.46
16. Innovation	4.54	1.08	.52	.77	3.25	0.61	.32	.73
17. Analytical Thinking	4.64	1.12	.48	.82	3.39	0.64	.31	.78

Note. Statistics are based on 35 occupations with Work Styles questionnaire responses from at least four incumbents (mean number of incumbents = 19.5, median = 11, harmonic mean = 9.81).

[a] This estimate of the standard error of measurement was calculated as $\underline{SEM} = \underline{SD} * \sqrt{(1 - r_k)}$.

[b] This estimate of reliability was obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k) = [BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

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Table 11-2

Reliability of Rated Differences Between Occupations Considering Varying Numbers of Raters: Work Styles

Descriptor	Level r_1 [a]	Level r_{30} [b]	Importance r_1	Importance r_{30}
1. Achievement/Effort	16	85	10	77
2. Persistence	17	86	18	87
3. Initiative	17	86	13	81
4. Energy	13	81	10	77
5. Leadership Orientation	36	94	36	94
6. Cooperation	13	82	12	80
7. Concern for Others	15	85	13	82
8. Social Orientation	20	88	15	84
9. Self-control	20	88	17	86
10. Stress Tolerance	11	79	15	84
11. Adaptability/Flexibility	09	75	10	76
12. Dependability	02	34	03	52
13. Attention to Detail	11	79	12	80
14. Integrity	15	84	17	86
15. Independence	09	75	08	72
16. Innovation	26	91	21	89
17. Analytical Thinking	31	93	26	91

Note. Reliability estimates are based on 35 occupations with Work Styles questionnaire responses from at least four incumbents (mean number of incumbents=19.5, median=11, harmonic mean=9.81). Decimals are omitted.

[a] Single rater estimates of reliability were obtained by calculating the intraclass correlation for single judge ratings across occupations: ICC(1,1) = [BMS-WMS]/BMS +(k-1)WMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

[b] Estimates of reliability for 30 raters were obtained by applying the Spearman-Brown correction formula to the single rater reliability estimates.

Table 11-3
Reliability of Rated Differences Between Occupations Considering Various Recoding Schemes: Work Styles

	Type of Scale and Recoding Scheme Applied				
	Level			Importance	
Descriptor	r_a	r_b	r_c	r_a	r_b
1. Achievement/Effort	64	64	40	52	50
2. Persistence	67	67	32	69	60
3. Initiative	67	67	00	59	60
4. Energy	58	58	07	52	47
5. Leadership Orientation	84	84	33	84	83
6. Cooperation	59	59	00	57	56
7. Concern for Others	64	64	00	60	63
8. Social Orientation	71	71	00	63	63
9. Self-control	70	70	00	66	67
10. Stress Tolerance	55	55	00	64	65
11. Adaptability/Flexibility	50	50	00	51	51
12. Dependability	15	15	00	26	32
13. Attention to Detail	55	55	21	57	53
14. Integrity	63	63	27	66	67
15. Independence	50	50	62	46	28
16. Innovation	77	77	49	73	65
17. Analytical Thinking	82	82	57	78	70

Note. Reliability estimates are based on 35 occupations with Work Styles questionnaire responses from at least four incumbents (mean number of incumbents=195, median=11, harmonic mean=981). Reliability estimates stipulated as r_a were calculated using the full eight point scale for level and retaining all of the data for the importance. Reliability estimates stipulated as r_b were calculated using a reduced seven point scale for level and excluding the data for the importance scale where the rater marked "NR" on the level scale. Reliability estimates stipulated as r_c were calculated using a binary coded scale for level (relevant/not relevant). Decimals are omitted.

Table 11-4a
Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Work Styles

Source of Variation	SS	df	MS	F
Occupations	1908.43	34	56.13	3.15*
S(Occupations)	11516.11	646	17.83	
Descriptor	1491.09	16	93.19	66.33*
Descriptor x Occupations	2577.73	544	4.74	3.37*
Descriptor x S(Occupations)	14522.43	10336	1.41	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.
*p<.04

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Table 11-4b
Analysis of Variance for Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Work Styles

Source of Variation	SS	df	MS	F
Occupations	607.86	34	17.88	2.80*
S(Occupations)	4118.02	646	6.37	
Descriptor	553.15	16	34.57	60.30*
Descriptor x Occupations	953.31	544	1.75	3.06*
Descriptor x S(Occupations)	5925.73	10336	.57	

Note. Occupations are treated as random, between-subjects effects, while descriptors are treated as fixed, within-subjects effects.
*$p<.05$

Table 11-5
Interrater Agreement Coefficients for Each Scale Type: Work Styles

Scale Type	Number of Raters on Each Variable r_k	r_1	r_{30}
Level	70	19	88
Importance	67	17	86

Note. Interrater agreement coefficient estimates are based on 35 occupations with Work Styles questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.54, median = 11, harmonic mean = 9.80). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Descriptor x Occupations" terms from Tables 11-4a, 11-4b, and 11-4c as true variance. Error variance was defined as the "Descriptor x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

Table 11-6a
Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Level Scale: Work Styles

Source of Variation	SS	df	MS	F
Occupations	770.39	34	22.66	3.10*
S(Occupations)	4719.71	646	7.31	
Aggregate	464.12	6	77.35	85.10*
Aggregate x Occupations	773.54	204	3.79	4.17*
Aggregate x S(Occupations)	3523.08	3876	.91	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.
*$p<.05$

Table 11-6b
Analysis of Variance for Aggregate Descriptor, Occupation, and Relevant Interactions as Sources of Variation on the Importance Scale: Work Styles

Source of Variation	SS	df	MS	F
Occupations	244.71	34	7.20	2.71*
S(Occupations)	1715.05	646	2.65	
Aggregate	183.69	6	30.61	82.04*
Aggregate x Occupations	281.95	204	1.38	3.70*
Aggregate x S(Occupations)	1446.39	3876	.37	

Note. Occupations are treated as random, between-subjects effects, while aggregate descriptors are treated as fixed, within-subjects effects.
*$p < .05$

Table 11-7

Interrater Agreement Coefficients for Aggregate Descriptors for Each Scale Type: Work Styles

Scale Type	Number of Raters on Each Variable r_k	r_1	r_{30}
Level	76	25	91
Importance	73	22	89

Note. Interrater agreement coefficient estimates are based on 35 occupations with Work Styles questionnaire responses from at least 4 incumbents (mean number of incumbents = 19.54, median = 11, harmonic mean = 9.81). Full sample interrater agreement coefficients (r_k) were obtained by considering the "Aggregate x Occupations" terms from Tables 11-6a, 11-6b, and 11-6c as true variance. Error variance was defined as the "Aggregate x S(Occupations)" term. Estimates of reliability for 1 and 30 raters were obtained by applying the Spearman-Brown correction formula to the k rater reliability estimates, where k is the harmonic mean of the number of raters for each occupation. Decimals are omitted.

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Table 11-8

Means and Standard Deviations of Correlations Between Level and Importance Scales Across Occupations and Descriptors: Work Styles

	Level			Importance		
Scale	n[a]	M	SD	n	M	SD
Level	--	--	--	35	.93	.11
Importance	17	.90	.05	--	--	--

Note. All correlations were calculated based on the mean of ratings assigned by raters for a given occupation, descriptor, and scale. Level-Importance means above the diagonal were calculated by taking the level scale means on a given occupation for all descriptors, correlating them with importance scale means, for that occupation, and then averaging them with the correlations for other occupations. Level-Importance means below the diagonal were calculated by taking the level scale means on a given descriptor for all occupations, correlating them with importance scale means, for that descriptor, and averaging them with correlations for other descriptors.

[a] Number of correlations averaged, not number of observations on which correlations were calculated.

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Table 11-9a

Intercorrelations of Descriptors for the Level Scale (Occupation-Level Data): Work Styles

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Achievement/Effort	--																
2. Persistence	78	--															
3. Initiative	65	79	--														
4. Energy	62	56	60	--													
5. Leadership Orientation	72	67	74	65	--												
6. Cooperation	-03	-12	02	21	06	--											
7. Concern for Others	10	02	18	40	34	73	--										
8. Social Orientation	19	14	21	32	33	74	69	--									
9. Self-control	05	-03	17	34	31	69	80	66	--								
10. Stress Tolerance	22	24	36	23	40	52	61	63	72	--							
11. Adaptability/Flexibility	57	62	56	47	55	38	48	58	47	66	--						
12. Dependability	47	38	35	37	41	47	45	66	52	56	84	--					
13. Attention to Detail	22	14	02	03	-02	17	01	20	08	27	51	57	--				
14. Integrity	37	33	35	31	44	29	47	35	55	60	49	53	22	--			
15. Independence	51	46	34	35	39	-18	-04	-35	-12	-12	21	00	06	32	--		
16. Innovation	71	68	70	60	78	-12	17	22	00	26	59	39	18	27	46	--	
17. Analytical Thinking	74	76	68	39	73	-26	-03	02	-09	28	55	33	27	35	52	81	--

Note. N=35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 11-9b

Intercorrelations of Descriptors for the Importance Scale (Occupation-Level Data): Work Styles

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Achievement/Effort	--																
2. Persistence	73	--															
3. Initiative	74	76	--														
4. Energy	53	47	55	--													
5. Leadership Orientation	73	65	79	58	--												
6. Cooperation	-11	-21	10	32	03	--											
7. Concern for Others	08	-04	24	44	29	66	--										
8. Social Orientation	08	-06	23	43	27	78	76	--									
9. Self-control	-03	-12	11	37	26	70	83	77	--								
10. Stress Tolerance	06	20	37	39	41	51	71	69	77	--							
11. Adaptability/Flexibility	54	50	57	52	56	35	43	60	44	59	--						
12. Dependability	30	40	41	40	34	33	35	47	49	56	74	--					
13. Attention to Detail	07	18	08	-05	-11	-03	-08	05	03	14	35	53	--				
14. Integrity	21	26	16	26	36	21	32	29	55	40	39	59	27	--			
15. Independence	37	45	29	22	19	-07	-07	-22	-10	-08	23	26	24	44	--		
16. Innovation	73	63	83	57	78	-04	22	18	07	30	59	33	02	18	40	--	
17. Analytical Thinking	74	76	75	34	68	-25	-01	-03	-12	21	44	32	22	22	50	81	--

Note. N=35. All correlations calculated based on the mean of ratings assigned on a given occupation, descriptor, and scale. Decimals are omitted.

Table 11-10a

Intercorrelations of Descriptors for the Level Scale (Incumbent-Level Data): Work Styles

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Achievement/Effort	--																
2. Persistence	63	--															
3. Initiative	56	62	--														
4. Energy	42	57	35	--													
5. Leadership Orientation	41	61	59	49	--												
6. Cooperation	23	48	41	39	36	--											
7. Concern for Others	25	41	40	44	46	64	--										
8. Social Orientation	21	44	40	43	50	60	63	--									
9. Self-control	22	42	40	52	43	64	62	59	--								
10. Stress Tolerance	35	53	47	49	44	51	51	51	63	--							
11. Adaptability/Flexibility	38	51	44	42	40	51	36	39	40	44	--						
12. Dependability	29	44	38	40	34	60	41	41	53	54	61	--					
13. Attention to Detail	11	40	30	35	37	50	44	45	47	61	45	50	--				
14. Integrity	26	41	33	48	36	53	46	44	59	57	35	46	56	--			
15. Independence	18	36	32	40	32	25	25	24	23	41	34	36	46	28	--		
16. Innovation	49	54	58	40	63	27	32	33	26	46	41	32	37	31	42	--	
17. Analytical Thinking	46	52	54	31	54	11	28	29	21	45	34	24	41	33	31	74	--

Note. N = 140 (four incumbents selected at random from each of 35 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale.

Table 11-10b

Intercorrelations of Descriptors for the Importance Scale (Incumbent-Level Data): Work Styles

Descriptor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Achievement/Effort	--																
2. Persistence	59	--															
3. Initiative	49	68	--														
4. Energy	40	48	35	--													
5. Leadership Orientation	51	59	64	49	--												
6. Cooperation	17	41	45	35	43	--											
7. Concern for Others	24	38	38	43	43	64	--										
8. Social Orientation	17	33	38	41	50	66	58	--									
9. Self-control	26	40	40	46	36	67	56	57	--								
10. Stress Tolerance	30	56	39	43	51	44	39	50	61	--							
11. Adaptability/Flexibility	29	42	37	42	42	57	30	39	47	43	--						
12. Dependability	15	34	35	36	41	55	43	46	56	52	55	--					
13. Attention to Detail	15	38	30	25	34	43	37	34	47	49	53	56	--				
14. Integrity	15	25	31	43	34	44	37	37	59	40	44	47	53	--			
15. Independence	26	40	32	26	39	23	22	29	26	38	35	41	34	22	--		
16. Innovation	54	55	54	36	59	21	23	30	27	42	32	24	32	26	40	--	
17. Analytical Thinking	48	45	46	21	46	08	22	23	18	33	22	16	35	22	29	64	--

Note. N = 140 (four incumbents selected at random from each of 35 occupations). All correlations calculated based on individual incumbent ratings assigned on a given occupation, descriptor, and scale.

Table 11-11
Principal Components Analysis Pattern Matrix for the Level Scale: Work Styles

Descriptor	Factor F1	F2	F3	Communality
1. Achievement/Effort	.85	.07	.22	.78
2. Persistence	.87	.01	.19	.79
3. Initiative	.83	.19	-.00	.73
4. Energy	.69	.37	-.15	.64
5. Leadership Orientation	.85	.32	-.07	.83
6. Cooperation	-.19	.84	.08	.75
7. Concern for Others	.09	.90	-.11	.83
8. Social Orientation	.05	.84	.22	.76
9. Self-control	.00	.92	-.02	.84
10. Stress Tolerance	.20	.75	.29	.69
11. Adaptability/Flexibility	.53	.53	.56	.87
12. Dependability	.30	.58	.64	.84
13. Attention to Detail	.02	.07	.92	.85
14. Integrity	.37	.52	.21	.46
15. Independence	.64	-.23	-.04	.46
16. Innovation	.86	.06	.17	.78
17. Analytical Thinking	.86	-.10	.31	.84
Percent of Variance	35	29	12	
Eigenvalue	7.30	3.96	1.48	

Note. N = 35. The correlation matrix was based on means calculated at the occupation level. F1 = Surgency, Achievement, High Activity Level Orientation, F2 = People Orientation, and F3 = Detail Orientation. These loadings are based on an orthogonal varimax rotation.

Table 11-12a

Descriptor Means and Standard Deviations on the Level Scale on Six Example Occupations: Work Styles

	Occupations											
	General Managers & Top Executives (n=43)		Computer Programmers (n=7)		Registered Nurses (n=25)		Police Patrol Officers (n=24)		Janitors & Cleaners[a] (n=30)		Maintenance Repairers, General Utility (n=27)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Achievement/Effort	5.54	1.06	4.62	1.18	5.08	1.21	4.84	1.30	4.14	2.04	4.23	2.00
2. Persistence	5.90	0.83	5.50	1.60	5.91	0.93	5.73	0.99	4.58	1.82	4.61	1.75
3. Initiative	6.27	0.75	5.37	0.74	5.97	1.24	5.47	1.12	4.61	1.66	5.35	1.56
4. Energy	5.18	1.36	4.12	1.24	5.32	1.42	5.42	1.12	5.26	1.58	4.87	1.62
5. Leadership Orientation	6.13	1.21	4.25	1.03	5.50	1.30	5.68	1.15	3.79	2.01	4.61	1.82
6. Cooperation	5.86	1.32	4.75	1.38	6.35	0.98	5.84	1.06	5.58	1.76	5.71	1.27
7. Concern for Others	5.13	1.45	3.62	1.30	6.58	0.74	5.63	1.46	4.58	1.95	4.66	1.64
8. Social Orientation	5.31	1.27	2.87	1.12	5.82	1.21	5.00	1.10	3.67	2.09	4.38	1.74
9. Self-control	5.47	1.45	3.50	1.41	6.38	1.07	6.68	0.67	4.61	2.16	5.23	1.54
10. Stress Tolerance	5.63	1.38	5.25	1.03	6.11	1.09	6.68	0.58	4.64	1.96	5.12	1.30
11. Adaptability/Flexibility	5.75	1.29	5.25	0.70	6.11	0.97	5.89	0.73	4.58	1.94	4.82	1.83
12. Dependability	6.15	1.31	5.62	1.50	6.58	0.65	6.57	0.60	5.82	1.76	6.00	1.16
13. Attention to Detail	5.47	1.26	6.12	0.83	6.29	0.90	6.31	0.82	5.35	1.55	5.69	1.17
14. Integrity	6.04	1.19	4.62	1.68	6.50	0.74	6.89	0.31	4.97	1.97	5.25	1.40
15. Independence	5.50	1.15	5.75	0.70	5.70	1.19	5.26	0.87	5.50	1.61	5.61	1.28
16. Innovation	5.36	1.27	5.87	1.12	5.17	1.33	5.00	1.05	3.67	2.01	5.02	1.26
17. Analytical Thinking	5.84	0.96	6.62	0.74	5.29	1.58	5.21	1.27	3.47	2.23	5.17	1.25

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 11-12b

Descriptor Means and Standard Deviations on the Importance Scale on Six Example Occupations: Work Styles

	Occupations											
	General Managers & Top Executives (n=43)		Computer Programmers (n=7)		Registered Nurses (n=25)		Police Patrol Officers (n=24)		Janitors & Cleaners[a] (n=30)		Maintenance Repairers, General Utility (n=27)	
Descriptor	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
1. Achievement/Effort	3.93	0.75	3.62	0.91	3.70	0.87	3.42	1.01	3.44	1.07	3.20	1.03
2. Persistence	4.18	0.58	3.75	1.03	4.02	0.71	3.78	0.53	3.38	1.12	3.25	1.01
3. Initiative	4.27	0.49	4.00	0.53	4.14	0.82	3.94	0.84	3.58	0.98	3.69	0.92
4. Energy	3.59	0.87	2.62	0.74	3.61	0.98	3.68	0.67	3.76	0.85	3.33	0.98
5. Leadership Orientation	4.38	0.78	3.00	0.75	3.88	0.94	3.84	0.83	2.88	1.20	3.30	1.07
6. Cooperation	4.06	0.97	3.37	0.91	4.41	0.74	4.00	0.81	4.00	1.20	3.89	0.82
7. Concern for Others	3.59	0.97	2.87	0.99	4.47	0.70	3.89	0.80	3.50	1.05	3.38	0.90
8. Social Orientation	3.63	0.89	2.37	0.74	3.94	0.98	3.42	0.83	3.00	1.10	3.12	1.03
9. Self-control	3.95	1.03	2.87	0.83	4.44	0.70	4.73	0.56	3.61	1.10	3.76	0.95
10. Stress Tolerance	3.90	0.83	3.50	0.92	4.32	0.80	4.73	0.45	3.29	1.11	3.46	0.82
11. Adaptability/Flexibility	3.97	0.92	3.37	0.51	4.20	0.80	3.94	0.62	3.29	1.03	3.30	1.02
12. Dependability	4.27	0.87	4.00	1.19	4.52	0.70	4.57	0.60	4.05	1.04	4.10	0.75
13. Attention to Detail	3.90	0.88	4.25	0.70	4.41	0.74	4.52	0.69	3.82	1.02	3.97	0.81
14. Integrity	4.38	0.81	3.25	1.03	4.50	0.66	4.89	0.31	3.67	1.19	3.74	0.93
15. Independence	3.86	0.87	4.00	0.75	4.26	0.79	3.47	0.61	3.94	1.07	3.76	0.84
16. Innovation	3.63	0.86	3.87	1.12	3.67	0.80	3.31	0.82	2.73	1.16	3.46	0.82
17. Analytical Thinking	4.00	0.80	4.62	0.74	3.82	1.02	3.52	0.90	2.70	1.19	3.58	0.88

[a]The full title for this occupation is "Janitors and Cleaners, except Maids and Housekeeping."

Table 11-13
Rotated Correlations Between Discriminating Variables and Canonical Discriminant Functions for Level Scale: Work Styles

Descriptor	Functions F1	F2	F3	F4	ΣF^2	η^2
1. Achievement/Effort	.36	.03	.03	.05	.13	.13
2. Persistence	.43	-.01	.12	.01	.19	.14
3. Initiative	.44	.00	.12	.09	.22	.14
4. Energy	.16	-.05	.09	.49	.28	.11
5. Leadership Orientation	.62	.40	.03	.17	.57	.13
6. Cooperative	-.12	.13	.32	.08	.14	.11
7. Caring	-.03	.33	.21	.19	.19	.13
8. Social	.20	.19	.61	.07	.46	.15
9. Self-control	.04	.52	.26	.10	.35	.15
10. Stress Tolerance	.16	.36	.21	-.14	.22	.10
11. Adaptability/Flexibility	.26	.12	.23	-.08	.14	.10
12. Dependability	.13	.09	.23	-.07	.08	.06
13. Attention to Detail	-.02	-.07	.16	-.38	.18	.10
14. Integrity	.03	.48	-.04	-.05	.24	.13
15. Independence	-.02	.02	-.46	.08	.22	.10
16. Innovate	.54	-.01	-.02	.13	.31	.19
17. Analytical	.60	.10	-.14	-.19	.43	.22
R_c	.61	.53	.44	.43		
Percent of Variance	26	18	11	10		
Eigenvalues	.60	.40	.24	.22		

Note. Statistics are based on 35 occupations with Work Styles questionnaire responses from at least 4 incumbents (mean number of incumbents = 18.9, median = 13, harmonic mean = 9.68). F1 = Achievement/Intelligence; F2 = Adjustment; F3 = Interpersonal Orientation; F4 = Energy.
ΣF^2 = Sum of squared rotated standardized discriminant function coefficients across four functions.
η^2 = Variance in Work Styles Level Scale ratings accounted for by occupations.

Table 11-17

Correlations Among Group Mean Ratings Profiles and Within Three Example Occupations: Work Styles

	Occ. 1 Group 1 (n = 33)	Occ. 1 Group 2 (n = 32)	Occ. 2 Group 1 (n = 38)	Occ. 2 Group 2 (n = 37)	Occ. 3 Group 1 (n = 39)	Occ. 3 Group 2 (n = 39)
Occ. 1 Group 1	1.00					
Occ. 1 Group 2	.94	1.00				
Occ. 2 Group 1	.65	.68	1.00			
Occ. 2 Group 2	.58	.64	.93	1.00		
Occ. 3 Group 1	.56	.66	.91	.91	1.00	
Occ. 3 Group 2	.66	.73	.95	.94	.94	1.00

Note. Within each occupation, raters were randomly grouped into halves.
Occ. 1 = First-line Supervisors and Managers/Supervisors, Clerical and Administrative Support Workers, Occ. 2 = Secretaries Except Legal and Medical, Occ. 3 = General Office Clerks.

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O*NET Final Technical Report

Volume III

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Notice

The American Institutes for Research and its subcontractors, Personnel Decisions Research Institutes, Inc., Management Research Institute, Inc., Jeanneret & Associates, Inc., and Westat, Inc., performed the work described herein under Contract Number 94-542, administered by the Utah Department of Employment Security, on behalf of the U.S. Department of Labor.

Under this contract, the American Institutes for Research and its subcontractors developed an operational prototype for an occupational data collection, analysis, and dissemination system--the Occupational Information Network or O*NET--to replace the Department of Labor's *Dictionary of Occupational Titles*. This report, *O*NET Final Technical Report*, submitted by the American Institutes for Research as a major deliverable under this contract, describes the empirical evidence provided by the preliminary data collection effort for the meaningfulness of the prototype system. An earlier report, *Development of Prototype Occupational Information Network (O*NET) Content Model*, described the development of the model underlying the O*NET and the design of the questionnaires used to collect the occupational information. A separate report, *O*NET: An Information System for the Workplace. Designing an Electronic Infrastructure* (Rose, Hesse, Silver, & Dumas, 1996), describes the development of the electronic database and provides technical documentation for the database.

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Please note that the analysis results tables in Chapters 3 through 11 are numbered uniformly across chapters. Because some analyses are not appropriate for every domain, some domains are missing certain table numbers. This is intentional. Please refer to chapter 2 and, particularly, Figure 2-17 for a listing of what tables should appear in each chapter.

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Chapter 12

Occupational Descriptor Covariates:

Potential Sources of Variance in O*NET Ratings

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The O*NET occupational information system relies on empirical data--ratings provided by job incumbents and occupational analysts--as the bases for its descriptions of occupations. This is one of its strengths, as demonstrated throughout this report. However, the O*NET's reliance on data collected from job incumbents and occupational analysts--indeed the reliance of most job analysis efforts to similar ratings--may also be considered problematic by those who question the accuracy of such ratings. Morgeson and Campion (1996), in particular, have recently highlighted concerns as to whether job incumbents and occupational analysts can and do provide accurate ratings of occupations in job analysis studies. In their article, they have described a myriad of social and cognitive factors that might influence the accuracy of ratings and of the resulting occupation descriptions.

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There are two ways in which the O*NET occupational information system might be used to address concerns about the accuracy of job analysis data. At the particular level, we might investigate whether the O*NET data are likely to be accurate, and explore the implications of the findings for the usefulness of the O*NET system. Alternately, we could use the O*NET data as an exemplar data set in an investigation of general issues in job analysis rating accuracy. The O*NET already has a large number of ratings over a variety of jobs and will continue to grow in the number of occupations covered and the number of ratings per occupation. It may be that some of Morgeson and Campion's (1996) concerns can eventually be addressed using data from the O*NET.

It is important to note, before we begin our discussion of possible sources of variance in job analysis ratings, particularly as they relate to the O*NET, that the O*NET data collection strategy was not designed to support an investigation of rating accuracy. While it may be possible, though difficult, to imagine designing and conducting a series of studies of sufficient breadth and control to thoroughly investigate a few of the possible factors that might influence rating accuracy, given the reality of limited funds and time, such studies become very improbable, as well as impractical.

The O*NET data collection was designed to inexpensively and efficiently account for many of the potential sources of variance by employing random sampling at several stages of rater selection. As detailed in Chapter 2, establishments were selected at random from specific Standard Industrial Classification (SIC) divisions, and raters were selected at random within occupations within the organization. Because of the scope of the data collection, it was (and will continue to be) possible to include a wide variety of raters with a variety of personal characteristics and from a variety of work environments. However, although the data collection design precludes careful examination of many of the potential sources of error, the coherence and sensibility of the results of the analyses presented throughout this report--particularly the high interrater agreement coefficients and the similarity of the job incumbents' and occupational analysts' ratings--suggest that the ratings largely reflect "true" variance.

Bearing in mind that the O*NET was not designed to support such an investigation, we will nonetheless examine the characteristics of the already-collected data, and suggest what implications potential findings might have on our understanding of sources of variance in general, and specifically as they relate to the O*NET. First, we will describe a model.

Model

The potential sources of variance discussed in this chapter include a variety of factors, such as raters' levels of familiarity with the occupation, organizations' attributes, questionnaire features, and a number of other factors that may influence occupational ratings. It is important to bear in mind that, while some of these may be construed as sources of error, others are generally considered true variance. As Morgeson and Campion (1996) point out, some of the sources of variance, including uniformity of data collection media, may actually inflate the observed reliability of the ratings by subtly biasing respondents to provide particular ratings.

The potential sources of variance in occupational ratings that we will consider here are outlined in Figure 12-1. This figure illustrates our model, explaining the way in which different factors may contribute to inaccuracies in final occupational ratings. The examples used here apply to the O*NET, but most are relevant for other job analysis efforts.

To the far left of the figure is a box representing the actual occupational demands. These demands are the reality we would like to reflect in the O*NET occupational information system. However, we recognize that the breadth of our occupational analysis unit--for example, whether we are targeting the fairly general category of mechanic or the more specific subspecialty of aircraft mechanic--will have some impact on how the occupation's features will be summarized, and on what activities and requirements will be considered typical. We also recognize that occupations may differ from establishment to establishment, within a given occupation depending on such factors as the industry type (for example, an electrical engineer for an electronics manufacturing firm might have different responsibilities from an electrical engineer for a broadcasting station), the organizational culture (for example, the management structure and degree of bureaucratization in a company), the size of the establishment, and the geographic region. All of these factors may influence an occupation's actual demands. The extent to which these factors vary within an occupation in a sample will affect the occupational profile that results.

Clearly, the intention is for the rater to appraise the occupation based solely on the actual demands of the occupation, either in a general sense, as in the case of an occupational analyst making the ratings, or in regard to a particular instance of the occupation, in the case of a job incumbent. However, the rater's appraisal of the occupation may be influenced by other factors. These factors include several attributes and experiences of the rater: personal attributes (e.g., sex, ethnicity, education); the rater's familiarity with the occupation (e.g., the rater's status as incumbent or occupational analyst); the rater's job level (e.g., incumbent or supervisor); and the rater's tenure on the job.

Finally, even assuming that the particular instance of the occupation is not unusual and the rater appraises the occupation accurately, there are still opportunities for added variance to creep into the ratings. This is reflected on the right side of Figure 12-1. For example, the reading level on the questionnaires might be too high for some job incumbents or the terminology may be unfamiliar. The questionnaire scales may lack the categories needed to accurately describe a particular occupation. Incumbent raters may be motivated to provide inaccurately favorable ratings for their occupation by a consciousness of the social desirability of their choices. When incumbents generate ratings in focus groups, groups processes--for example, motivational losses, pressures to conform to the group norm--may impact the variance observed in ratings (Morgeson & Campion, 1996). Finally, the data collection media (for example, paper and pencil administration versus computer administration) may affect the ratings obtained.

Evidence

For some of the sources of variance included in the model in Figure 12-1, the data we have collected are suggestive of their possible effects, even though the O*NET data collection was not designed with the intention of enabling investigation of these factors. However, for other factors included in the model, we simply do not have--and may never have--sufficient data to carry out analyses. For still other factors, the nature of the factor precludes empirical testing. All the factors in the model will be discussed below.

Influences on Actual Job Demands

Following our model, we will first consider the factors--industry type, organizational culture, establishment size, geographical region, and occupational unit--that are likely to affect actual job demands.

Industry Type

The establishments participating in the O*NET prototype data collection were selected from establishments in Standard Industrial Classification (SIC) categories that were identified as likely to employ individuals in the 80 occupations targeted in the initial data collection. The selection of establishments was stratified across 143 selected SICs and across four establishment sizes. Figure 12-2 presents the numbers of establishments in each SIC that contributed data to the initial O*NET data collection database. (Additional establishments also contributed data, but for occupations with too few respondents to be included in these analyses.) In most occupations, incumbents were sampled from a number of establishments in a variety of SICs. For example, for the occupation Cashiers, questionnaires were completed by 78 job incumbents from 24 establishments in 5 of the 9 Standard Industrial Classification divisions, in this case, Manufacturing; Transportation, Communication, Electric, Gas and Sanitary Services; Retail Trade; Services; and Public Administration.

Eventually, after a large amount of data have been collected, it may be possible to perform comparisons of occupational ratings for individual occupations across industries. Of course, occupations will vary considerably with respect to their occurrence across industries. In this analysis, industry could be analyzed at the level of the nine major SIC groupings into which the establishments are classified. Sufficient data are not yet available to allow this analysis to be performed across occupations. An illustrative analysis was performed for the occupation of Secretary, Except Legal and Medical and is reported in Table 12-1. In this analysis, the Skills Questionnaire level ratings for 12 incumbents from four establishments in the Manufacturing sector are compared with those for 12 incumbents from five establishments in the Public Administration sector. In this analysis, no statistically significant differences between the mean ratings for incumbents in the two sectors were found. In other words, the skills required for Secretaries in the Manufacturing sector are very similar to those required for Secretaries in the Public Administration sector. However, for other occupations, in other sectors, differences in ratings might well occur. In particular, Organizational Context and Generalized Work Activities ratings might be expected to differ across industry types.

Organizational Culture

By organizational culture, we mean such aspects of an organization as its management structure, the degree of bureaucratization in a company, and the company's emphasis on employee responsibility. Also included are the degree to which an organization is involved in the production or use of new technology and, particularly, whether an organization can be classified as "high performance." In Chapter 2 of this report, we discuss common criteria for classification as a high performance organization: for example, organizational emphasis on the importance of innovation and technology in the workplace.

Analysis of organizations' responses to the establishment version of the Organizational Context questionnaire, reported in Chapter 8, suggest the ways in which organizations differ in terms of organizational culture. In Chapter 3, Tables 3-17b and 3-17c, we compared the Skills level ratings of incumbents working in organizations that could be classified as high performance (based on the responses of their organizational representatives to the Organizational Context questions presented in Appendix A) with the ratings of incumbents working in more traditional organizations. Comparisons were made for two occupations--General Office Clerks and First Line Supervisors, Clerical/Administrative. In this analysis, we found that while General Office Clerks in high performance organizations reported needing higher levels of a variety of skills, First Line Supervisors did not (see Chapter 3 for a complete description of the analysis). This analysis illustrates an organizational culture feature that does impact at least some of the ratings.

Establishment Size

Establishments of widely varying sizes have contributed and will continue to contribute data to the O*NET's database. Establishments, which are defined for the purposes of the O*NET data collection as single sites (so that an organization may consist of multiple establishments)

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must have at least five employees in order to participate, but may have several thousand. Establishments participating in the initial O*NET data collection ranged in size from 0 to 5,000 full-time employees, with a median of 70. The size of the establishment is expected to have direct effects on the data collected from the establishment (for example, on how many employees are available for the data collection and in how many occupations). It may also have indirect effects (for example, the duties of a mechanical engineer in a small company may be more varied than the duties of a mechanical engineer in a large, specialized engineering shop).

The version of the Organizational Context questionnaire that was administered to organizational representatives provides information about the size, among other characteristics, of the establishment. These data can be combined with the incumbent data from those establishments to compare occupational ratings across establishment size. Unfortunately, because small establishments by definition have fewer employees, they can contribute fewer respondents, particularly to some occupations, such as Secretary, that only become prevalent in larger organizations. In addition, they may be less willing to allow employees to take time on the job to complete the questionnaires, thus further decreasing participation. There are currently an insufficient number of job incumbents from small organizations in the data base to permit even an exemplary analysis comparing incumbent responses by establishment size. A special effort to target smaller organizations would likely be necessary to collect sufficient data to allow analyses of this factor.

Geographical Region

The geographical region in which an establishment is located and where an incumbent works may also impact on occupational ratings. For example, a lawyer practicing in New York City may experience different job demands than a lawyer in a rural Midwestern community.

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Organizations that have establishments in several geographical regions and are centrally organized may also have different attributes than organizations that are located in a single region.

Information about the geographical region in which an establishment is located was collected through the organizational context questionnaires administered to organizational representatives. The incumbent data collected within occupations across establishments in the initial O*NET data collection is currently too sparse to permit meaningful analyses.

Occupational Unit

The breadth or specificity of the occupational categories that are being described in a job analysis may affect the accuracy of the data. For example, use of broader occupational units, such as "mechanic," might require the collection and combination of ratings from incumbents in a variety of occupational subspecialties, including "automobile mechanic" and "aircraft mechanic." This might result in some loss of precision in the resulting occupational profiles. On the other hand, occupational analysts might find it easier to provide ratings for these broader categories than for occupation subspecialties.

The O*NET is currently using a set of 1,122 occupational units, developed by the Occupational Analysis Field Centers (OAFCs). The occupational units represent a taxonomy of occupations that is intermediate in number of categories between the Occupational Employment Statistics (OES) taxonomy and the Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1991) taxonomy. Some of the OES categories are subdivided and many of the DOT categories are combined.

One possible analysis that might suggest the importance of this factor would involve subdividing several of the current occupational units and collecting ratings from occupational analysts on those units. An additional analysis of interest would be to compare ratings of more homogeneous subgroups of incumbents within a current occupational unit, perhaps grouped on the basis of their indications of occupational knowledge specialties on the Knowledges Questionnaire.

Influences on Job Appraisal

The next group of factors are related to how the rater perceives the job. Included here are the rater's personal attributes, such as sex, ethnicity, and education; the rater's familiarity with the job; the rater's job level; and the rater's time on the job.

Raters' Personal Attributes

The personal attributes of raters--for example, sex, ethnicity, and educational achievement--are very likely to differ across occupations. For example, despite efforts to hire women in occupations traditionally dominated by men and, to some extent, men into jobs traditionally held by women, many occupations are still dominated by one sex. For example, of the 95 Registered Nurses who provided ratings in the initial O*NET data collection, 93 were women. Similarly, of the 67 Police Patrol Officers who provided ratings, 64 were men.

Of the 2,197 incumbents who responded to at least one questionnaire in the initial O*NET data collection, 64% were female and 36% were male; 76% selected White/Not of Hispanic Origin for their ethnicity, 8% selected African American/Not of Hispanic Origin, 6% selected Hispanic, 5% selected Native American, and 3% selected Asian/Pacific American (the remaining 2% marked Other or did not respond); and 95% had at least a high school diploma, with only 8% of those also having a Bachelor's Degree.

To what extent do these differences in personal attributes contribute to differences in occupational ratings? And, where individuals differ systematically across, but not within, occupations, how do these differences in personal attributes contribute to perceived occupational differences? The O*NET data collection is designed to randomly select respondents across these rater attributes, in order to best control for the effects of variations on ratings. However, this method of control has the result that, if we decide we want to use these same data to determine the differential effects of various attributes, we must have enormous quantities of it. In no occupations are there enough data from the initial O*NET data collection to perform analyses to determine to what extent ratings made by incumbents within the occupation differ depending on incumbent attributes. It is also conceivable that occupational analysts' ratings may be influenced by rater attributes--for example, male analysts might tend to rate traditionally female-dominated jobs less highly than would female analysts. An analysis of variance might be performed to address this issue, with sex, race, and educational level as possible sources of variance within and across occupations. An analysis of the effects of one attribute (race, for example) within an occupation, would have to carefully covary out other possible sources of variance, such as differences in job tenure between minority and majority job incumbents in an occupation that until recently was predominately held by individuals of a particular ethnicity. Personal attributes might be expected to affect ratings in all the domains to some degree, although perhaps most notably in the Work Styles and Occupational Values domains.

Raters' Job Familiarity: Incumbents' Versus Analysts' Ratings

In five of the domains (Basic and Cross-Functional Skills, Generalized Work Activities [GWAs], Abilities, Work Context, and Knowledges), both job incumbents and occupational analysts provided ratings for some occupations. Job incumbents were individuals with at least six months experience in the occupation and included not only individuals actually performing the occupation, but also some supervisors. Most of the incumbents completed more than one of the nine questionnaires and a few completed as many as five.

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Occupational analysts were trained raters (employment specialists at the OAFCs and Industrial/Organizational Psychology graduate students), who familiarized themselves with a particular occupation by studying a list of occupation tasks, then provided ratings for that occupation. Each task list was based on occupation descriptions from the DOT. Each occupation was rated by at least five raters independently, to minimize the effects of rater error. During a rating cycle, each rater rated a set of 125 occupational units on one O*NET Content Model category for level, importance, and frequency, when applicable.

While job incumbents have the advantage of more detailed knowledge of their particular occupation, occupational analysts might be argued to have the advantage of perspective--having knowledge of a large number of occupations and being able to compare the particular occupation being rated to the characteristics of other occupations.

For each of the five domains in which both analysts and incumbents provided ratings, analyses comparing these ratings were performed. The results of these analyses are reported in each of the domain chapters. In general, these analyses found the incumbents' and analysts' ratings to be moderately to highly correlated. In the Skills domain, for example, the median correlation between incumbents' and analysts' ratings was .73.

Despite these similarities, there were some differences between the two sets of ratings. Again taking the Skills domain as an example, analysts' ratings for the level of Skill required for an occupation tended to be lower than incumbents' ratings, with the exception of some of the technical skills, which the analysts rated slightly higher than did the incumbents. Smaller, but consistent, differences were also found for the importance ratings.

Incumbents' and analysts' ratings were each highly reliable, across occupations and across domains. Figure 12-3 shows the average interrater agreement for incumbents' ratings for the actual number of raters per occupation in these data (r_k) and the predicted agreement for 30 raters per occupation (r_{30}).

For analysts' ratings, descriptor category reliabilities were determined by computing the agreement in ratings of five raters. The reliability of a single rater or r_1 was estimated based on a sample of five raters and statistically "stepped up" as an estimate of the reliability of five raters (r_5). Reliabilities for each descriptor category were then averaged across all 10 cycles of ratings, or 1122 Occupational Units. Abilities and Work Context reliabilities are based on 130 Occupational Units pending completion of the final rating cycle. Values for the reliability of ratings in the descriptor categories range from .81 for Generalized Work Activities frequency to .88 for Generalized Work Activities level, as can be seen in Figure 12-4. Analyses of the ratings confirmed that the descriptors could be reliably rated using the DOT task data.

In general, incumbents and analysts were found to separately provide reliable occupational ratings, and their ratings are moderately to highly correlated. However, the amplitude of the ratings tended to be smaller for the analysts, though this was not true across all descriptors within the various domains. This finding raises interesting questions about the absolute versus relative nature of the scaling and the effect of occupational familiarity on the ratings. This finding guided our decision to report analysts' and incumbents' ratings separately in the initial version of the O*NET database.

<u>Raters' Job Level</u>

Occupational ratings were provided both by job incumbents and by their supervisors (both were referred to as incumbents throughout this report). We might expect job incumbents to be at least as familiar, and possibly more familiar, with the particular requirements of their job as are supervisors, but supervisors may be more aware of variations in job requirements across job assignments and how job requirements compare with the requirements of other jobs. We would expect the effect of job level on ratings to extend across the domains.

Of 2,197 incumbents in 29 occupations providing ratings, 70% identified themselves as job incumbents, 7% as supervisors, and 20% said they both worked in the job and supervised others in the job (3% did not respond to the question). The numbers of supervisors may be inflated because many of the individuals in management-related occupations such as First Line Supervisor and General Manager reported that they were supervisors of job incumbents in those positions. It is possible that they misunderstood the question, which requested that the rater select "the category that best describes your relationship to this job." Without specifically targeting supervisors, its is unlikely that the O*NET data collection will result in sufficient numbers of supervisors to allow meaningful comparisons of their ratings with incumbents' ratings.

Raters' Job Tenure

The amount of time a rater has spent in a job might also be expected to influence judgments made about the job. In collecting these data, we requested that job incumbents have at least six months of experience on the job. In fact, the data we collected in the initial O*NET data collection were provided by incumbents with amounts of job experience ranging from less than a month to more than ten years (median job experience was between six and ten years). However, individuals with extensive experience in a single job may lack experience in other jobs; experience in other jobs might provide a perspective for rating the requirements of the current job. The interesting comparison in this case may be between incumbents with very little job experience--for example, less than a year--and those with substantial experience--for example, six or more years. An illustration of such an analysis is presented in Table 12-2. In this analysis, the Skills level ratings for 14 Secretaries, Not Medical and Legal with less than a year experience

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were compared with those for 38 Secretaries with six or more years experience. The results strongly support the notion that experience has a relatively minor effect on these ratings; the mean ratings correlate .93 and only two of the 46 descriptors have statistically significant differences at the .05 level, about what would be expected by chance.

Influences on Job Ratings

The last group of factors that may contribute to rating variance contains those factors that influence not the job itself or the rater's perception of the job, but only the ratings produced. These factors are reading level, measurement scales, social desirability, group processes, and data collection media.

Reading Level

In creating the O*NET questionnaires, every effort was made to choose easily understood terms and write the descriptor definitions and anchors at no more than an eighth grade reading level. It is probable, however, that, as with many other job analysis questionnaires, some portions of the questionnaires may pose reading difficulties for individuals in some jobs, especially those that do not have even modest requirements for reading comprehension.

In the try-out of the draft questionnaires in the Fall of 1994 (Mumford & Sager, 1995), 202 job incumbents from a variety of jobs, ranging from typist to van driver to occupational analyst completed drafts of the O*NET questionnaires. After completing each questionnaire, these job incumbents were asked: (1) Did you find the instructions in this section of the questionnaire easy to understand? and (2) Did you find the questions easy to understand? On a scale of 1 to 5, where 5 is the most positive and 1 the most negative, average ratings ranged from 3.67 for the instructions and 3.82 for the questions for the Training, Education, Licensure, and Experience Questionnaire to 4.42 and 4.28 for the Occupational Values Questionnaire. Based on

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these results, the questionnaire instructions were revised and simplified. While these understandability ratings were quite high, we would expect ratings of the current questionnaires, which use the revised instructions, to be higher.

This does not mean that some of the job incumbents asked to participate in the initial O*NET data collection may not have been discouraged from participating or influenced in their responses by the reading difficulty of the questionnaires. In fact, some organizational representatives reported that they were refusing to continue their establishment's participation in the initial O*NET data collection because the questionnaires appeared to be too complex for their employees to understand. As far as we can determine, this was the organizational representative's opinion, and not a report of problems encountered after distribution.

Measurement Scales

Attributes of the questionnaires used to collect the occupational ratings can, of course, affect the quality of the data collected. For example, if performance of a job's duties involves a task that is not included on the occupation-specific task questionnaire or within one of the categories of activities included on the Generalized Work Activities (GWAs) questionnaire, no data about that task will be collected. In creating the questionnaires, the need for completeness was balanced with the equally important needs for parsimony and practicality in the time required for data collection. In Chapter 16, which describes analyses of the occupation-specific questionnaire data, for example, we found that some tasks that appeared on the occupation-specific questionnaires--certain law enforcement activities, for example--could not be readily classified into any activity from the GWAs questionnaire.

An additional feature of the questionnaires that directly impacts the quality of the data is the actual rating scales on which job incumbents or occupational analysts were asked to make their ratings. For example, on several of the questionnaires (i.e., Skills, Abilities, Knowledges, Work Styles, and GWAs), anchors were provided for the level rating scale. Raters were asked to make their ratings in relation to these examples or descriptions of low, medium, and high levels of the descriptor. Although these anchors were provided to aid raters in understanding the descriptor and placing their ratings on a common scale across occupations, it is possible that the particular examples given may have influenced the ratings in ways not intended. For example, one of the anchors for the Skills questionnaire descriptor, Reading Comprehension, is "Reading a memo from management describing new personnel policies." It is possible that an individual rater's associations or experience with this activity may adversely affect the accuracy of his or her ratings for this descriptor--for example, a recent bad experience with organizational personnel representatives. It is difficult, however, for us to conjure up examples that plausibly could have serious, systematic effects.

Social Desirability

Social psychologists have suggested that respondents may tend to respond to questions in ways that they think will place them in a positive light (e.g., Crowne & Marlowe, 1964). To reduce the impact of this source of variance, the O*NET data in the initial data collection were collected under conditions of anonymity; job incumbents could mail their questionnaires back or return them, sealed, to coordinators within their establishments. Even so, they may have experienced some anxiety about their ratings. Incumbents might be expected to be most likely to attempt to give socially desirable responses in such domains as Knowledges and Work Styles, but such effects could occur in almost any domain.

The effect of social desirability is difficult to assess, because it may tend to inflate ratings uniformly across incumbent raters. One would expect occupational analysts, who are presumably

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rating an occupation objectively, to not be influenced by this factor. However, occupational analysts' and job incumbents' ratings may differ for other reasons having to do with actual or "true" occupational factors, as well, making it difficult to determine what part of the difference might be due to the effect of social desirability pressures on job incumbents.

Group Processes

The initial O*NET data were collected from job incumbents and occupational analysts, who completed the domain questionnaires individually. Therefore, group processes, such as careless responding or being influenced by the opinions held by others in the group are likely to be more relevant in future data collections, which may include collection of data through focus groups. However, the tendency to respond carelessly or thoughtlessly may have had an impact in this data collection as well, particularly if incumbents perceived themselves as being a part of a larger group that was providing ratings. Promises of anonymity may have heightened such an effect. One analysis that might shed light on the extent to which incumbents responded thoughtfully in making ratings is an analysis of the not relevant responses, because not relevant responses might be seen as an easy response if one were interested in hurrying through the rating process. Comparisons of the reliabilities of the full-scale ratings with the reliabilities of the same ratings dichotomized into relevant/not relevant (for example, those reported in Chapter 16 for the occupation-specific task ratings) suggest that respondents are making the relevant/not relevant distinction reliably within occupation and descriptor. Additionally, we expected that rater set might lead to random responding. However, the reliabilities of the full-scale ratings tend to be high (for example, for the Skills level scale, they range from .75 to .92) across almost all questionnaires and scales, suggesting that raters are attending to the rating task and that random responding is not a problem.

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Data Collection Media

All the data analyzed in preparing this report were collected using paper-and-pencil versions of the O*NET questionnaires. The versions of the questionnaires used by incumbents to provide ratings and those used by analysts differ slightly--for example, analysts do not provide ratings for whether particular skills are required at job entry. However, the differences are minor. As Morgeson and Campion (1996) point out, using the same medium to collect occupational information across raters may have the paradoxical effect of artificially inflating the reliability of the ratings. Until comparable data are available from other media, it will be impossible to assess the amount of variance in occupational ratings that is due to the paper-and-pencil form of the measures. Electronic versions of the O*NET questionnaires have been prepared and will provide some data for such a comparison. The electronic versions are very similar in appearance and identical in wording and structure to the paper-and-pencil versions, however. A more convincing, but much less practical, demonstration might be comparison of the questionnaire results with information about the same occupation and worker attributes based on job observations, critical incidents analysis, or focus groups. In such a comparison, however, we would introduce other complicating factors, such as whether the definitions of the descriptors were adequately and comparably conveyed.

Discussion and Conclusions

The O*NET occupational information system is undoubtedly one of the largest occupational analysis efforts ever undertaken, and, as such, could afford a valuable opportunity to investigate data accuracy issues that are of concern in many job analyses. Additionally, its reliance on empirical data heighten concerns about the accuracy of the O*NET occupation descriptions based on those data.

The analysis results presented elsewhere in this volume support the usefulness of the O*NET data. Although the O*NET data do not lend themselves to analyses of most of the potential sources of rating variance, the evidence is strong that the ratings are accurately describing the targeted jobs--for example, agreement among raters within job is high, even across incumbents and analysts. Additionally, the results for particular occupations are consistent with our prior knowledge of the jobs.

Because the O*NET data collection was designed to control many of the potential sources of rating variance through random sampling, and was not designed to measure the effects of these factors, it may not be especially well-suited for use in investigations of potential sources of rating variance. However, it is our hope that tentative results based on the O*NET data may provide some guidance for prioritizing the factors to be targeted in future studies.

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Figure 12-1
Potential Sources of Variance in O*NET Ratings

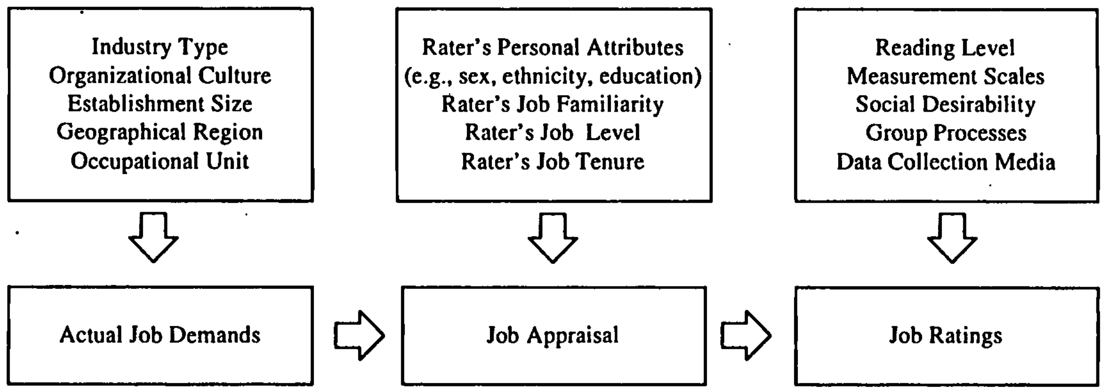

Figure 12-2

Numbers of Participating Establishments by Standard Industrial Classification Division

Standard Industrial Classification Division	Number of Establishments
Agriculture, Forestry and Fishing	3
Construction	2
Manufacturing	22
Transportation, Communication, Electric, Gas and Sanitary Services	5
Wholesale Trade	5
Retail Trade	15
Finance, Insurance and Real Estate	17
Services	98
Public Administration	10

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Figure 12-3
Estimated Reliabilities of Incumbents' Ratings

Questionnaire	Scale	r_k	r_{30}
Skills	Level	.79	.93
	Importance	.79	.93
	Job Entry Requirement	.60	.83
Knowledges	Level	.86	.95
	Importance	.85	.94
Training, Education, Licensure, & Experience	Instructional Program	.78	.92
	Educational Subject Area	.74	.90
	Licensure	.85	.95
	Experience	.79	.93
Generalized Work Activities	Level	.80	.92
	Importance	.78	.92
	Frequency	.74	.90
Work Context		.87	.95
Organizational Context	Across Occupations	.64	.84
	Across Organizations	.45	.79
Abilities	Level	.82	.93
	Importance	.82	.93
Occupational Values		.60	.82
Work Styles	Level	.70	.88
	Importance	.67	.86

Note: r_k is the observed interrater agreement coefficient; r_{30} is the estimated interrater agreement coefficient for 30 raters.

Figure 12-4
Estimated Reliabilities of Analysts' Ratings

Questionnaire	Scale	Average $\underline{r}_5$
Abilities	Level	.87
	Importance	.85
Generalized Work Activities	Level	.88
	Importance	.85
	Frequency	.81
Knowledges	Level	.83
	Importance	.83
Skills	Level	.87
	Importance	.84
Work Context		.82

Note: $\underline{r}_5$ is the average estimated reliability of analyst ratings for five raters.

Table 12-1

Comparison of Level Scale Ratings for Secretaries, Not Medical and Legal in Establishments in the Manufacturing and Public Administration Sectors: Basic and Cross-Functional Skills

	Manufacturing (n = 12)		Public Administration (n = 12)			
Descriptor	M	SD	M	SD	t	F
1. Reading Comprehension	4.58	1.16	4.83	1.27	-0.50	1.20
2. Active Listening	3.67	1.72	4.42	1.31	-1.20	1.72
3. Writing	3.75	1.06	4.42	1.24	-1.42	1.37
4. Speaking	2.67	2.23	3.92	1.40	-1.53	2.54
5. Mathematics	2.08	1.88	2.17	1.34	-0.13	1.97
6. Science	0.08	0.29	0.17	0.58	-0.45	4.00*
7. Critical Thinking	2.50	1.88	2.00	1.91	0.65	1.03
8. Active Learning	1.92	1.98	2.75	1.14	-1.27	3.02
9. Learning Strategies	2.58	1.88	2.17	1.53	0.60	1.51
10. Monitoring	3.00	0.95	2.25	1.82	1.27	3.67*
11. Social Perceptiveness	3.33	1.44	2.17	1.59	1.89	1.22
12. Coordination	2.42	2.27	3.00	1.76	-0.70	1.66
13. Persuasion	2.75	1.76	1.58	1.56	1.71	1.27
14. Negotiation	1.75	1.86	1.83	1.70	-0.11	1.20
15. Instructing	3.33	1.78	3.67	0.89	-0.58	4.00*
16. Service Orientation	3.33	1.78	2.92	1.44	0.52	1.53
17. Problem Identification	3.67	1.50	2.58	1.93	1.54	1.66
18. Information Gathering	2.92	0.90	3.42	1.93	-0.81	4.60*
19. Information Organization	2.83	2.12	2.42	2.07	0.49	1.05
20. Synthesis/ Reorganization	3.42	1.16	2.83	1.53	1.05	1.74
21. Idea Generation	1.50	1.73	1.82	1.66	-0.45	1.09
22. Idea Evaluation	2.50	1.51	1.83	1.47	1.10	1.06
23. Implementation Planning	1.83	1.90	1.75	1.42	0.12	1.79
24. Solution Appraisal	2.75	1.36	1.75	1.54	1.68	0.28
25. Operations Analysis	1.42	1.24	1.58	1.83	-0.26	2.18
26. Technology Design	0.50	1.17	0.00	0.00	1.48	--
27. Equipment Selection	2.83	2.08	2.42	1.56	0.55	1.78
28. Installation	0.33	0.89	0.17	0.58	0.55	2.35
29. Programming	0.08	0.29	0.00	0.00	1.00	--
30. Testing	0.00	0.00	0.00	0.00	--	--
31. Operation Monitoring	0.00	0.00	0.33	0.78	-1.48	--
32. Operation and Control	2.00	0.85	1.50	1.45	1.03	2.91
33. Product Inspection	2.42	1.38	2.00	1.81	0.63	1.72
34. Equipment Maintenance	1.00	1.65	0.92	1.31	0.14	1.59
35. Troubleshooting	0.67	0.98	1.50	1.68	-1.48	2.94
36. Repairing	0.75	1.06	0.75	1.22	0.00	1.32
37. Visioning	2.08	1.56	1.33	1.50	1.20	1.08
38. Systems Perception	1.00	1.13	1.50	1.73	-0.84	2.34

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Table 12-1 (continued)
Comparison of Level Scale Ratings for Secretaries, Not Medical and Legal in Establishments in the Manufacturing and Public Administration Sectors: Basic and Cross-Functional Skills

Descriptor	Manufacturing (n = 12)		Public Administration (n = 12)			
	M	SD	M	SD	t	F
39. Identification of Downstream Consequences	1.50	1.38	1.00	1.81	0.76	1.72
40. Identification of Key Causes	1.42	1.98	2.00	2.04	-0.71	1.06
41. Judgment and Decision Making	1.83	2.17	2.08	2.07	-0.29	1.10
42. Systems Evaluation	1.17	1.85	0.55	1.51	0.89	1.50
43. Time Management	3.33	1.37	3.42	1.83	-0.13	1.78
44. Management of Financial Resources	2.08	2.02	1.92	2.15	0.20	1.13
45. Management of Material Resources	2.08	1.73	1.67	1.72	0.59	1.01
46. Management of Personnel Resources	1.75	1.60	1.67	1.72	0.12	1.16

Note. Statistics are based on Skills questionnaire responses from 12 incumbents from four establishments in the Manufacturing sector and 12 incumbents from five establishments in the Public Administration sector.
The t statistic tests for differences in group means.
The F statistic tests for differences in group standard deviations.
*p < .05

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Table 12-2

Comparison of Level Scale Ratings for Secretaries, Not Medical and Legal With Less Than a Year and Six or More Years Experience: Basic and Cross-Functional Skills

Descriptor	Less Than a Year (n = 14) M	SD	Six or More Years (n = 38) M	SD	t	F
1. Reading Comprehension	4.71	1.77	4.66	1.07	0.11	2.74*
2. Active Listening	4.64	1.86	4.50	0.98	0.27	3.60*
3. Writing	4.71	0.99	4.43	1.17	0.86	1.40
4. Speaking	4.29	1.68	3.55	1.62	1.41	1.08
5. Mathematics	3.43	2.10	2.34	1.77	1.72	1.41
6. Science	1.29	2.05	0.32	1.07	1.68	3.67*
7. Critical Thinking	3.50	1.99	3.39	1.70	0.18	1.37
8. Active Learning	3.43	2.28	3.29	1.75	0.21	1.70
9. Learning Strategies	3.43	1.45	3.18	1.67	0.52	1.33
10. Monitoring	2.86	1.75	3.29	1.72	-0.79	1.04
11. Social Perceptiveness	3.93	1.27	3.22	1.55	1.68	1.49
12. Coordination	3.07	1.90	3.18	1.74	-0.19	1.19
13. Persuasion	3.00	1.66	3.08	1.51	-0.16	1.21
14. Negotiation	2.43	1.65	2.16	1.87	0.51	1.28
15. Instructing	3.92	2.18	3.55	1.50	0.57	2.11
16. Service Orientation	3.93	1.90	3.45	1.86	0.82	1.04
17. Problem Identification	3.36	2.13	3.55	1.70	-0.31	1.57
18. Information Gathering	4.14	1.41	3.66	1.42	1.10	1.01
19. Information Organization	3.57	2.17	3.37	1.75	0.31	1.54
20. Synthesis/ Reorganization	3.36	1.45	3.16	1.10	0.47	1.74
21. Idea Generation	2.43	1.83	2.22	1.70	0.38	1.16
22. Idea Evaluation	2.64	1.74	2.66	1.36	-0.03	1.64
23. Implementation Planning	2.43	1.79	2.47	1.69	-0.08	1.12
24. Solution Appraisal	2.29	1.98	2.79	1.28	-0.89	2.39*
25. Operations Analysis	1.14	1.51	2.21	1.83	-2.13*	1.47
26. Technology Design	1.79	2.29	0.55	1.29	1.90	3.15*
27. Equipment Selection	3.43	1.91	2.76	1.92	1.11	1.01
28. Installation	0.79	1.63	0.26	0.79	1.15	4.26*
29. Programming	0.64	1.65	0.47	1.08	0.36	2.33*
30. Testing	0.64	1.65	0.11	0.51	1.20	10.47*
31. Operation Monitoring	0.43	0.76	0.45	0.89	-0.08	1.37
32. Operation and Control	1.93	1.38	1.84	1.22	0.21	1.28
33. Product Inspection	2.07	2.20	2.39	1.33	-0.52	2.74*
34. Equipment Maintenance	0.71	1.07	0.71	1.25	0.01	1.36
35. Troubleshooting	1.71	1.68	1.29	1.49	0.83	1.27
36. Repairing	0.50	0.76	0.66	1.12	-0.56	2.17
37. Visioning	1.14	1.23	2.03	1.53	-2.14*	1.55
38. Systems Perception	1.64	1.50	1.50	1.61	0.30	1.15

Table 12-2 (continued)
Comparison of Level Scale Ratings for Secretaries, Not Medical and Legal With Less Than a Year and Six or More Years Experience: Basic and Cross-Functional Skills

Descriptor	Less Than a Year (n = 14) M	SD	Six or More Years (n = 38) M	SD	t	F
39. Identification of Downstream Consequences	1.86	1.70	1.29	1.54	1.09	1.22
40. Identification of Key Causes	2.50	2.03	2.26	2.05	0.37	1.02
41. Judgment and Decision Making	2.86	1.61	2.29	1.90	1.07	1.39
42. Systems Evaluation	1.14	1.23	0.84	1.54	0.74	1.57
43. Time Management	3.64	1.28	4.03	1.65	-0.88	1.66
44. Management of Financial Resources	2.14	2.38	1.53	1.98	0.86	1.44
45. Management of Material Resources	2.71	1.94	2.05	1.71	1.13	1.29
46. Management of Personnel Resources	2.21	2.15	1.76	1.67	0.71	1.66

Note. Statistics are based on Skills questionnaire responses from 14 incumbents from 11 establishments with less than a year of experience on the job and 38 incumbents from 23 establishments with six or more years of experience.
The t statistic tests for differences in group means.
The F statistic tests for differences in group standard deviations.
*$p < .05$

Chapter 13

Cross-Domain Analysis Results

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The content model underlying the O*NET occupational information system specifies a number of domains that might be used in describing jobs and occupations. The analyses for descriptors within each of these O*NET content domains, described to this point, show that data collected using the O*NET descriptors are generally very reliable. These analyses also provide a great deal of information concerning the structure of each domain, but most of these analyses are necessarily internal. The within-domain analyses do, however, provide preliminary evidence that the O*NET descriptors discriminate between occupations in a sensible manner.

The present chapter describes further analyses to assess the construct validity of the measures. These analyses involved examining relationships between descriptors from the various content domains, across occupations, and assessing the structure of these cross-domain

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relationships. Much of the data concerning descriptors from different content domains was actually collected from different incumbents in the same occupations, and this provides for an even stronger test of cross-domain relationships. These cross-domain analyses can be viewed as preliminary evidence of external validity. They also provide information concerning the overlap between the various content domains.

Sample

There is a great deal of overlap between the samples used in the within-domain analyses (described in previous chapters) and the sample used in the present cross-domain analyses, but also a few differences. The cross-domain analyses were conducted after the within-domain analyses, and additional data were collected while the within-domain analyses were being conducted. These additional data were included in the cross-domain analyses, but not the within-domain analyses. Thus, the raw data set for these cross-domain analyses (before screening based on missing data and small occupations) contained 2487 respondents, which is 301 more respondents than were available for the within-domain analyses. However, a stricter screen was also applied to these data: occupations were only included in the cross-domain analyses if at least four incumbents (i.e., respondents) were available for each of the nine questionnaires (i.e., domains). Recall that occupations were included in the within domain analyses if at least four incumbents were available for a particular questionnaire. The additional 301 incumbents were included in these cross-domain analyses (in part) to make up for this stricter data screen and provide as many occupations as possible for these analyses.

Only respondents who had completed the paper-and-pencil versions of the questionnaires were included in the present analyses. Questionnaires were excluded if more than ten percent of the questions were not answered. Response rates for each questionnaire were examined separately and individual questionnaires, not entire observations, were dropped. Figure 13-1 shows the 29 occupations included in the cross-domain analyses, the number of incumbents from each occupation represented in this data set, and the number of establishments from which these incumbents were drawn. Although we use the word "incumbent" to describe the respondents in this sample, 7% were actually the supervisors of job incumbents and 20% both supervised and performed the target occupation.

Most respondents completed more than one of the nine questionnaires and a few completed as many as five. Thus, a certain percentage of the data available for comparing any two content model domains are based on responses from the same incumbents. Table 13-1 shows the percentage of data for any given comparison (i.e., pair of domains) that is based on responses from the same incumbents.

Approach

The initial plan for the cross-domain analyses focused on an expanded set of factor analyses, incorporating descriptors from several domains into a single analysis. However, based on discussions with experts from the various content domains, our approach was modified somewhat. The number of occupations available for the cross-domain analyses is necessarily smaller than that for the within-domain analyses, since only occupations for which there were data for all domains could be included. The number of descriptors is also, by definition, larger when more than one domain is considered, leading to serious sample size problems for these analyses. In order to minimize these sample size problems and generate more defensible results, we developed composites to summarize information concerning the descriptors in each domain, and relationships between these composites were examined across domains. To generate at least some preliminary cross-domain information concerning the individual descriptors, we also

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conducted a second set of analyses focused on examining individual descriptors from each of several domains in the context of the generalized work activities (GWAs). Specifically, the structure of the relationships between descriptors from a particular domain and the GWAs were examined. Finally, several a priori hypotheses concerning expected relationships between individual descriptors across domains were generated and tested. Each of these analyses, along with the results obtained, are described in more detail in the sections that follow.

Relationships Between Factor-Based Composites

The entire O*NET content model, across all domains, contains a total of over 300 descriptors, and the sample of occupations available for cross-domain analyses was only 29 (with an average of about 24 incumbents per occupation within each domain). In order to minimize the number of relationships to be assessed, we identified a smaller set of composites to represent the descriptors in each domain. These composites were then intercorrelated across occupations and factor analyzed to assess the overall structure of the O*NET across all domains.

Identification of Composites

The composites were identified based on the solutions selected in the within-domain principal components analyses, described in the relevant chapter for each domain, and then modified based on rational considerations. First, using the principal components solution chosen for each domain (presented in the relevant content domain chapters), one preliminary factor-based composite was developed for each principal component extracted. Items were assigned to a composite if they loaded at least .6 on the relevant factor. Items with substantial loadings on other factors (i.e., within .2 of the primary loading) were not included. Since the principal component analyses were based on limited samples of occupations (between 30 and 37 occupations for each content domain), these factor-based composites were then refined based on rational considerations.

For each domain, this set of preliminary composites was then reviewed by the individuals primarily responsible for the relevant content domain, and changes were made based on the content model itself, results of past research, and other rational considerations. In general, these modifications were minor, and involved assigning additional descriptors to composites (e.g., those that loaded less than .60 on the relevant composite). For the abilities domain these revisions were somewhat more extensive. The O*NET principal components analysis for this domain yielded a solution that was somewhat difficult to interpret, and past research in the abilities domain has typically identified a wide variety of fairly distinct abilities. Therefore, a total of 10 composites was identified for the abilities domain, based in part on past research and in part on the principal components solution for the O*NET data. Figure 13-2 shows the composition of each of the final factor-based composites. For two domains--training, education, licensure, and experience and organizational context--no composites were created, because very little theory is available to interpret the correlations between higher-order factors in these two domains and those from the other domains. Composite scores were formed by calculating mean scores across the descriptors included in each of the composites. Level ratings were used to form scores for abilities, skills, knowledges, work styles, and generalized work activities. Occupational values scores used an importance scale, and work context ratings were varied.

Composite Intercorrelations

Table 13-2 shows the intercorrelations of scores on these factor-based composites across the 29 occupations included in the cross-domain analyses. Reliability estimates for the composites are presented on the diagonal of this matrix. These were calculated by computing the composite scores for each incumbent providing ratings, and then assessing the interrater reliability of these composite ratings across occupations. These reliabilities limit the extent to which the composites can correlate, and are provided as an aid in interpreting the obtained correlational results. Note that for some of the composites (e.g., Social Comfort, Structure, and Detail Orientation) the interrater reliability is quite low.

Here are some highlights of the composite correlations across domains. Two of the GWA composites--Working with Information and Working with and Directing Others--have generally similar patterns of correlations with the skill, ability, and work style composites. For example, they both correlate highly with Cognitive Abilities, Cognitive Skills, and Organizational Skills, but in all three cases the correlation is slightly higher for Working with Information. These two GWA composites also correlate with Speech Ability, but in this case the correlation for Working with and Directing Others is slightly higher. Both of these GWAs also correlate at about the same level with the work style composite labeled Surgency/Achievement Orientation. These similarities are not too surprising in light of the fact that these two GWA composites correlate .72 with each other. Perhaps this reflects the fact that occupations that involve working with people very often also involve working with information (e.g., managerial occupations).

In view of the high correlation between these two GWAs, several differences in the obtained patterns of correlations are notable. For example, Technical Skills and Math Ability correlate significantly with Working with Information, but not with Working with and Directing Others. In contrast, Working with Others correlates significantly with the work style composite People Orientation while Working with Information does not. The differences and similarities in the patterns of correlations across occupations for these two GWA composites are conceptually sound and lend a degree of construct validity to these GWA descriptors as well as the skill, ability and work style descriptors with which they correlate.

The pattern of correlations for the third GWA composite--Manual and Physical Activities--is very different, and lends further support to the construct validity of the descriptors. For example, this composite correlates positively with Physical Ability, Psychomotor Ability, Dexterity, and Vision and Hearing Ability, while the other two GWAs have nonsignificant and slightly negative correlations with these four ability composites across occupations. Manual and Physical Activities correlates significantly with only one of the three skill composites: Technical Skills. Again, the pattern of correlations for this GWA composite with the skill and ability composites are intuitively appealing and support the construct validity of the descriptors.

There is a fair degree of conceptual overlap between the descriptors in the knowledges, skills, and abilities domains, so obtaining the expected correlations between these descriptors across occupations was an important source of construct validity evidence. As expected, Cognitive Ability correlated highly with both Cognitive and Organizational Skills, and also correlated significantly with Technical Skills. Spatial Ability correlated positively with all three skill composites. Interestingly, Memory ability correlated significantly with the Cognitive Skills composite but not with the other two skill composites. Abilities such as Physical and Psychomotor did not correlate significantly with any of the three skill composites.

The knowledge composites labeled Science and Technology and Medicine correlate significantly with Technical Skill requirements and to a somewhat lesser extent with Organizational Skills. This is not surprising because occupations in science and technology and in medicine often require technical skills. Both the Business Administration and the Art and Humanities knowledge composites correlated with Cognitive and Organizational Skills, but not

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with Technical Skills. Clerical and Food Production knowledge, on the other hand, were not significantly correlated with any of the skill composites, perhaps because they are rather specific, lower-level knowledges. Finally, Law Enforcement knowledge requirements correlated positively with Cognitive Skill requirements, perhaps reflecting the cognitive demands involved in law enforcement occupations.

Relationships between ability and knowledge requirements are generally along the lines one would expect as well, and some are rather interesting. For example, occupations that require Clerical knowledge tend not to require Physical Abilities ($r = -.56$). This brings to mind someone who spends his or her day in a chair pushing paper. Similarly, the correlation between Business Administration knowledge and Physical Ability requirements, while not significant, is also negative. Not surprisingly, Law Enforcement knowledge requirements are correlated with Psychomotor, Vision and Hearing, Spatial, and Attention Ability requirements, probably in part due to the fact that there are two law enforcement occupations in the sample. Cognitive Ability requirements are most strongly related to the Arts and Humanities knowledge composite, but also related to several other knowledge composites, including Law Enforcement, Medicine, and Business Administration. Another very understandable finding is that Speech Ability is most strongly related to the Business Administration and Arts and Humanities composites. The abilities most strongly related to medical knowledge requirements are Spatial and Attention. The strong correlation between Arts and Humanities knowledges and Spatial Abilities is somewhat surprising, but Spatial Ability seems to correlate with a broader array of other descriptors than most of the other ability composites. Math Ability requirements are related to both Science and Technology and Business Administration knowledge requirements. Finally, Food Production knowledges correlate only with Physical Abilities, perhaps a reflection of the nature of the occupations in our sample. Similarly, Dexterity is only correlated with the knowledge composite called Medicine, again probably a function of the particular occupations in our sample.

The correlations between the Surgency/Achievement Orientation work styles composite and both Cognitive and Organizational Skills are very strong, perhaps suggesting an achievement related constellation of job requirements that covary across occupations. Technical Skill requirements are negatively related to the work styles composite labeled People Orientation. Perhaps occupations that require technical skills also tend to involve working alone, or perhaps interpersonal interactions are not a critical aspect of these occupations.

Not surprisingly, there is a strong relationship between the GWA composite labeled Manual and Physical Activities and a work context that involves Environmental Factors. Similarly, Working with Information is negatively related to the work context composite Physical Activity, while Manual and Physical Activities are positively related to this latter aspect of work context. Work context involving Business/Office is negatively related to Manual and Physical Activities, and positively related to Working with and Directing Others. Finally, it is not too surprising that Managerial Relations is most strongly related to Working with and Directing Others.

As might be expected, occupational values related to Individual Advancement and Career Accomplishment are correlated with the Surgency/Achievement Orientation work styles composite. These two value composites are also fairly strongly related to the GWAs involving Working with Information and Working with and Directing Others (but not Manual and Physical Activities) and also to Cognitive and Organizational Skills and work context involving Managerial Relations. The occupational values involving Structure are positively related to working in a Business/Office context. Finally, it is somewhat surprising that the occupational values related to Stability are quite strongly related to knowledge requirements in the Arts and Humanities and Law Enforcement areas.

It should be kept in mind that these cross-domain comparisons are to some extent dependent on the sample of occupations included in the present analyses. While the sample does include a range of occupations, there are only 29 occupations available, and it is unlikely that such a small sample is totally representative of occupations in general. For example, this sample includes nurses and other medical professionals, but not medical doctors and some of the other more highly educated medical professionals. It is likely that if a broader sample of medical professionals were available, some of the correlations involving medical knowledge and other descriptors particularly relevant to the medical profession would be different. In addition, a sample of 29 does not provide a great deal of statistical power. It is likely that some of the correlations that were not significantly different from zero in the present research would be significant if a larger sample were available, since correlations of less than about .37 are not significant at the $p < .05$ level in a sample this small.

Although most of the data used in each comparison (i.e., the individual correlations) were collected from different incumbents, a certain percentage of these data were collected from the same incumbents. As discussed previously, Table 13-1 shows the extent to which this occurred. For several pairs of domains, virtually all of the data came from the same sample of incumbents, and this is primarily because the number of questionnaires and the length of the questionnaires limited how many different combinations of domains could be presented to individual incumbents. There is some reason to expect that data collected from the same incumbents will result in higher correlations, either because of real differences in jobs within an occupation or because of response bias. The sample available in the present research was not large enough to provide a good test of this conjecture. Thus, correlations between GWAs and occupational values should be interpreted with caution, especially as they compare with correlations between other pairs of domains.

Factor Analysis of Composites

In order to provide a summary of the structure of these cross-domain relationships, the intercorrelations of the factor-based composites were factor analyzed using principal components analysis with a varimax rotation. A four factor solution was selected based on the eigenvalues and the meaningfulness of the resulting solutions. The factor pattern matrix for this solution is presented in Table 13-3.

The first factor has strongest loadings for composites that involve working with or managing others and achievement or accomplishment. The GWA factor that involves Working with Information loads on this factor, but it also has a fairly high loading on the third factor. Again, the high correlation between this GWA and Working with and Directing Others appears to have affected the relationships obtained. Interestingly, higher levels of Cognitive and Organizational Skills are also strongly related to this factor.

The second factor is primarily defined by Manual and Physical Activities, and Vision/Hearing, Physical, and Dexterity Abilities, with Law Enforcement knowledge and Environmental Factors from work context. The third factor might be labeled "General Office" and has high loadings for Clerical, Speech, and Memory Abilities, as well as Attention and Cognitive Abilities. However, these latter two abilities are split across factors two and one, respectively. In terms of work context, this factor has a strong positive loading for Business/Office and Structured/Machine Operations, and a substantial negative loading for Physical Activity.

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The fourth factor is somewhat difficult to interpret, because it is defined in part by positive loadings and in part by negative loadings. It might be labeled "Technical versus Interpersonal." Technical Skills and Science and Technology Knowledges have strong positive loadings on this factor. On the other hand, the work style labeled Social Orientation (Work Style Descriptor #8) and work context involving Dealing with the Public (Work Context Descriptor #6f) have substantial negative loadings. The GWA composite Working with and Directing Others also has a fairly strong negative secondary loading on this fourth factor.

In order to compare the structure of the level and importance ratings, which are available for each descriptor in many of the domains, this factor analysis was conducted again using the importance ratings where appropriate. For five of the seven domains included in this factor analysis both level and importance ratings are available. For the remaining two domains--work context and occupational values--only a single rating was collected for each descriptor. Thus, this second principal component analysis included the same data as the initial analyses for these latter two domains, and factor-based composites computed using the importance data for the remaining five domains. The results were virtually identical to those obtained using the level ratings, which is not too surprising given the high correlations obtained between the level and importance ratings in all of the within domain analyses. The same four factors emerged, and the loadings were very similar to those obtained for the level ratings.

Analyses of Cross-Domain Structure

Analyses using the factor-based composites are necessarily somewhat limited. For most domains, a subset of the descriptors could not be included on any composite. In addition, the composites provide a fairly broad summary of each content domain and lack the detailed information available for the specific descriptors. Although the sample sizes were limited for the

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present analyses, we made an initial attempt to examine the cross-domain relationships in more detail. These analyses focused on relationships between the generalized work activities and each of several other content domains: abilities, work styles, occupational values, skills, knowledges, and work context.

The first set of analyses described here were aimed at understanding the relationships between generalized work activities (GWAs) and abilities. First, we computed the correlations between each of the individual ability descriptors and each of the individual GWA descriptors, resulting in a correlation matrix where the columns represented abilities and the rows represented GWAs. This matrix of correlations was then treated as the data of interest, and we intercorrelated the columns. That is, the pattern of correlations of each ability descriptor across all of the GWAs was intercorrelated with the pattern of GWA correlations for each of the other ability descriptors. This resulted in a 52 by 52 intercorrelation matrix. The sample size for these correlations is 42, because they are based on correlations with each of the 42 GWAs. This intercorrelation matrix was then factor analyzed, in order to obtain a summary of the relationships between the ability descriptors, as they relate to one another through the generalized work activities. This was done using principal components analysis with a varimax rotation, and a three factor solution was selected based on the eigenvalues and the meaningfulness of the resulting solutions.

Table 13-4 shows the factor pattern matrix for this solution. Essentially, this factor pattern matrix can be viewed as reflecting the structure of the relationships between the ability descriptors, as reflected through the GWA descriptors.

Because the input for this factor analysis was the set of correlations between abilities and GWAs, abilities loading highly on the same factor are expected to have similar patterns of correlations with the 42 GWAs. In order to confirm that this was the case, we plotted the correlations between four abilities from the same factor (Factor 1) and a representative subset of the GWAs. Nine of the 42 GWAs were selected for this purpose. One GWA was selected from each of the nine second-order factors in the GWA content model, with an attempt to select the most reliable GWAs and also to ensure that the resulting set of GWAs adequately represented the three principal components found in the within-domain analysis. Figure 13-3 plots the nine correlations for each of the four abilities. As expected, the patterns of correlations between these four abilities and the nine selected GWAs are virtually identical.

We then chose one representative ability from each of the three factors, that is, an ability with a high loading on the relevant factor and relatively small loadings on all the other factors, and plotted the correlations between each of these abilities and the same nine GWAs. The results are shown in Figure 13-4. These patterns of correlations are useful in interpreting the factor solution shown in Table 13-4, because the loadings of the abilities on each of the three factors are based on their patterns of correlations with the GWAs.

Table 13-4 shows that ability descriptors with large loadings on the first factor include Far Vision (Ability Descriptor #42) and Spatial Orientation (Ability Descriptor #18). Figure 13-4 shows that the first factor is made up of abilities that have relatively high correlations with Operating Vehicles (GWA Descriptor #20) and slightly negative correlations with Staffing Organizational Units (GWA Descriptor #41) and Analyzing Data (GWA Descriptor #9). It is sensible to expect occupations that involve operating vehicles to require far vision and spatial orientation, so these results are consistent with rational expectations. It is interesting to note that many of the physical abilities load positively on this first factor and negatively on the second factor. The second factor appears to be made up of high-level cognitive abilities, such as Problem Sensitivity (Ability Descriptor #7), Inductive Reasoning (Ability Descriptor #9), and Originality

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(Ability Descriptor #6), based on the loadings shown on Table 13-4. Figure 13-4 shows that variables from this factor correlate positively with several of the selected GWAs including Communicating, External (GWA Descriptor #28), Identifying Objects (GWA Descriptor #2), Getting Information (GWA Descriptor #1), and Developing Objectives (GWA Descriptor #13). This factor, then, appears to reflect the fact that many cognitive ability requirements tend to be correlated with certain managerial and information intensive GWAs. Table 13-4 shows that the third factor has high loadings for Perceptual Speed (Ability Descriptor #17) and Near Vision (Ability Descriptor #41), implying activities involving close, exact work. GWA correlations on Figure 13-4 show that these abilities are, in fact, those that correlate most highly with Repairing, Mechanical (GWA Descriptor #23).

Analyses were conducted for five other domains, parallel to the analyses just described for abilities. For each of these domains, occupation-level correlations between the individual descriptors for that domain and the individual GWAs were computed, the columns of the resulting correlation matrices were intercorrelated and factor analyzed, and correlations between representative descriptors from the resulting factors and each of the nine selected GWAs were plotted.

Table 13-5 shows the three factor solution for work styles, Figures 13-5 and 13-6 plot the correlations with the nine GWA descriptors for work styles within and across factors respectively. These results are not as clear as those for abilities, but there are some interesting relationships. The first factor has highest loadings for some of the more cognitive and achievement oriented work styles such as Analytical Thinking (Work Style Descriptor #17), Persistence (Work Style Descriptor #2), and Achievement/Effort (Work Style Descriptor #1). GWAs with which these work styles correlate most highly include Developing Objectives (GWA

Descriptor #13) and Identifying Objects (GWA Descriptor #2). The second factor is defined primarily by work styles related to interpersonal interactions, such as Cooperation (Work Style Descriptor #6) and Concern for Others (Work Style Descriptor #7), and the correlations between these work styles and GWAs appear generally low, with a moderate negative correlation for Operating Vehicles (GWA Descriptor #20). Perhaps this suggests that most work activities, with the exception of driving vehicles, require at least some interpersonal interaction. The third factor is defined by a high positive loading for Attention to Detail (Work Style Descriptor #13) and a high negative loading for Energy (Work Style Descriptor #4). This could suggest that work activities requiring a work style with particularly high attention to detail are generally sedentary. Again, correlations between work styles from this factor and GWAs are generally low, and the highest correlation shown on Figure 13-6 for the Attention to Detail work style (Work Style Descriptor #13) is with Identifying Objects (GWA Descriptor #2).

The four factor solution for occupational values is shown on Table 13-6, and the relevant GWA correlations are shown in Figures 13-7 and 13-8. The first factor appears to be defined by achievement-related values, such as Responsibility (Occupational Value Descriptor #13), Achievement (Occupational Value Descriptor #2), and Ability Utilization (Occupational Value Descriptor #1). Figure 13-8 shows that these achievement related values tend to be negatively related to Operating Vehicles (GWA Descriptor #20) and Repairing, Mechanical (GWA Descriptor #23) and positively related to Communicating, External (GWA Descriptor #28), Developing Objectives (GWA Descriptor #13), and Getting Information (GWA Descriptor #1). The second factor is defined by Company Policies (Occupational Values Descriptor #6) and related values, and these values have very small positive relationships with all nine representative GWAs, with the largest one for Developing Objectives (GWA Descriptor #13). Perhaps this

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factor reflects systematic differences in the types of organizations within which certain occupations are found, but it is difficult to draw any strong conclusions based on the present analyses. The third factor has highest loadings for Security (Occupational Value Descriptor #14) and Social Service (Occupational Value Descriptor #15), and these values correlate most highly with Operating Vehicles (GWA Descriptor #20). The fourth factor is defined by Moral Values (Occupational Value #11) and Coworkers (Occupational Value Descriptor #8), and the values from this factor have small negative loadings with all nine GWAs shown on Figure 13-8. One GWA not included in this figure--Handling Objects (GWA Descriptor #17)--correlated somewhat more strongly with Moral Values (Occupational Values Descriptor #11) (r = .48). These latter two factors are difficult to explain. This could be due to the fact that the occupational values descriptors are generally somewhat less reliable than those in most of the other domains, or perhaps because there is less theory available to explain relationships between work activities and workers' occupational values. Also, the majority of the data for these two domains was collected from the same incumbents, and this could have affected the obtained results.

Table 13-7 and Figures 13-9 and 13-10 show the results for skills. The first factor is defined by higher-level cognitive, managerial and interpersonal skills. These skills tend to correlate quite highly with a variety of GWAs including Developing Objectives (GWA Descriptor #13) and Directing Subordinates (GWA Descriptor #37). The second factor is made up of more technical skills including Installation (Skill Descriptor #28), Troubleshooting (Skill Descriptor #35), and Repairing (Skill Descriptor #36), and these skills have very high correlations with Repairing, Mechanical (GWA Descriptor #23) and somewhat lower correlations with Operating Vehicles (GWA Descriptor #20). The final factor is defined almost exclusively by Programming (Skill Descriptor #29) skill requirements. Programming has its highest correlations on Figure 13-10 with Getting Information (GWA Descriptor #1) and Analyzing Data (GWA Descriptor #9). Examination of GWAs not included on this table showed that Programming (Skill Descriptor #29) has substantial correlations with the GWAs labeled Thinking Creatively (GWA Descriptor #11) (r = .63), Interacting with Computers (GWA Descriptor #19) (r = .63) and Implementing Ideas (GWA Descriptor #22) (r = .57). Apparently occupations that involve programming activities have a rather distinct pattern of skill requirements, although this could also be at least partly an artifact of the limited sample of occupations available for the present analyses.

Table 13-8 and Figures 13-11 and 13-12 show the results for knowledges. The first factor is defined by knowledges related to business, professional and managerial activities. Figure 13-12 shows that these knowledges correlate with several GWAs including Getting Information (GWA Descriptor #1), Identifying Objects (GWA Descriptor #2), and Analyzing Data (GWA Descriptor #9). Apparently these are knowledges that are important in traditional business settings. The second factor is defined by a rather odd assortment of knowledges including Foreign Language (Knowledge Descriptor #25) and Public Safety and Security (Knowledge Descriptor #29). These knowledges are not very strongly correlated with any of the GWAs, and it is difficult to identify what they have in common. The third factor seems to involve knowledges that are likely to be related to manual and physical activities, such as Building and Construction (Knowledge Descriptor #12) and Mechanical (Knowledge Descriptor #13). This is confirmed by the fact that their highest correlations are with Repairing, Mechanical (GWA Descriptor #23) and they also correlate with Operating Vehicles (GWA Descriptor #20). The fourth factor is basically science and medical knowledge. Correlations between these knowledges and those shown on Figure 13-12 are generally small, but knowledge of Biology (Knowledges Descriptor #17) does

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correlate with Monitoring Processes (GWA Descriptor #3) ($\underline{r}$ = .64), Repairing, Electronic (GWA Descriptor #24) ($\underline{r}$ = .64), and Teaching Others (GWA Descriptor #36) ($\underline{r}$ = .47). The sample for these analyses includes Medical and Clinical Laboratory Technologists and Registered Nurses, and perhaps this can at least partially explain these somewhat surprising results.

Finally, Table 13-9 and Figures 13-13 and 13-14 show the results for work context. The first factor on Table 13-9 appears to be defined by hazardous work environments, and Figure 13-14 shows that these work context descriptors correlate most highly with Operating Vehicles (GWA Descriptor #20) and Repairing, Mechanical (GWA Descriptor #23). Not too surprisingly, these aspects of work context are also correlated with Inspecting Equipment (GWA Descriptor #4) ($\underline{r}$ = .56), Performing Physical Work Tasks (GWA Descriptor #16) ($\underline{r}$ = .67) and Controlling Machines (GWA Descriptor #18) ($\underline{r}$ = .58). The second factor is defined by work context descriptors involving managerial relations, and these descriptors have strong correlations with Directing Subordinates (GWA Descriptor #37) and Staffing Organizational Units (Descriptor #41). The third factor focuses on interpersonal job requirements, especially those that involve dealing with the public or difficult interpersonal situations. Figure 13-14 shows that these latter work context descriptors tend to have low correlations with the nine representative GWAs, but a negative correlation with Repairing, Mechanical (GWA Descriptor #23). GWA correlations not included on Figure 13-14 that are large for these descriptors include Resolving Conflicts (GWA Descriptor #32) ($\underline{r}$ = .52) and Working with the Public (GWA Descriptor #33) ($\underline{r}$ = .54). Finally, the fourth factor is a combination of descriptors such as Written Reports (Work Context Descriptor #2k), Details and Completeness (Work Context Descriptor #32), but also Diseases/Infections (Work Context Descriptor #17), perhaps a reflection of the fact that two of the occupations included in our sample involve nursing. GWA descriptors not shown on Figure

13-14 that have substantial correlations with Written Reports (Work Context Descriptor #2k) include Documenting Information (GWA Descriptor #25) (r = .64), Assisting Others (GWA Descriptor #30) (r = .58) and Establishing Relationships (GWA Descriptor #29) (r = .50).

A Priori Cross-Domain Relationships

One final set of analyses was conducted to provide an additional test of the extent to which cross-domain relationships obtained in these O*NET prototype data are consistent with rational and theoretical expectations. This involved generating and testing a series of hypotheses concerning expected correlations, across domains, between individual descriptors. We began by identifying pairs of domains for which strong hypotheses could be generated concerning expected relationships. There are clear similarities across a subset of the skill and ability descriptors. For example, one of the ability descriptors is Written Comprehension (Ability Descriptor #2) and one of the skill descriptors is Reading Comprehension (Skill Descriptor #1). It would be truly surprising if occupations rated as requiring written comprehension were not also rated as requiring reading comprehension. Similarly, there are some strong conceptual similarities between certain work context and occupational context descriptors. Another pair of domains for which strong hypotheses could be generated was skills and GWAs; similarly, knowledges have some necessary relationships with a subset of the training and education requirements. Finally, evidence from past research is available concerning relationships between GWAs and certain work context descriptors.

Each of these five pairs of domains was examined closely, and those pairs of descriptors expected to correlate across domains were identified. In generating these cross-domain hypotheses, we focused on identifying only those descriptors for which very strong relationships were expected. In other words, we identified those pairs of descriptors for which a finding of no

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relationship would be very unexpected and cast doubt on the construct validity of the descriptors involved. In order to provide an overall assessment of the extent to which these analyses support the construct validity of the descriptors for each pair of domains, we compared the mean of these expected correlations to the mean of the correlations between all other pairs of descriptors across the same two domains. Correlations were first converted using Fisher's r to z transformation, then averaged, and the resulting average z-scores were converted back to standard correlation coefficients. It is worth noting that the present analyses focused on subsets of the most obvious expected correlations between descriptors, and many other pairs of domains and individual descriptor correlations remain that would be interesting to examine in the context of past research and available theory.

Twelve pairs of ability and skill descriptors were identified as involving very similar content, and thus hypothesized to correlate highly. The average of these twelve correlations was .74, while the overall average correlation between all other pairs of descriptors across these two domains was only .19. A couple of examples of these hypothesized relationships between ability and skill descriptors are Written Comprehension (Ability Descriptor #2) requirements and Reading Comprehension (Skill Descriptor #1) requirements ($r = .84$); Originality ($r = .81$); Idea Generation (Skill Descriptor #21); and Problem Sensitivity (Ability Descriptor #7) and Problem Identification (Skill Descriptor #17) ($r = .61$).

For the work context and organizational context domains, there were nine pairs of descriptors that appeared to have a great deal of conceptual similarity. Although these two domains are relatively distinct, there is some overlap. For example, Decision Latitude (Work Context Descriptor #27) is an aspect of an individual employee's work context, but Empowerment (Organizational Context Descriptor #1) is a construct that is often manipulated and studied at the organizational level. Clearly incumbents who report a large degree of Decision Latitude would also be expected to rate their jobs high on Empowerment. The average correlation across the nine pairs of work and organizational context descriptors identified as overlapping was .59; the average across the other pairs of descriptors was only .06. The correlation between Empowerment and Decision Latitude was .51. The latter construct correlated .67 with Autonomy (Organizational Context Descriptor #2) and .47 with a measure of Decentralization (Organizational Context Descriptor #13). An organizational context variable, Percent of Time Spent in Teams (reflecting a team approach to organizational structure; Organizational Context Descriptor #26), correlated .57 with a related work context variable called Work/Contribute to Teams (Work Context Descriptor #6e).

The conceptual links between skills and generalized work activities (GWAs) are not quite as strong as those identified between skills and abilities, but 24 pairs of skill and GWA descriptors were identified that were expected to correlate substantially. The average of these 24 expected correlations was .69, while the average of all of the remaining skill-GWA correlations was .45. For example, the correlation between the Speaking (Skill Descriptor #4) skill requirement and Communicating, Internal (GWA Descriptor #27) was .74. Negotiation Skill (Skill Descriptor #14) requirements correlated .55 with the GWA Selling or Influencing (GWA Descriptor #31). The skill requirement labeled Operation and Control (Skill Descriptor #32) correlated .65 with the GWA called Controlling Machines (GWA Descriptor #18).

It is reasonable to expect that if an occupation requires a higher level of education in a particular content area it will generally require a higher level of knowledge in that same content area as well. Thus, we compared the content areas for 15 education requirements with the content of the 33 knowledge descriptors and found 18 matches. The average of these 18 expected correlations was .67, and the average of the remaining correlations was .32. For example, knowledge descriptors labeled English Language (Knowledge Descriptor #24) correlated .84 with level of education required in English Language/Arts (Education Descriptor #3c). A few of these correlations are somewhat lower than would be expected. Language (Education Descriptor #3e) education requirements correlated only .27 (not significant) with Foreign Language knowledge (Knowledge Descriptor #25). Still, most of the relationships between knowledge and training requirements are as expected.

Finally, past research, especially that involving the Position Analysis Questionnaire, provides information concerning relationships between certain aspects of work context and work tasks (i.e., the GWAs). For example, work activities involving controlling machines have been found to be related to certain environmental factors. The O*NET content model contains a large number of rather specific aspects of work context, so we used the work context factor-based composites to test for the expected relationships with individual GWA descriptors. A total of 15 expected relationships were identified, and the average of these correlations was .64; the average of the remaining correlations between work context composites and GWA descriptors was .11. The correlation between Controlling Machines (GWA Descriptor #18) and Environmental Factors was .70. The correlation between the Managerial Relations composite and the GWA Directing Subordinates (GWA Descriptor #37) was .81. In general, hypotheses involving the Business/Office composite were not as strongly supported as those involving the other work context composites. Possible explanations for this latter finding include the composition of this composite (it is made up of only two descriptors) and the characteristics of the occupations in the sample (e.g., the sampling of business occupations may not be representative).

Conclusions

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Several different analytical approaches were used in these cross-domain analyses, and each provides a somewhat different perspective on the relationships between descriptors from the various O*NET content domains. In general, these results strongly support the construct validity of the O*NET descriptors across all content domains, and provide some interesting insights concerning these cross-domain relationships. The fact that most of the cross-domain comparisons involved data from different incumbents strengthens the potential generalizability of these findings. All of the tests of a priori cross-domain hypotheses showed that where strong correlations were expected, strong correlations were in fact obtained.

In general, work activities involving information and people had strong correlations with many cognitive ability and skill requirements. The achievement-oriented work styles and those most cognitively oriented were also strongly related to activities involving information and people, as well as to cognitive ability and skill requirements. Work styles involving interpersonal interactions were positively correlated with activities and environments involving working with others. These relationships are summarized in the factor analysis results, where the first factor was defined by descriptors related to interpersonal and managerial activities, cognitive skill requirements, and achievement-related worker characteristics. This factor was labeled "Management and Achievement." Although activities involving working with information and working with people had generally similar patterns of correlations with descriptors from other domains, the differences in these patterns of correlations support the construct validity of these composites. For example, the working with information composite was more strongly related to technical skills and math ability, whereas working with people was more strongly related to the people oriented work style.

Manual and physical work activities, on the other hand, were correlated with technical skills and with psychomotor and physical ability requirements. Environmental factors from the work context domain also tended to be positively correlated with manual and physical activities and related worker requirements. In fact, manual and physical activities, physical and psychomotor abilities, and environmental factors defined the second factor in the factor analysis.

In addition to obtaining the expected relationships across domains, the present analyses also generally showed that constructs not conceptually related do not correlate. For example, physical and psychomotor ability requirements were not significantly correlated with work activities involving information or people. These analyses also uncovered a few somewhat unexpected but conceptually appealing relationships. For example, office activities and related requirements tended to be negatively correlated with physical activities and related worker requirements. Technical skill requirements were negatively related with a work context that involves interacting with the public, and finally, law enforcement knowledge requirements correlated significantly with ability requirements such as psychomotor, vision and hearing, and spatial.

The more detailed analyses of relationships between individual O*NET descriptors and GWAs provide some additional insights. For example, one of the ability factors, identified based on patterns of correlations with GWAs, included Far Vision (Ability Descriptor #42) and Spatial Orientation (Ability Descriptor #18), and these abilities, in turn, tended to correlate most highly with activities such as Operating Vehicles (GWA Descriptor #20), The fact that Operating Vehicles appears to be related to a constellation of distinctly different abilities, which were actually assigned to different composites in the composite-level analyses, could only be uncovered in these descriptor-level analyses. Another constellation of abilities with similar GWA

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correlations included Perceptual Speed (Ability Descriptor #17) and Near Vision (Ability Descriptor #41), and these abilities correlated most highly with repair activities (e.g., Repairing, Mechanical; GWA Descriptor #23). Similar analyses for work styles indicated that work styles related to interpersonal interactions do, in fact, tend to have similar patterns of GWA correlations. For skills, these analyses revealed that Programming Skill (Skill Descriptor #29) has a very distinct pattern of correlations with GWAs, with the largest correlations involving GWAs such as Thinking Creatively (GWA Descriptor #11) and Interacting with Computers (GWA Descriptor #19).

In summary, results of the cross-domain analyses provide good support for the O*NET content model and some interesting information concerning relationships between various occupational requirements, work activities and other characteristics. Although the results are limited by the fact that the sample used contains only 29 occupations, the sample did include a fairly wide variety of occupations (see Figure 13-1), and most of the results obtained here are likely to hold up when larger, more representative samples are available. A larger sample will also allow for more detailed analyses of the structures of these cross-domain relationships, as well as providing the power to detect relationships that are somewhat weaker but still important.

Figure 13-1
Twenty-Nine Occupations With Four or More Respondents Across all Nine O*NET Questionnaires

Occupation Code	Occupation Title	Number of Respondents	Number of Establishments
15005	Education Administrators	43	12
19005	General Managers & Top Executives	147	52
25105	Computer Programmers	22	3
31305	Teachers, Elementary School	84	8
32502	Registered Nurses	97	19
32902	Medical & Clinical Laboratory Technologists	19	5
49008	Salespersons, Except Scientific & Retail	41	11
49011	Salespersons, Retail	64	12
49021	Stock Clerks, Sales Floor	33	7
49023	Cashiers	78	24
51002	First Line Supervisors, Clerical/Administrative	174	35
53102	Tellers	20	7
53905	Teachers' Aides & Assistants, Clerical	39	14
55108	Secretaries, Except Legal & Medical	248	67
55305	Receptionists & Information Clerks	34	14
55338	Bookkeeping, Accounting, & Auditing Clerks	94	39
55347	General Office Clerks	264	67
61005	Police & Detective Supervisors	39	1
63014	Police Patrol Officers	69	4
65008	Waiters & Waitresses	60	12
65026	Cooks, Restaurant	19	7
65038	Food Preparation Workers	89	18
66008	Nursing Aides, Orderlies, & Attendants	56	9
67005	Janitors & Cleaners	117	34
85132	Maintenance Repairers, General Utility	110	31
87902	Earth Drillers, Except Oil & Gas	20	1
92974	Packaging & Filling Machine Operators	40	5
97102	Truck Drivers, Heavy or Tractor Trailer	41	6
97111	Bus Drivers, Schools	36	4

Figure 13-2
Composition of Factor-Based Composites Used in Cross-Domain Analyses

Ability Factor-Based Composites

1. *Physical*
   Static Strength; Dynamic Strength; Explosive Strength; Trunk Strength; Stamina; Gross Body Conditioning; Gross Body Equilibrium; Dynamic Flexibility; Extent Flexibility

2. *Psychomotor*
   Rate Control; Control Precision; Multi-limb Coordination; Reaction Time; Response Orientation; Speed of Limb Movement

3. *Dexterity*
   Manual Dexterity; Finger Dexterity; Arm-Hand Steadiness; Wrist-Finger Speed

4. *Vision/Hearing*
   Depth Perception; Peripheral Vision; Night Vision; Far Vision; Glare Sensitivity; Visual Color Discrimination; Sound Localization; Hearing Sensitivity; Auditory Attention

5. *Cognitive*
   Deductive Reasoning; Originality; Fluency of Ideas; Inductive Reasoning; Problem Sensitivity; Information Ordering; Category Flexibility; Written Expression; Written Comprehension; Oral Expression; Oral Comprehension

6. *Math*
   Math Reasoning; Number Facility

7. *Spatial*
   Visualization; Spatial Orientation; Flexibility of Closure; Speed of Closure

8. *Speech*
   Speech Clarity; Speech Recognition

9. *Attention*
   Perceptual Speed; Near Vision; Selective Attention; Time Sharing

10. *Memory*
    Memorization

Generalized Work Activity Factor-Based Composites

1. *Manual and Physical Activities*
   Inspecting Equipment; Performing Physical Work Tasks; Controlling Machines; Operating Vehicles; Repairing, Mechanical; Repairing, Electronic; Handling Objects

2. *Working with and Directing Others*
   Establishing Relationships; Assisting Others; Selling or Influencing; Resolving Conflicts; Working with the Public; Coordinating Others Work; Developing Teams; Teaching Others; Directing Subordinates; Developing Others

3. *Working with Information*
   Getting Information; Identifying Objects; Monitoring Processes; Estimating Characteristics; Evaluating Information; Processing Information; Analyzing Data; Making Decisions; Thinking Creatively; Using Job Knowledge; Organizing and Planning; Interacting with Computers; Implementing Ideas; Interpreting Information; Communicating, Internal; Providing Consultation

Note. Nine Generalized Work Activities are not part of any composite.

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Figure 13-2 (Continued)
Composition of Factor-Based Composites Used in Cross-Domain Analyses

Work Style Factor-Based Composites

1. *Surgency/Achievement Orientation*
Achievement/Effort; Persistence; Initiative; Energy; Leadership Orientation; Independence; Innovation; Analytical Thinking

2. *Detail Orientation*
Attention to Detail

3. *People Orientation*
Cooperation; Concern for Others; Social Orientation; Self-control; Stress Tolerance

Note. Three Work Styles are not part of any composite.

Knowledge Factor-Based Composites

1. *Arts and Humanities*
Geography; Therapy and Counseling; Foreign Language; Fine Arts; History and Archeology

2. *Science and Technology*
Production and Processing; Engineering and Technology; Design; Building and Construction; Mechanical; Physics

3. *Law Enforcement*
Public Safety and Security; Law, Government, and Jurisprudence

4. *Clerical*
Clerical

5. *Medicine*
Chemistry; Biology; Medicine and Dentistry

6. *Business Administration*
Sales and Marketing; Customer and Personal Service

7. *Food Production*
Food Production

Note. Thirteen Knowledges are not part of any composite.

Occupational Value Factor-Based Composites

1. *Individual Accomplishment*
Ability Utilization; Achievement; Authority; Creativity; Responsibility; Variety; Autonomy

2. *Structure*
Activity; Independence (negatively weighted); Supervision HR; Supervision Tech

3. *Stability*
Security; Social Status

4. *Social Comfort*
Co-workers; Moral Values; Recognition; Working Conditions

5. *Career Advancement*
Advancement; Compensation; Social Service (negatively weighted)

Note. One Occupational Value is not part of any composite

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Figure 13-2 (Continued)
Composition of Factor-Based Composites Used in Cross-Domain Analyses

Skill Factor-Based Composites

1. *Cognitive Skills*
   Reading Comprehension; Active Listening; Writing; Speaking; Critical Thinking; Active Learning; Learning Strategies; Monitoring; Social Perceptiveness; Coordination; Persuasion; Instructing; Problem Identification; Information Gathering; Service Orientation; Information Organization; Synthesis/Reorganization; Idea Generation; Idea Evaluation; Implementation Planning; Solution Appraisal; Time Management; Negotiation; Systems Perceptions

2. *Technical Skills*
   Mathematics; Science; Operations Analysis; Technology Design; Equipment Selection; Installation; Programming; Testing; Operation Monitoring; Operation and Control; Product Inspection; Equipment Maintenance; Troubleshooting; Repairing

3. *Organizational Skills*
   Visioning; Identification of Downstream Consequences; Systems Evaluation; Management of Financial Resources; Management of Material Resources; Management of Personnel Resources; Identification of Key Causes; Judgment and Decision Making

Work Context Factor-Based Composites

1. *Environmental Factors*
   Indoors, Controlled (negatively weighted); Outdoors, Exposed; Outdoors, Covered; Open Vehicle/Equipment; Enclosed Vehicle/Equipment; Distracting Noise; Extreme Temperatures; Poor Lighting; Cramped Work Space; Whole Body Vibration; High Places; Hazardous Conditions; Hazardous Equipment; Climbing Ladders, etc.; Special Safety Attire

2. *Physical Activity*
   Sitting (negatively weighted); Standing; Walking or Running; Kneeling or Crouching; Keeping/Regaining Balance; Bending/Twisting Body

3. *Health and Safety*
   Written Reports; Physical Aggression; Diseases; Special Uniform

4. *Interacting with the Public*
   Public Speaking; Deal with Public

5. *Managerial Relations*
   Face-to-Face Groups; Communications; Supervise/Develop Others; Persuade or Influence; Take Opposing Position; Coordinate/Lead Activity; Responsible for Others Work; Accountable for Results; Decision Latitude

6. *Structured/Machine Operations*
   Level of Automation; Accuracy/Exactness; Details and Completeness; Repetitive Activities; Structured Tasks/Goals (negatively weighted); Machine Driven Pace;

7. *Business/Office*
   Business/Office Clothes; Deadline Time Pressure (negatively weighted);

Note. Thirty-four Work Context descriptors are not of any composite.

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Figure 13-3
Correlations Between Representative Abilities and Selected Generalized Work Activities: Within a Single Cross-Domain Factor

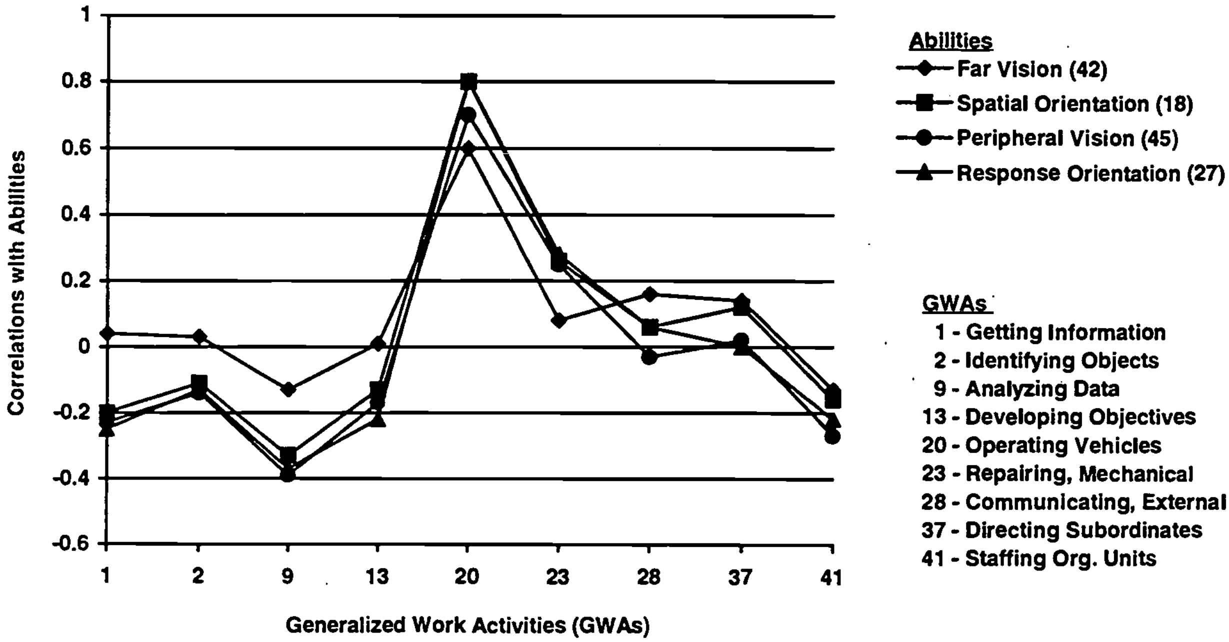

Figure 13-4
Correlations Between Representative Abilities and Selected Generalized Work Activities: Across All Cross-Domain Factors

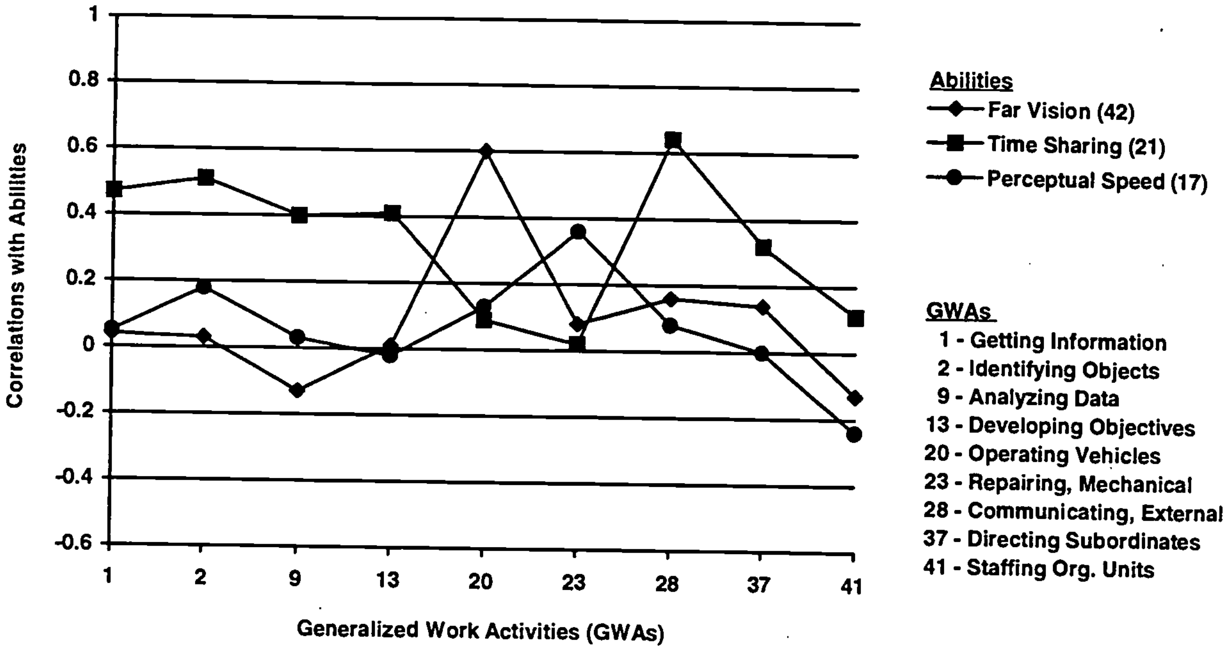

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Figure 13-5
Correlations Between Representative Work Styles and Selected Generalized Work Activities: Within a Single Cross-Domain Factor

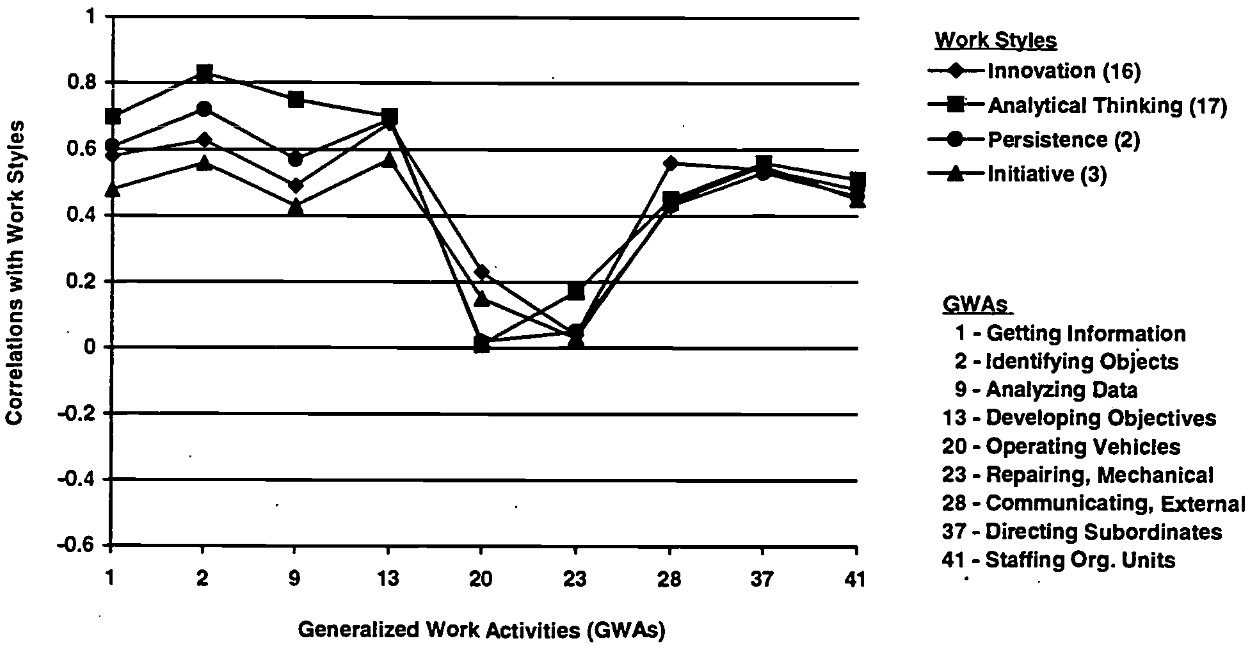

Figure 13-6
Correlations Between Representative Work Styles and Selected Generalized Work Activities: Across All Cross-Domain Factors

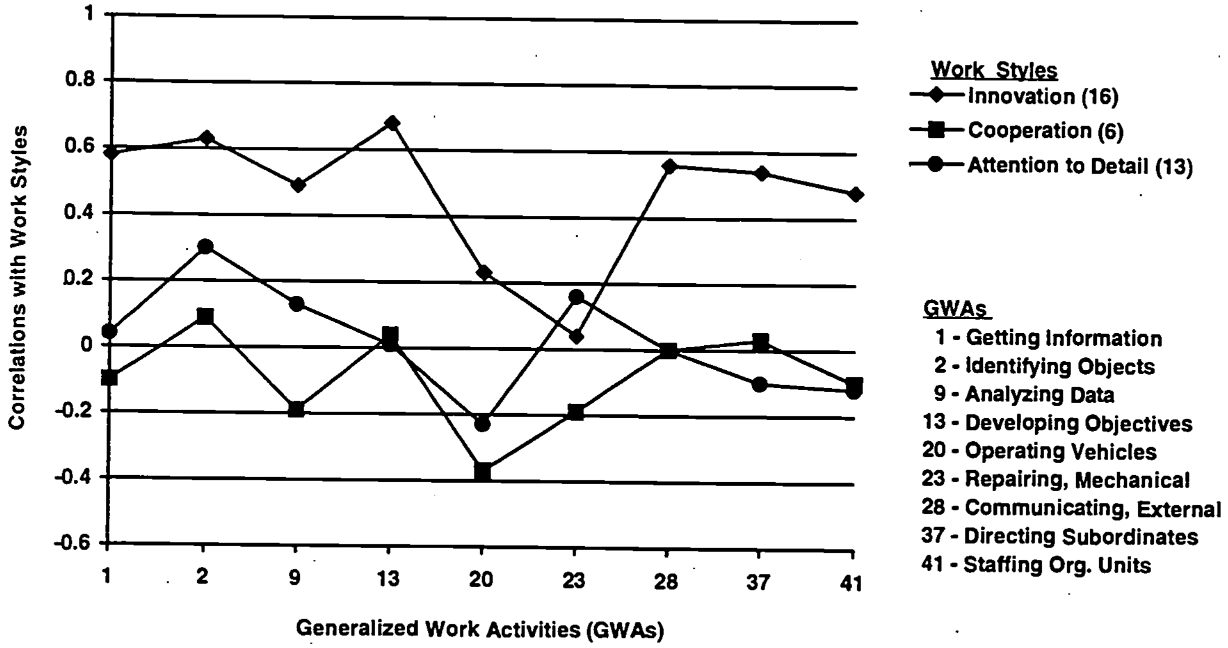

Figure 13-7

Correlations Between Representative Occupational Values and Selected Generalized Work Activities: Within a Single Cross-Domain Factor

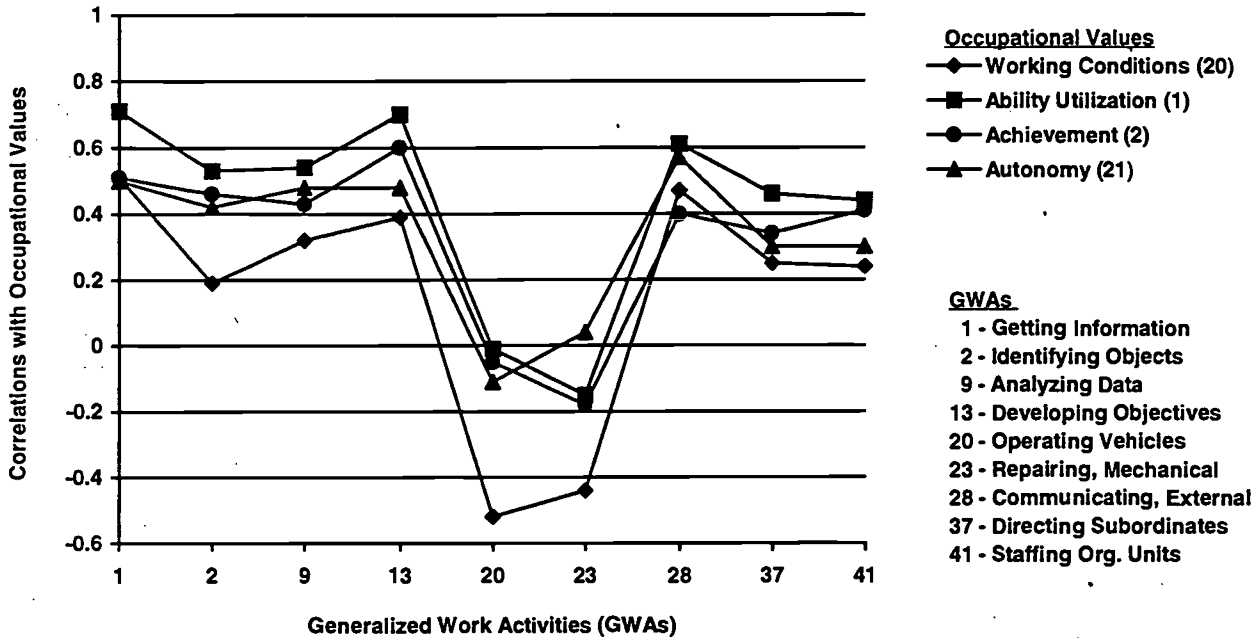

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Figure 13-8

Correlations Between Representative Occupational Values and Selected Generalized Work Activities: Across All Cross-Domain Factors

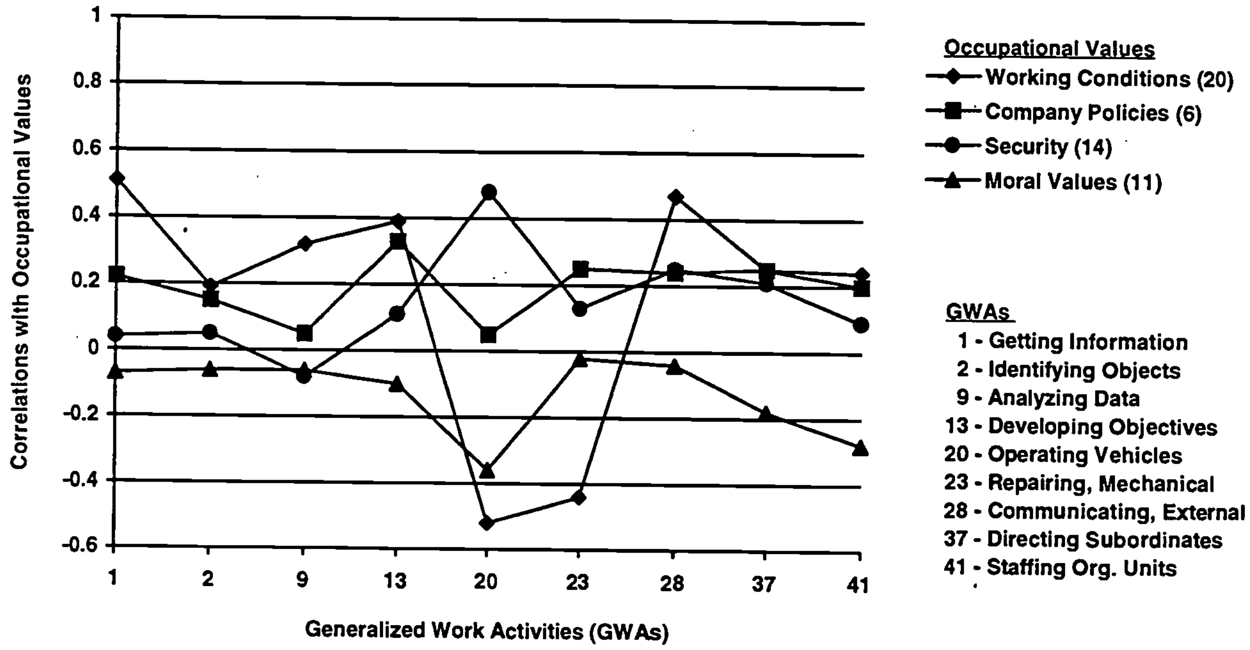

Figure 13-9

Correlations Between Representative Skills and Selected Generalized Work Activities: Within a Single Cross-Domain Factor

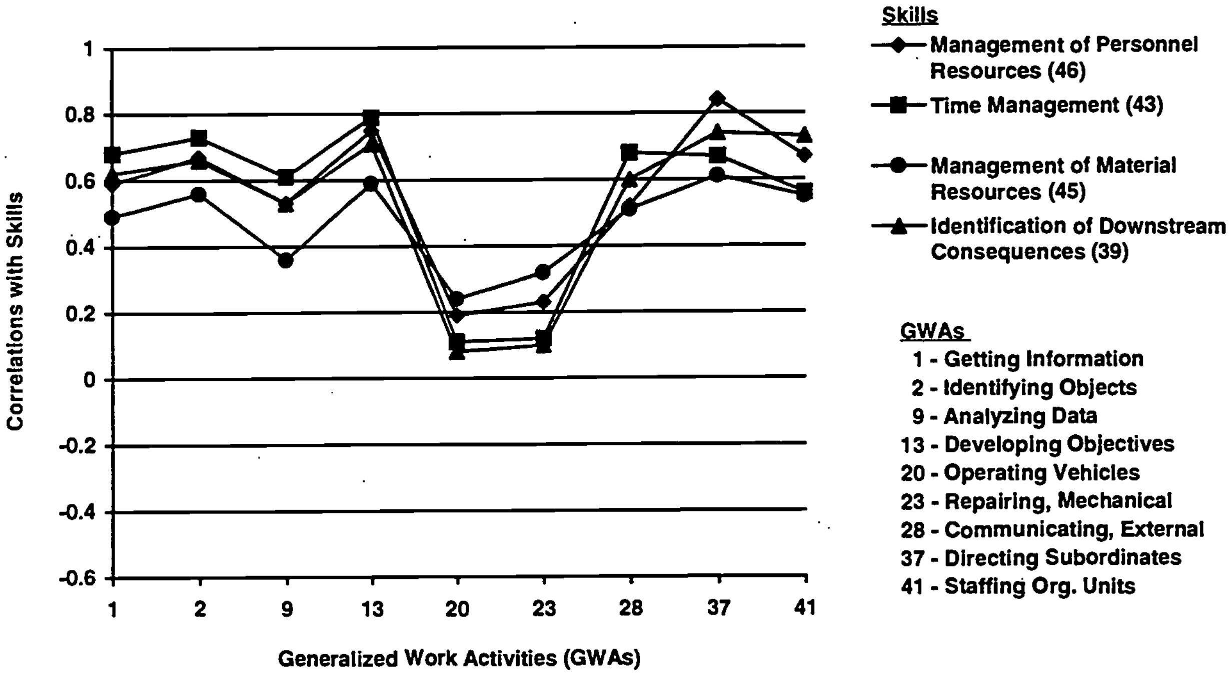

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Figure 13-10

Correlations Between Representative Skills and Selected Generalized Work Activities: Across All Cross-Domain Factors

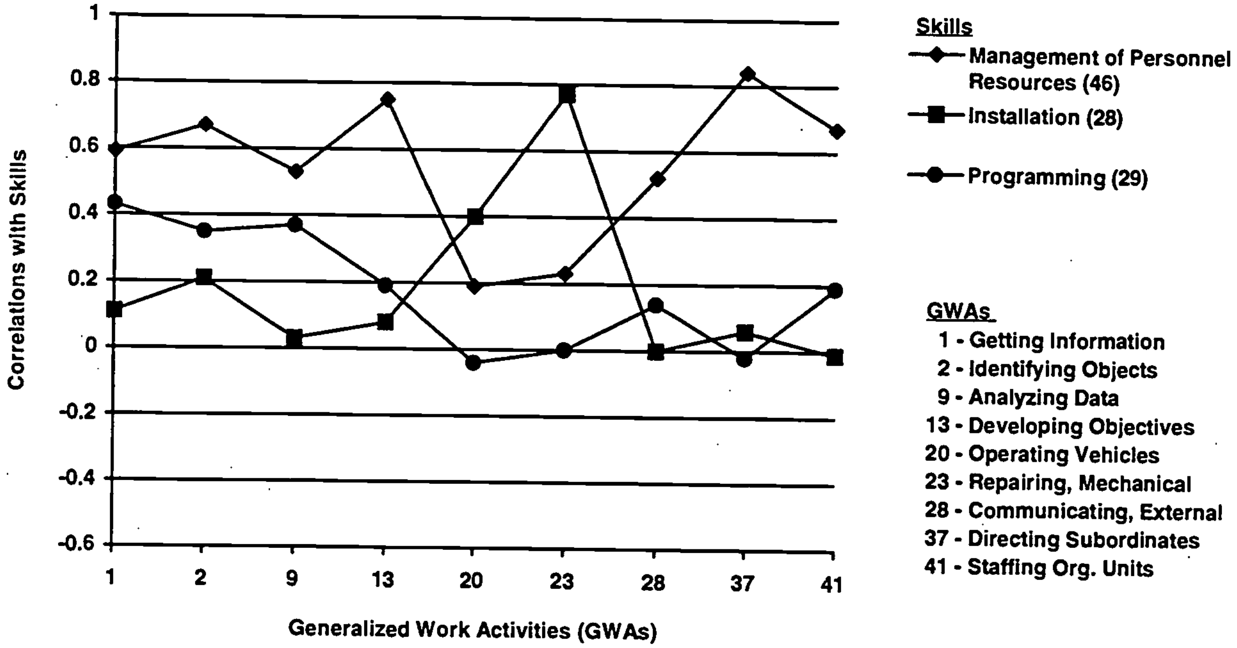

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Figure 13-11
Correlations Between Representative Knowledges and Selected Generalized Work Activities: Within a Single Cross-Domain Factor

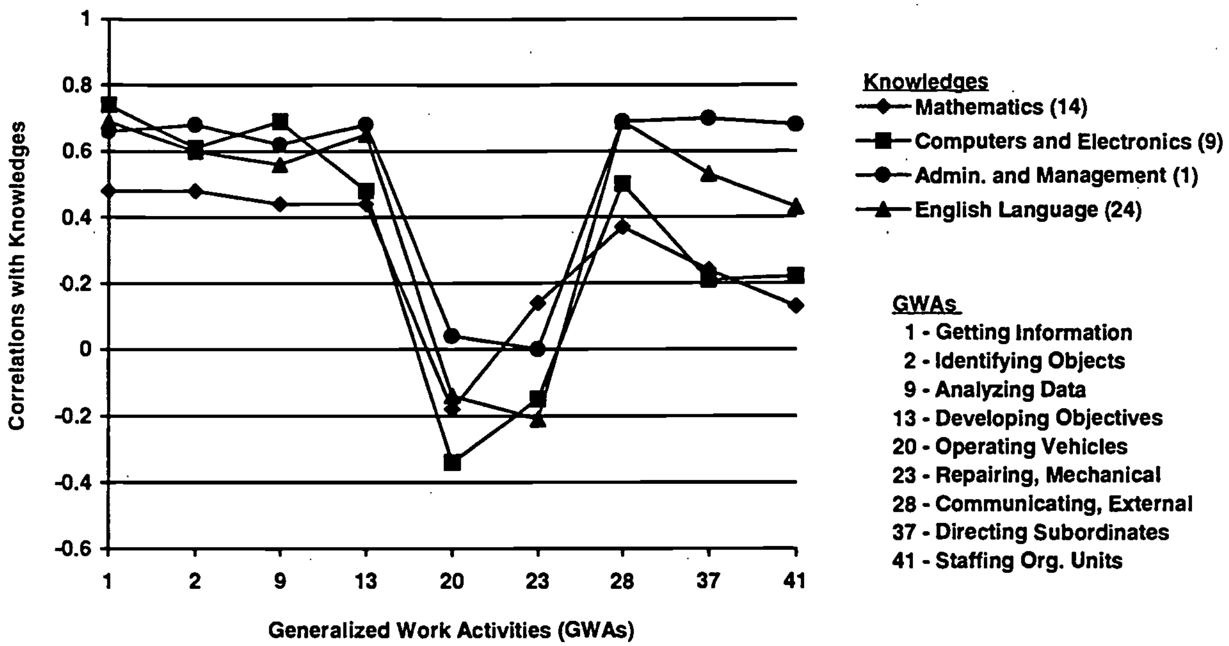

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Figure 13-12

Correlations Between Representative Knowledges and Selected Generalized Work Activities: Across All Cross-Domain Factors

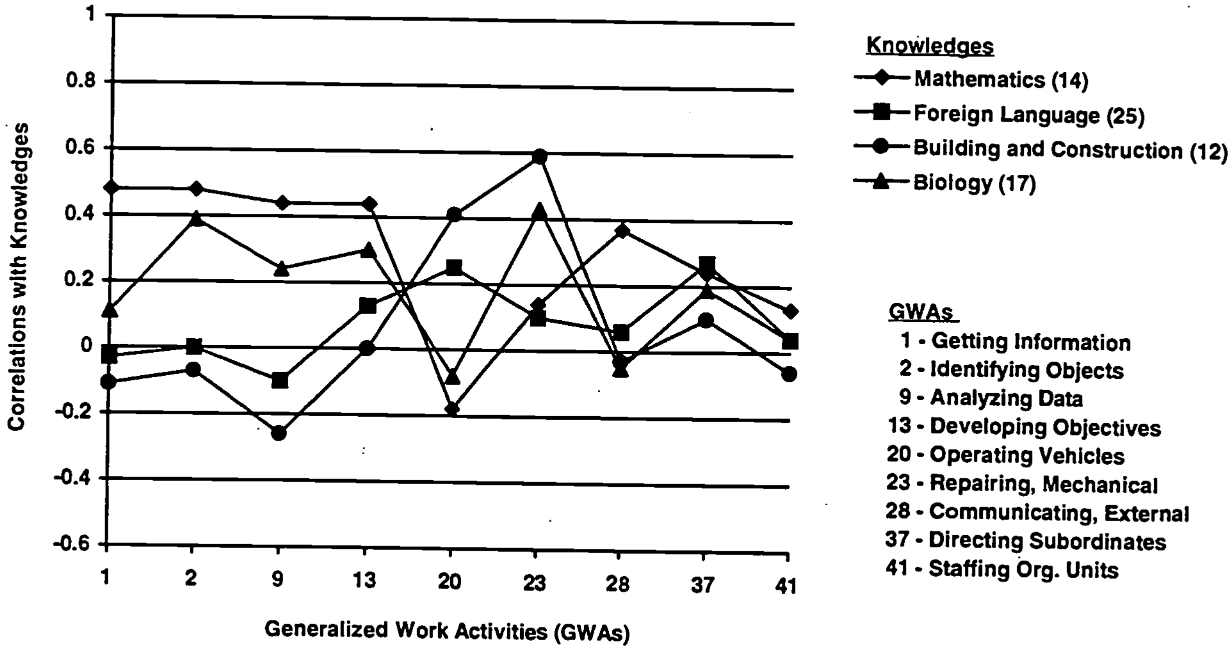

Figure 13-13

Correlations Between Representative Work Context and Selected Generalized Work Activities: Within a Single Cross-Domain Factor

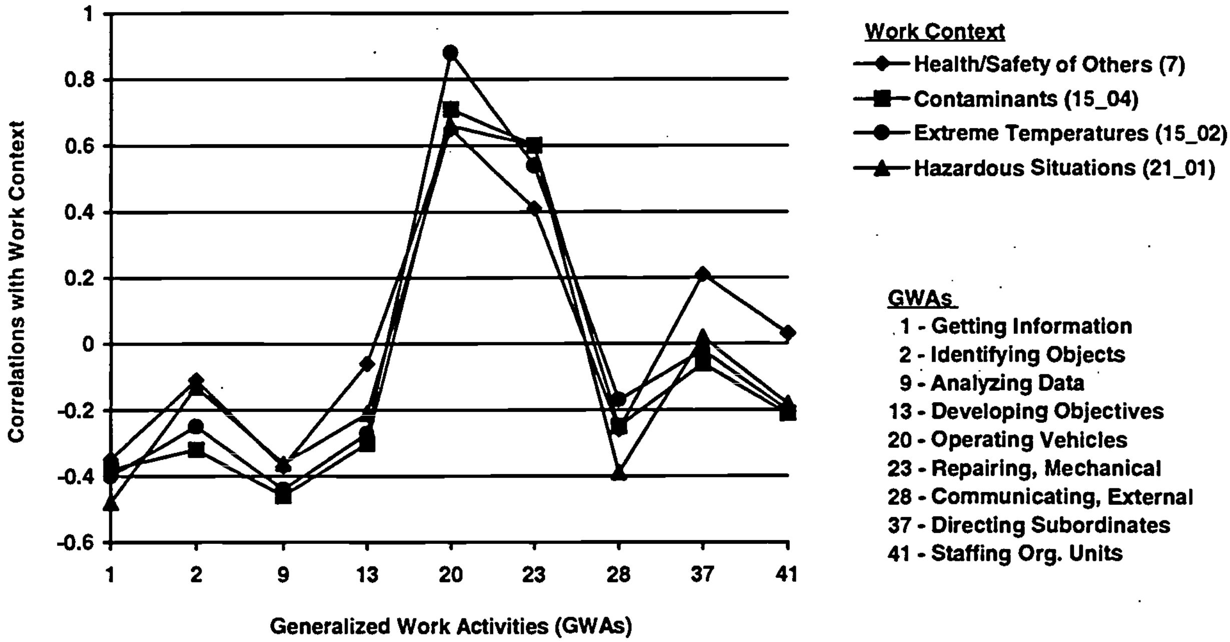

Figure 13-14
Correlations Between Representative Work Context and Selected Generalized Work Activities: Across All Cross-Domain Factors

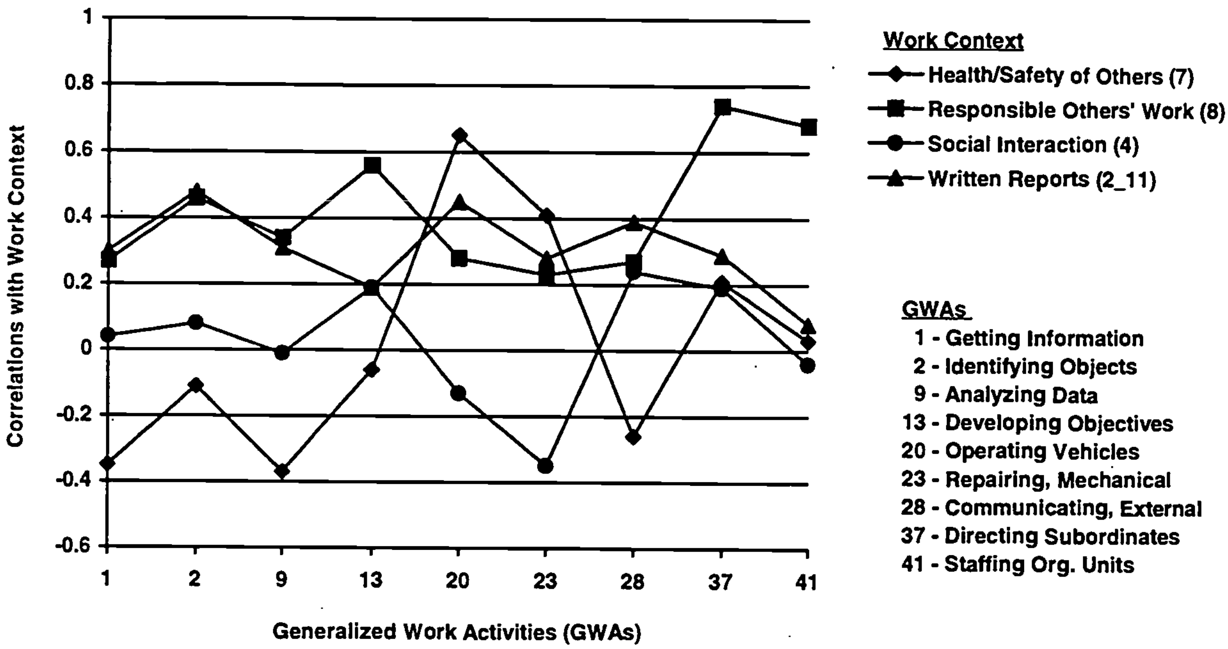

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Table 13-1
Percentage of Data Across Pairs of Domains Collected from Same Incumbents

Domain	1	2	3	4	5	6	7	8	9
1. Abilities	--								
2. Generalized Work Activities	10	--							
3. Organizational Context	9	12	--						
4. Occupational Values	10	93	12	--					
5. Skills	11	11	9	11	--				
6. Training, Licensure, and Experience	10	10	12	10	10	--			
7. Work Context	10	10	12	10	12	10	--		
8. Work Styles	11	11	12	11	10	88	11	--	
9. Knowledge	9	12	91	12	9	12	11	13	--

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Table 13-2

Intercorrelations of Factor-Based Composites Across Domains

Composites by Domain	1	2	3	4	5	6	7	8	9	10	11	12	13
Generalized Work Activities													
1. Working with Information	(.90)												
2. Working w/ & Directing Others	.72	(.90)											
3. Manual and Physical Activities	-.20	-.12	(.87)										
Work Context													
4. Environmental Factors	-.20	.01	.80	(.97)									
5. Physical Activity	-.53	-.22	.54	.43	(.94)								
6. Managerial Relations	.66	.75	.12	.20	-.10	(.93)							
7. Structured/Machine Operations	.05	-.09	.13	.07	-.31	-.03	(.80)						
8. Business/Office	.39	.45	-.56	-.37	-.57	.10	.26	(.90)					
9. Health and Safety	.04	.33	.35	.26	.15	.18	.01	-.15	(.96)				
10. Interacting with the Public	.21	.57	-.22	-.04	-.09	.23	-.12	.41	.17	(.89)			
Skills													
11. Cognitive Skills	.85	.75	-.07	.04	-.37	.72	.02	.36	.21	.26	(.94)		
12. Technical Skills	.44	.08	.52	.35	-.04	.38	.27	-.30	.13	-.34	.51	(.91)	
13. Organizational Skills	.72	.68	.05	.15	-.21	.79	.07	.26	.02	.06	.84	.58	(.94)
Knowledges													
14. Arts and Humanities	.26	.52	.03	.25	.03	.38	-.04	.30	.12	.25	.47	.12	.40
15. Science and Technology	.08	.03	.54	.53	.26	.28	.31	-.20	-.12	-.26	.21	.56	.39
16. Law Enforcement	.30	.62	.22	.46	-.05	.44	.14	.22	.59	.29	.42	.11	.37
17. Clerical	.32	.08	-.47	-.39	-.65	-.15	.44	.62	-.14	-.11	.29	-.06	.09
18. Medicine	.20	.27	.43	.16	.04	.35	.39	-.03	.47	-.05	.35	.53	.33
19. Business Administration	.43	.55	-.33	-.15	-.19	.45	.09	.44	-.13	.60	.53	-.01	.54
20. Food Production	-.28	-.09	.31	.27	.49	-.02	.05	-.20	-.17	-.10	-.31	-.06	-.14

Table 13-2 (continued)
Intercorrelations of Factor-Based Composites Across Domains

Composites by Domain	14	15	16	17	18	19	20	21	22	23	24	25	26
35. Structure	.15	.08	-.17	.33	.31	.18	-.11	-.30	-.26	-.02	-.20	.30	.24
36. Social Comfort	.24	.15	-.02	.35	.00	.59	.10	-.35	-.46	-.32	-.33	.29	.29
37. Career Advancement	.40	.23	.27	-.14	.05	.60	.13	.09	-.04	-.23	-.04	.29	.23
38. Stability	.63	.23	.79	.25	.17	.09	-.04	.25	.35	.03	.40	.43	.02

Table 13-2 (continued)
Intercorrelations of Factor-Based Composites Across Domains

Composites by Domain	27	28	29	30	31	32	33	34	35	36	37	38
Abilities (continued)												
27. Spatial	(.77)											
28. Speech	.53	(.74)										
29. Attention	.83	.60	(.77)									
30. Memory	.60	.86	.68	(.70)								
Work Styles												
31. Surgency/Achievement Orient.	.38	.17	.14	.21	(.85)							
32. People Orientation	-.03	.25	-.07	-.09	.25	(.79)						
33. Detail Orientation	-.03	-.06	.12	-.10	.32	.37	(.58)					
Occupational Values												
34. Individual Accomplishment	.27	.23	.08	.25	.64	.08	.09	(.87)				
35. Structure	.15	.23	.34	.18	.23	-.05	.14	.27	(.42)			
36. Social Comfort	.16	.43	.13	.38	.18	.04	-.08	.37	.39	(.20)		
37. Career Advancement	.32	.25	-.03	.17	.56	.20	-.03	.51	-.14	.30	(.60)	
38. Stability	.50	.29	.28	.18	.42	.27	.09	.53	-.05	-.01	.43	(.80)

Note. N = 29. Correlations of .37 or greater are significant at the $p < .05$ level. Interrater reliability estimates for each composite appear on the diagonal. These were obtained by calculating the intraclass correlation for k ratings across occupations: ICC(1,k)=[BMS-WMS]/BMS (Shrout & Fleiss, 1979), where k is the harmonic mean of the number of ratings provided on each occupation.

Table 13-3
Principal Components Analysis Pattern Matrix: Cross-Domain Factor-Based Composites

Domain and Composite Label	Factor F1	F2	F3	F4	Communality
WC: Managerial Relations	.88	.11	-.03	.04	.79
SK: Cognitive Skills	.87	.05	.21	.23	.92
SK: Organizational Skills	.87	-.01	.39	.05	.90
WS: Surgency, Achievement Orientation	.83	-.04	.05	.07	.70
GWA: Working with/Directing Others	.80	.08	.25	-.41	.86
OV: Individual Accomplishment	.79	-.15	.06	-.05	.65
OV: Career Advancement	.77	.06	-.13	-.11	.62
GWA: Working with Information	.75	-.23	.41	.09	.79
KN: Business Administration	.58	-.24	.28	-.18	.50
OV: Stability	.57	.40	.13	-.28	.58
KN: Arts and Humanities	.47	.44	.32	-.18	.56
OV: Social Comfort	.35	-.31	.34	-.04	.33
AB: Psychomotor	-.14	.92	-.05	-.03	.87
AB: Vision/Hearing	-.08	.91	.11	-.16	.88
AB: Physical	-.10	.88	-.35	-.09	.91
AB: Dexterity	-.34	.82	.19	.16	.84
WC: Environmental Factors	.16	.80	-.29	.15	.78
GWA: Manual and Physical Activities	.01	.73	-.33	.42	.82
KN: Law Enforcement	.40	.65	.26	-.35	.77
AB: Spatial	.44	.61	.55	.09	.88
WC: Health and Safety	.10	.54	.04	-.31	.40
KN: Medicine	.24	.48	.34	.33	.51
KN: Food Production	-.07	.40	-.17	.12	.21
AB: Attention	.08	.49	.80	.13	.91
AB: Memory	.26	.12	.79	-.09	.72
AB: Cognitive	.55	.12	.75	.09	.88
AB: Speech	.27	.08	.74	-.38	.77
KN: Clerical	-.4	-.33	.70	.00	.60
WC: Business/Office	.18	-.26	.69	-.38	.72
AB: Math	.29	-.09	.66	.40	.68
WC: Structured/Machine Operations	-.22	.18	.64	.38	.64
OV: Structure	.08	-.20	.43	.22	.29
WC: Physical Activity	-.09	.42	-.62	.06	.57
SK: Technical Skills	.39	.30	.14	.75	.83
KN: Science and Technology	.28	.54	.10	.56	.68
WS: Detail Orientation	.07	-.15	.14	.26	.11
WS: People Orientation	.20	.01	-.03	-.60	.40
WC: Interacting with Public	.28	.02	.20	-.67	.58
Percent of Variance	21	20	17	9	
Eigenvalues	10.53	7.57	4.10	3.24	

Table 13-3 (continued)
Principal Components Analysis Pattern Matrix: Cross-Domain Factor-Based Composites

Note. N = 29.The correlation matrix was based on means calculated at the occupation level. F1 = Management and Achievement, F2 = Manual and Physical, F3 = General Office, F4 = Technical versus Interpersonal. These loadings are based on an orthogonal varimax rotation. Domains are abbreviated: WC = Work Context; SK = Skills; WS = Work Styles; GWA = Generalized Work Activities; OV = Occupational Values; KN = Knowledges; AB = Abilities.

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Table 13-4
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Abilities

	Factor			
Ability Descriptors	F1	F2	F3	Communality
1. Oral Comprehension	-.48	.84	-.18	.98
2. Written Comprehension	-.46	.87	-.02	.97
3. Oral Expression	-.39	.90	-.17	.99
4. Written Expression	-.46	.86	-.20	.99
5. Fluency of Ideas	-.44	.85	-.27	.99
6. Originality	-.38	.87	-.13	.93
7. Problem Sensitivity	-.15	.96	-.12	.95
8. Deductive Reasoning	-.41	.90	-.01	.97
9. Inductive Reasoning	-.24	.93	-.06	.93
10. Information Ordering	-.45	.84	.26	.98
11. Category Flexibility	-.51	.77	-.16	.88
12. Math Reasoning	-.66	.67	.06	.88
13. Number Facility	-.67	.71	.07	.96
14. Memorization	-.37	.89	-.14	.95
15. Speed of Closure	-.43	.88	-.02	.97
16. Flexibility of Closure	-.20	.88	.21	.86
17. Perceptual Speed	.28	.17	.92	.96
18. Spatial Orientation	.95	-.26	.09	.97
19. Visualization	.37	.30	.56	.54
20. Selective Attention	.11	.88	.35	.90
21. Time Sharing	-.17	.96	.02	.96
22. Arm-hand Steadiness	.73	-.40	.51	.95
23. Manual Dexterity	.71	-.51	.46	.98
24. Finger Dexterity	.56	-.54	.61	.98
25. Control Precision	.70	-.46	.48	.93
26. Multi-limb coordination	.78	-.53	.28	.96
27. Response Orientation	.92	-.24	.26	.98
28. Rate Control	.82	-.44	.24	.92
29. Reaction Time	.87	-.35	.31	.97
30. Wrist Finger Speed	.19	-.38	.69	.66
31. Speed of Limb Movement	.83	-.48	.21	.96
32. Static Strength	.78	-.56	.23	.98
33. Explosive Strength	.88	-.43	.16	.98
34. Dynamic Strength	.82	-.50	.20	.96
35. Trunk Strength	.75	-.59	.28	.99
36. Stamina	.81	-.53	.16	.96
37. Extent Flexibility	.71	-.64	.29	.99
38. Dynamic Flexibility	.74	-.63	.18	.99
39. Gross Body Coordination	.80	-.54	.20	.97

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Table 13-4 (continued)
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Abilities

Ability Descriptors	F1	F2	F3	Communality
	Factor			
40. Gross Body Equilibrium	.74	-.63	.14	.97
41. Near Vision	.48	.14	.73	.78
42. Far Vision	.96	.14	-.02	.94
43. Visual Color Discrimination	.67	-.35	.57	.90
44. Night Vision	.92	-.32	.16	.96
45. Peripheral Vision	.93	-.28	.20	.99
46. Depth Perception	.90	-.35	.22	.99
47. Glare Sensitivity	.88	-.16	.31	.90
48. Hearing Sensitivity	.88	-.27	.36	.97
49. Auditory Attention	.91	-.24	.27	.96
50. Sound Localization	.91	-.28	.28	.98
51. Speech Recognition	-.08	.82	-.28	.75
52. Speech Clarity	-.28	.88	-.30	.94
Percent of Variance	44	39	11	
Eigenvalues	38.41	7.75	2.47	

Note. N = 42. The correlation matrix was based on occupation-level correlations between abilities and generalized work activities. F1 = Operating Vehicles and Physical Tasks with Physical and Perceptual Abilities, F2 = Cognitively Demanding Tasks with High Level Cognitive Abilities, F3 = Manual/Repair Tasks with Perceptual/Psychomotor Abilities. These loadings are based on an orthogonal varimax rotation.

Table 13-5
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Work Styles

Work Style Descriptors	Factor F1	F2	F3	Communality
1. Achievement/Effort	.91	.33	-.06	.94
2. Persistence	.95	.28	.07	.98
3. Initiative	.95	.24	-.10	.96
4. Energy	.31	.32	-.73	.73
5. Leadership Orientation	.86	.45	-.13	.97
6. Cooperation	-.03	.91	-.04	.83
7. Concern for Others	.27	.91	-.13	.92
8. Social Orientation	.20	.91	-.28	.94
9. Self-control	-.19	.92	-.24	.94
10. Stress Tolerance	.59	.76	.15	.96
11. Adaptability/Flexibility	.81	.54	.08	.96
12. Dependability	.50	.80	-.07	.89
13. Attention to Detail	.29	-.05	.82	.77
14. Integrity	.50	.81	.02	.90
15. Independence	.80	-.08	.06	.65
16. Innovation	.98	.09	-.08	.98
17. Analytical Thinking	.95	-.01	.22	.95
Percent of Variance	45	36	9	
Eigenvalues	10.23	3.81	1.23	

Note. N = 42. The correlation matrix was based on occupation-level correlations between work styles and generalized work activities. F1 = Demanding/Cognitive Tasks with Cognitively Oriented and Achievement-Related Work Styles, F2 = Working with Others with Interpersonal Work Styles, F3 = Detail Oriented Work Tasks with High Attention to Detail and Low Energy. These loadings are based on an orthogonal varimax rotation.

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Table 13-6
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Occupational Values

Occupational Value Descriptors	Factor F1	F2	F3	F4	Communality
1. Ability Utilization	.92	.36	-.02	-.07	.99
2. Achievement	.89	.39	.05	-.04	.96
3. Activity	.79	.37	-.27	.11	.85
4. Advancement	.74	.55	-.04	-.09	.85
5. Authority	.78	.41	.40	-.08	.95
6. Company Policies	.30	.85	.10	.06	.83
7. Compensation	.39	.67	-.17	-.31	.72
8. Co-workers	.12	.08	.17	.85	.78
9. Creativity	.87	.44	.15	-.10	.98
10. Independence	-.18	-.81	.01	.10	.69
11. Moral Values	-.12	-.21	-.17	.90	.91
12. Recognition	.62	.73	-.05	-.06	.92
13. Responsibility	.78	.30	.27	-.31	.86
14. Security	.50	-.08	.89	-.30	.89
15. Social Service	.23	-.16	.82	.40	.91
16. Social Status	.84	.09	.47	-.09	.95
17. Supervision Human Resources	.42	.76	-.22	.10	.81
18. Supervision Technical	-.58	.01	.66	.42	.95
19. Variety	.85	.30	.40	-.01	.98
20. Working Conditions	.91	.15	-.13	.18	.90
21. Autonomy	.88	.30	-.22	.14	.93
Percent of Variance	13	21	13	11	
Eigenvalues	45.72	10.67	6.60	5.56	

Note. N = 42. The correlation matrix was based on occupation-level correlations between abilities and generalized work activities. F1 = Achievement-Related Values with Information/Interpersonal Tasks, F2 = Company Policy-Related Values, F3 = Security/Social Service, F4 = Moral Values/Coworkers. These loadings are based on an orthogonal varimax rotation.

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Table 13-7
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Skills

	Factor			
Skill Descriptors	F1	F2	F3	Communality
1. Reading Comprehension	.86	-.26	.39	.95
2. Active Listening	.82	-.47	.29	.97
3. Writing	.86	-.32	.36	.97
4. Speaking	.90	-.30	.27	.96
5. Mathematics	.81	.08	.52	.94
6. Science	.67	.47	.47	.89
7. Critical Thinking	.91	-.19	.37	.99
8. Active Learning	.90	.08	.39	.98
9. Learning Strategies	.93	-.06	.19	.91
10. Monitoring	.95	-.18	.20	.97
11. Social Perceptiveness	.88	-.41	.00	.95
12. Coordination	.94	-.09	.29	.98
13. Persuasion	.92	-.33	.15	.97
14. Negotiation	.92	-.36	.05	.98
15. Instructing	.86	.06	.27	.81
16. Service Orientation	.86	-.46	-.05	.95
17. Problem Identification	.89	-.13	.40	.97
18. Information Gathering	.90	-.18	.34	.97
19. Information Organization	.88	-.11	.44	.99
20. Synthesis/Reorganization	.89	-.15	.43	.99
21. Idea Generation	.92	-.07	.36	.98
22. Idea Evaluation	.91	-.14	.37	.99
23. Implementation Planning	.89	-.14	.42	.99
24. Solution Appraisal	.92	-.20	.32	.99
25. Operations Analysis	.80	.13	.55	.97
26. Technology Design	.68	.50	.52	.98
27. Equipment Selection	.66	.70	.19	.95
28. Installation	-.20	.95	.01	.94
29. Programming	.43	.28	.81	.91
30. Testing	.16	.87	.46	.99
31. Operation Monitoring	-.35	.89	-.23	.97
32. Operation and Control	-.32	.91	-.16	.95
33. Product Inspection	.15	.97	.07	.96
34. Equipment Maintenance	-.41	.85	-.28	.97
35. Troubleshooting	-.05	.95	.30	.99
36. Repairing	-.30	.94	.02	.98
37. Visioning	.83	.26	.10	.76
38. Systems Perception	.93	.31	.13	.97
39. Identification of Downstream Consequences	.96	-.10	.10	.94
40. Identification of Key Causes	.96	-.12	.21	.97
41. Judgment and Decision Making	.93	-.23	.24	.98

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Table 13-7 (continued)
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Skills

Skill Descriptors	Factor F1	F2	F3	Communality
42. Systems Evaluation	.94	.10	.25	.96
43. Time Management	.97	-.16	.15	.99
44. Management of Financial Resources	.94	-.19	.06	.92
45. Management of Material Resources	.97	.16	-.09	.97
46. Management of Personnel Resources	.97	-.07	-.11	.96
Percent of Variance	65	21	10	
Eigenvalues	33.26	9.15	1.64	

Note. N = 42. The correlation matrix was based on occupation-level correlations between abilities and generalized work activities. F1 = High-Level Cognitive, Interpersonal, and Managerial Skills, F2 = Technical Skills with Repair Activities, F3 = Programming. These loadings are based on an orthogonal varimax rotation.

Table 13-8
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Knowledges

Knowledge Descriptors	Factor F1	F2	F3	F4	Communality
1. Administration and Management	.90	.30	-.14	-.17	.95
2. Clerical	.78	.08	-.43	-.08	.81
3. Economics and Accounting	.75	.34	-.22	-.42	.90
4. Sales and Marketing	.68	.21	-.16	-.59	.87
5. Customer and Personal Service	.64	.48	-.37	-.33	.88
6. Personnel and Human Resources	.80	.48	-.18	-.10	.91
7. Production and Processing	-.25	-.03	.84	.12	.79
8. Food Production	-.70	-.02	.60	.20	.87
9. Computers and Electronics	.93	-.06	-.27	.01	.94
10. Engineering and Technology	-.02	-.34	.78	.47	.95
11. Design	.58	-.07	.73	.11	.89
12. Building and Construction	-.40	.00	.90	.10	.98
13. Mechanical	-.39	-.19	.78	.43	.98
14. Mathematics	.96	.05	.00	.13	.95
15. Physics	-.27	.08	.79	.53	.98
16. Chemistry	-.28	.04	.56	.76	.98
17. Biology	.16	.14	.16	.94	.96
18. Psychology	.60	.70	-.36	.06	.99
19. Sociology and Anthropology	.57	.77	-.24	.00	.97
20. Geography	.48	.83	-.01	-.10	.93
21. Medicine and Dentistry	-.10	.45	.22	.84	.97
22. Therapy and Counseling	.48	.83	-.11	.08	.93
23. Education and Training	.80	.51	-.15	.16	.96
24. English Language	.87	.39	-.28	-.09	.99
25. Foreign Language	-.23	.87	.36	.05	.94
26. Fine Arts	.39	.72	.30	.12	.78
27. History and Archeology	.50	.79	.06	.19	.92
28. Philosophy and Theology	.47	.86	-.18	-.04	.99
29. Public Safety and Security	-.27	.86	-.05	.15	.84
30. Law, Government, and Jurisprudence	.42	.78	-.38	.09	.95
31. Telecommunications	.71	.53	-.04	-.20	.84
32. Communications and Media	.81	.52	-.27	-.07	.84
33. Transportation	-.33	.48	.62	-.23	.77
Percent of Variance	35	27	19	12	
Eigenvalues	17.43	7.31	3.43	2.17	

Note. N = 42. The correlation matrix was based on occupation-level correlations between knowledges and generalized work activities. F1 = Management/Business and Professional, F2 = Social Sciences and Humanities, F3 = Technical, F4 = Science and Medicine. These loadings are based on an orthogonal varimax rotation.

Table 13-9
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Work Context

Work Context Descriptors	F1	F2	F3	F4	Communality
	Factor				
1. Communication Formality	-.56	.69	.30	.29	.97
2. Communication Methods					
2a. Face-to-Face Individuals	-.09	.05	.64	.15	.44
2b. Face-to-Face Groups	-.33	.82	.23	-.1	.83
2c. Public Speaking	-.34	.26	.81	-.23	.89
2d. Video Conference	-.52	.36	.52	-.12	.68
2e. Voice Mail	-.80	.48	.25	.04	.93
2f. Telephone	-.78	.27	.39	.26	.90
2g. Interactive Computer	-.72	.10	.58	.16	.89
2h. Electronic Mail	-.89	.41	-.02	.07	.97
2i. Handwritten Notes	-.67	.43	.44	.27	.90
2j. Letters and Memos	-.74	.51	.31	.01	.91
2k. Written Reports	.10	.30	.17	.88	.90
3. Communication Subjectivity	.03	.59	.59	-.37	.84
4. Social Interaction	-.17	.25	.91	.12	.94
5. Privacy of Communication	-.74	.61	.14	.06	.94
6. Job Interactions					
6a. Supervise/Develop Others	.15	.79	.02	.02	.65
6b. Persuade or Influence	-.66	.53	.37	-.25	.92
6c. Provide Service to Others	-.28	.12	.73	-.05	.62
6d. Take Opposing Position	-.50	.78	-.19	-.09	.90
6e. Work/Contribute to Team	-.06	.50	.13	-.07	.27
6f. Deal with Public	-.42	.19	.85	.05	.93
6g. Coordinate/Lead Activity	-.08	.91	.17	-.05	.87
7. Health/Safety of Others	.98	.04	.01	.03	.96
8. Responsible Others Work	.05	.94	.03	-.17	.91
9. Conflict Situations	-.13	.71	.58	.18	.89
10. Unpleasant Individuals	.29	.07	.86	.27	.90
11. Physical Aggression	.66	.18	.47	.48	.92
12. Work Settings					
12a. Indoors, Controlled	-.92	.11	.25	-.06	.92
12b. Indoors, Uncontrolled	.83	-.08	-.29	-.19	.81
12c. Outdoors, Exposed	.93	-.04	.08	.02	.88
12d. Outdoors, Covered	.91	-.15	.04	-.10	.86
12e. Open Vehicle/Equipment	.88	-.13	-.32	.00	.90
12f. Enclosed Vehicle/Equipment	.70	.16	.23	.13	.59
13. Privacy of Work Area	-.73	.64	.19	.05	.98
14. Physical Proximity	.82	-.14	.21	.25	.79
15. Environmental Conditions					
15a. Distracting Noise	.93	-.11	-.02	-.03	.87
15b. Extreme Temperatures	.94	-.20	-.19	-.07	.96
15c. Poor Lighting	.93	-.24	-.13	.06	.94
15d. Contaminants	.95	-.23	-.14	.04	.97

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Table 13-9 (continued)
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Work Context

Work Context Descriptors	Factor F1	F2	F3	F4	Communality
15e. Cramped Work Space	.92	-.31	-.19	.02	.98
15f. Whole Body Vibration	.88	-.18	-.29	-.05	.87
16a. Radiation: Likelihood of Injury	.46	-.06	.39	.61	.73
17. Diseases/Infections	.16	.05	-.71	.14	.55
18. High Places	.89	-.21	-.32	-.16	.97
19. Hazardous Conditions	.87	-.18	-.42	.13	.98
20. Hazardous Equipment	.92	-.15	-.31	-.02	.97
21. Hazardous Situations	.94	-.25	-.21	-.05	.98
22. Body Positioning					
22a. Sitting	-.82	.38	-.01	.32	.92
22b. Standing	.80	-.40	.01	-.29	.89
22c. Climbing Ladders, etc.	.85	-.24	-.39	-.21	.97
22d. Walking or Running	.85	-.36	.05	-.31	.95
22e. Kneeling or Crouching	.86	-.40	-.11	-.20	.95
22f. Keeping/Regaining Balance	.93	-.25	-.09	-.17	.96
22g. Handling Tools, Objects	.77	-.56	-.29	-.10	.99
22h. Bending/Twisting Body	.86	-.45	-.01	-.20	.98
22i. Making Repetitive Motions	.60	-.69	-.35	-.05	.97
23. Work Attire					
23a. Business/Office Clothes	-.82	.34	.43	.06	.98
23b. Special Uniform	.67	-.27	.32	.43	.81
23c. Maintenance Clothes	.82	-.29	-.44	-.20	.99
23d. Common Safety Attire	.90	-.19	-.33	.16	.98
23e. Special Safety Attire	.93	-.11	-.19	.11	.93
24f. Consequence of Error	.48	.49	-.34	.61	.95
25 .Level of Decisions					
25a. Impact of Decisions	-.31	.76	.33	.42	.96
25b. Frequency of Decisions	-.19	.58	.67	.36	.95
26. Accountable for Results	-.31	.85	.11	.28	.90
27. Decision Latitude	-.46	.81	.25	.18	.98
28. Frustrating Circumstances	-.45	.72	-.30	.26	.87
29. Level of Automation	-.71	-.07	-.31	.43	.79
30. Task/Performance Clarity	.63	-.62	.15	.16	.83
31. Accuracy/Exactness	-.54	-.03	.18	.78	.93
32. Details and Completeness	-.50	-.15	.03	.71	.78
33. Constant Awareness	.72	.00	.55	.34	.94
34. Repetitive Activities	.58	-.73	-.15	.25	.95
35. Unstructured Tasks/Goals	-.62	.72	.21	-.07	.95
36. Level of Competition	.09	.41	.26	-.64	.65
37. Deadlines/Time Pressure	.88	-.16	-.27	.18	.90
38. Work With Distractions	-.64	.39	.18	.50	.85
39. Machine Driven Pace	.63	-.50	-.50	.03	.90

Table 13-9 (continued)
Principal Components Analysis Pattern Matrix for Cross-Domain Analysis of Correlations with Generalized Work Activities: Work Context

Work Context Descriptors	F1	F2	F3	F4	Communality
	Factor				
Percent of Variance	47	20	14	8	
Eigenvalues	45.72	10.67	6.61	5.56	

Note. N = 42. The correlation matrix was based on occupation-level correlations between abilities and generalized work activities. F1 = Hazardous Work Environments, F2 = Managerial Relations, F3 = Interpersonal: Especially Public and/or Conflict, F4 = Careful Documentation. These loadings are based on an orthogonal varimax rotation.

Chapter 14

Occupation Classification: Using Basic and Cross-Functional Skills and Generalized Work Activities to Create Job Families

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This chapter presents results of job clustering analyses using the measures of broad skills and work activities from the O*NET content model. These measures consist of 46 basic and cross-functional skills and 42 GWAs. We begin with a brief introduction describing the specific objectives of the job clustering analyses, a description of the data used, and background on the analytic approach. We then present and discuss the results and their implications for occupation classification using the O*NET taxonomy.

Introduction

The overall objective of the job clustering analyses was to answer the following question: What is the utility of the newly developed O*NET measures of basic and cross-functional skills and generalized work activities (GWAs) for job classification purposes? This is a central

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question because these descriptors were designed specifically for comparing occupations within and across organizations. Furthermore, these measures of skills and work activities represent the two domains of primary focus in most prior classification work, namely, human attributes of work performance and the nature of work itself (Pearlman, 1980). Hence, these O*NET measures represent alternative perspectives commonly used to describe jobs.

Occupation classification involves grouping jobs or occupations on the basis of shared characteristics, such as tasks performed or skills required. In personnel psychology and human resource management, classifying jobs or occupations represents the necessary first step in performing a wide range of personnel functions. For example, in wage and salary administration, it is legally advisable to place highly related jobs in the same salary range. Similarly, highly related jobs may use the same selection and performance appraisal instruments, thereby significantly decreasing the development and administrative burden associated with these functions. In short, job classification uses job description information to determine which jobs are administratively equivalent, and therefore simplifies most major functions of personnel administration greatly. Understanding the characteristics of the O*NET skills and work activities descriptors in identifying highly-related occupations, or job families, is an important issue because these descriptors are intended to provide descriptive information applicable across many jobs and/or occupations.

Related to the need to evaluate the classification utility of the O*NET measures of skills and work activities is the fact that the Department of Labor (DOL) is participating in the national move toward a skills-based emphasis in describing jobs. This effort stems largely from the ever increasing global economic competition which, in turn, creates the need for continued mastery of new skills and technologies by the nation's workforce. The world of work is moving toward a state characterized by the need for a high degree of employment flexibility and technical know-how among workers of most occupations. The O*NET basic and cross-functional skills and GWAs represent this perspective of work, and thus provides a sound basis for skill-based occupation classification.

Analysis Overview

The characteristics of the basic and cross-functional skills and GWAs were examined with respect to three issues that affect the results of any classification effort. Specifically, this study compared the quality of cluster solutions which were based on:

- different variable sets,
- different clustering procedures, and
- different samples.

Prior research demonstrates that job description variables, clustering procedures, and samples can influence the results of clustering efforts (e.g., Cornelius, Carron, & Collins, 1979). Therefore, these three areas formed critical domains across which cluster solutions were examined.

First, cluster solutions based on different variable sets were compared. As noted above, the O*NET job descriptors chosen for these analyses included basic and cross-functional skills and GWAs. Each of these descriptors are defined broadly enough to make comparisons across jobs. Thus, this first comparison helps reveal differences between job cluster solutions using different descriptors. These analyses resulted in comparisons of job family solutions based on (1) GWAs, (2) basic and cross-functional skills, or (3) GWAs and skills combined.

Second, the cluster solutions from two types of agglomerative hierarchical clustering methods were compared. In general, cluster analysis is a class of statistical techniques in which cases (e.g., occupations) are grouped on the basis of their similarities across a set of descriptive variables (e.g., job descriptors). Agglomerative hierarchical methods represent one of several

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approaches to conducting a cluster analysis. While other clustering methods exists (e.g., divisive hierarchical, k-medoid), agglomerative hierarchical clustering is widely used and properties of this method are thoroughly understood. These analyses involved a comparison of clustering solutions based on two widely used algorithms for developing clusters with agglomerative hierarchical procedures.

Finally, cluster solutions based on different samples were compared. Data for both job incumbents and occupational analysts were available and cluster solutions across these samples were compared. These analyses were intended to reveal whether differences between incumbents' and analysts' ratings would produce differences in cluster solutions. This comparison has obvious implications for future data collection efforts using the O*NET taxonomy because analysts' ratings of occupations are widely used for a variety of purposes.

These comparisons helped evaluate the overall quality of the various cluster solutions without regard to the specific assignment of occupations to clusters. However, an important outcome stemming from these comparisons was a determination of whether or not the resulting cluster solutions are qualitatively similar in terms of occupation assignment. We concluded these analyses by assessing the extent to which the occupations were being cluster in the same or different clusters across the various conditions noted above.

Data Description

Database Construction

Three databases were available for this investigation. The first database, called the "1,122 analysts data," contained ratings made by trained occupational analysts. These occupational analysts consisted of occupational analysts and Industrial/Organizational psychology graduate students. The analysts rated 1,122 occupational units, where occupational units represented a

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taxonomy of jobs with a level of specificity in between the more general Occupational Employment Statistics (OES) taxonomy and the more specific Dictionary of Occupational Titles (DOT) taxonomy. Ratings occurred on a subset of the O*NET content model categories, including basic and cross-functional skills and GWAs. At any one time, five analysts independently rated the level, importance, and/or frequency of 125 occupational units on a single content model category (e.g., GWAs). Analysts were rotated to fit this data collection structure, thereby ensuring a mix of raters and minimizing rating errors. From completed ratings, mean level scores on each descriptor served as the rating for each occupational unit. Thus, the 1,122 analysts data contained mean ratings for 1,122 occupational units on level, importance, and frequency, if applicable, for the selected O*NET content model categories.

The second database, called the "29 incumbent data," was comprised of level, importance, frequency, and/or job entry requirement ratings for 29 occupational units by approximately 700 incumbent workers. It is estimated that these 29 occupational units encompass 34 percent of the employed population. Also, these 29 occupational units represent a subset from an original list of 80 targeted occupational units where four or more incumbents responded to all of the O*NET data collection questionnaires. Job incumbents typically completed more than one and as many as five questionnaires. As with the analysts data, mean incumbents' ratings on level, importance, and frequency, if applicable, across the job descriptors served as the occupational unit scores. Thus, the incumbent database contains mean ratings on 29 occupational units, as opposed to the 1,122 rated occupational units of the complete analyst database.

Finally, a third database consisting of 29 occupational units corresponding to those occupations rated by incumbent workers was abstracted from the 1,122 analysts data. This database is called the "29 analysts data." Because this extracted database is a subset of the 1,122 analysts data, it shares all the other properties of that larger database.

From each of these three databases, only the level ratings were used in the current analyses.

Description of Variables

To this point, basic and cross-functional skills and GWAs have been described only as being broadly defined. In the O*NET framework, basic and cross-functional skills represent general procedures or strategies contributing to performance on job tasks. Basic and cross-functional skills are regarded as two key kinds of capacities in performance. First, basic skills represent the performance capacities of individuals which facilitate learning or the more rapid acquisition of knowledge in general, whereas cross-functional skills represent experienced-based performance capacities and contribute to performance across many jobs. Examples of the basic skills include Reading Comprehension (Skill Descriptor #1) and Critical Thinking (Skill Descriptor #7), and examples of cross-functional skills include Information Gathering (Skill Descriptor #18) and Solution Appraisal (Skill Descriptor #24).

Generalized work activities are broadly defined work functions. As such, GWAs are like basic and cross-functional skills in that they remain equally applicable across many jobs and occupations. An example of a GWAs is Interacting with Computers (GWA Descriptor #19). As a work function, interacting with computers likely applies to many seemingly distinct occupations (e.g., computer analysts, secretary) and thus provides a mechanism for describing and classifying occupations.

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Clustering Technique

There are many decisions to make when conducting a cluster analysis. Prior research provides some basic guidelines, and this analysis used these guidelines in an effort to focus the scope of the analyses and eliminate potential methodological confounds.

In terms of the analytic scope, these analyses examined the characteristics of the basic and cross-functional skills and GWAs with respect to two clustering algorithms and two modes of combining descriptors across three samples. Where possible, decisions regarding specific aspects of clustering methodology not directly relevant to exploring these issues were standardized. All standardization decisions were made on the basis of supported recommendations from the available literature. Once made, these aspects of the analyses remained constant. For example, Euclidean distance was chosen as the distance measure, and thus all the analyses used this measure without exception.

The second advantage to this standardization approach was that it reduced the influence of potential methodological confounds. It would be difficult to interpret differences among cluster solutions if the methods used to produce those solutions varied substantially. That is, the more elements of the research design that could be fixed, the better.

Clustering Approach

There were essentially four major analytic decisions to make in conducting these analyses. These decisions concerned data standardization, profile similarity measurement, clustering methodology, and criteria for evaluating cluster solutions. Each of the decisions are discussed below. First, however, it is important to understand another aspect of cluster analysis, data conversion, which pertains to how the data are treated and not what they are or where they originate (these latter issues have been previously addressed).

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Most often, data consist of individual ratings on a series of variables pertaining to some domain(s) of interest. Here, however, data consisted of mean occupational ratings on several job descriptors. The level of analysis is the occupation and not the individual. Furthermore, occupations form the targeted domain in the data analysis; the relationship among occupations across variables is the focus, as opposed to the relationship of variables across occupations.

Data Standardization

These analyses clustered occupational groupings with respect to the shape of their profile only, where profile refers to the overall pattern of responses across a set of job descriptors. Both the scatter and level dimensions of occupational grouping profiles were eliminated by standardizing the data within each occupational grouping. This required converting the skills and work activities scales, separately, to z-score values within each occupation. The effect of this procedure was to give each occupational grouping, or case, a mean value of 0 and a standard deviation of 1 across each set of skill and work activities measures.

The decision to create occupational families using only the shape dimension of the score profile centered on three reasons. First, shape represents a primarily qualitative--as opposed to a quantitative--dimension of a profile. It can be argued that the most coherent description of occupational families is one that emphasizes qualitative differences: differences in kind or type. Thus, occupational groupings that share the same relative emphasis on skills and work activities get grouped together, ignoring differences between occupations in the level or variability of these skills or work activities.

Clustering on profile measures that take into account (or even emphasized) the level, or amount, of these attributes, might result in occupations being assigned to separate clusters in ways that would be difficult to explain. For example, it is typical for occupations in the same

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career field to differ primarily by level of skill required (e.g., entry-, mid-, and executive-level). Here, the career field represents qualitatively similar occupations because they all share a similar shape of skill profile, but differ with respect to the level of skills required. If differences in skill level dominated the construction of occupational families, then some occupations may be grouped with other occupations from different career fields because they require the same overall level of different skills. Such clustering makes the subsequent occupational structure difficult to interpret and use.

The second reason for clustering on shape is that level differences within a job family can be relatively straightforwardly identified post-hoc by looking at mean score differences across profile variables. Furthermore, there are clear advantages to looking at level after occupational groupings have been constructed based on the shape of the profile. For example, such a post-hoc identification of level differences allows the identification of career paths, career development plans, promotion tracks, and training needs. Hence, level effects are not regarded as meaningless; indeed they are extremely useful, but are simply identified at a later phase of the analysis. The same holds true for score profile variability, or scatter effects. After job family construction, differences within family with respect to profile score scatter can be identified by looking at variability across descriptor measures.

Finally, clustering on shape reduces the level of complexity in the distance measure by having it reflect a single profile dimension. This should enhance the interpretability of the resulting occupational structure, and thus reduce the likelihood of ambiguous interpretations that may arise from solutions representing information about shape, level, and scatter simultaneously.

Distance Measure

In cluster analysis, grouping cases proceeds on the basis of commonality, as defined by a dissimilarity or similarity measure. Euclidean distance, or D, represented the measure of distance between occupational groupings for these analyses. Euclidean distance between two items, X and Y, is the square root of the sum of squared differences between all values for those items (Cronbach & Gleser, 1953; Norusis/SPSS, Inc., 1993). With raw score data, D represents all three dimensions of a profile score: scatter, level, and shape. However, given the within-case standardization of the data, both scatter and level dimensions were removed.

Euclidean distance is used extensively in clustering applications and therefore is well understood in terms of its properties. Unlike Squared Euclidean distance, Euclidean distance does not exaggerate larger distances between objects (Cronbach & Gleser, 1953). Further, use of Euclidean distances is currently considered the preferred distance metric in occupational clustering (Colihan & Burger, 1995) and for most other applications (Kaufmann & Rousseeuw, 1990).

Methodology

Agglomerative hierarchical clustering algorithms were used for developing the occupational groupings. All agglomerative hierarchical procedures begin by treating each case as a distinct group, then iteratively building increasingly larger clusters until all cases are clustered together. These procedures first identify the two cases with the most similar profiles on the clustering variables based on a procedure-specific criterion. Next, the remaining cases are evaluated and either used to form a new, different cluster, or assigned to an existing cluster. As the cases are combined, the metric representing the distance between groups is recalculated. The procedure ends when all the cases are combined into one cluster. It is clear from this description that hierarchical procedures produce groups of increasing levels of generality.

While this is the overall process for all agglomerative procedures, there exists many different clustering methods for combining the occupational units into clusters. We used the Ward and Hook ("Ward's" method; Ward & Hook, 1963) and the within-groups average linkage methods. These two methods were used for two reasons. First, for both methods, the mathematical model represented by the algorithms reflects the nature of the intended application (Everitt, 1993). Both Ward's and within-group average linkage methods attempt to find clustering solutions that maximize within-group similarity. The Ward's method seeks to minimize the within-groups error (and thus maximize between-groups variance), while the within-group average linkage method attempts to minimize within-group distance from the group centroid. In the present effort, the result would be an occupational structure in which occupations within each cluster would have the most similar profiles of skills and work activities. The occupational families themselves, however, would tend to have dissimilar average profiles on the skills and work activities scales. Clearly, these models are consistent with the objectives of typical occupational family development efforts.

Second, both the Ward's within-group average linkage methods have track records of reliable application both generally and in developing clusters of people or jobs (Colihan & Burger, 1995). For example, Everitt (1993) recommends Ward's and group average methods as the most widely applicable of the hierarchical class of techniques (p. 142). Ward's method has been widely adopted by researchers in areas as diverse as botany, archeology, and sociology (Kaufmann & Rousseeuw, 1990). Furthermore, Ward's method is considered by those working in the area of occupation classification to be one of the most commonly used and effective of the available clustering methods (Harvey, 1986; 1990). Average linkage methods were shown in a recent Monte Carlo study to recover clusters as well as Ward's method when combined with other methods for defining the number of clusters in the data (Colihan & Burger, 1995).

Use of Job Descriptors

There are many possible ways to use GWAs and basic and cross-functional skills as job descriptor information, and the present investigation explored five specific ways for using the job descriptor information. Generally speaking, these approaches involved using the skills and GWA data either separately or in combination to form job clusters.

The first two approaches evaluated the utility of using GWAs or basic and cross-functional skills to the exclusion of the other category of job descriptor information. This method requires less data and thus represents a more parsimonious approach from a data requirement perspective. However, the utility of this approach depends on many other factors, including the extent to which job families based on either one are useful and clearly defined given the exclusion of the other category of job descriptor data.

The remaining three approaches under investigation involved using both types of descriptor information together in deriving the job families. The more straight-forward approach involved using all GWA and skills descriptors at a single clustering step. Also, two-stage clustering methodologies were employed. In these approaches, the occupations were clustered first on one set of descriptors (i.e., skills or GWAs). Then, separate cluster analyses were carried out within each initial cluster, but using the alternate set of descriptors.

The two-stage, hierarchical approach to clustering provides a unique approach to job classification in which the type of descriptor data represents different domains. There are several reasons for trying out such an approach. It is difficult to know, a priori, whether or not one type of data (e.g., GWAs) will dominate the classification process if several types of data are clustered simultaneously. The two-staged approach allows for a more controlled usage of the job descriptors. Additionally, this approach might be useful if there is some rationale for a particular order of clustering. For instance, it might be argued that clustering first on skills produces more stable job families given the more enduring nature of skills in comparison to work activities. Then, clustering on GWAs within each skills-based job family demonstrates how similar sets of skills may be applied to different work activities. This approach might represent one perspective of work in which employees first master skills (e.g., college education) before applying those skills to specific domains (e.g., on the job).

We applied the two-stage approach in two ways: using skills, then GWAs, and vice-versa.

Criteria

This section describes a set of objective criteria used to evaluate the quality of the cluster solutions obtained from our analyses. These objective criteria are ways of representing cluster solution stability and coherence. Of course, in practice, subjective criteria (e.g., apparent utility, acceptability, or parsimony for particular purposes) are equally important in evaluating particular cluster solutions. However, these analyses emphasized more objective criteria to better facilitate making multiple comparisons across multiple clustering solutions. The specific objective criteria are: percent of cases correctly reclassified, simple structure, mean squared error, and effect size.

Percent (or Number) Correctly Reclassified

The percent of respondents correctly reclassified provides an index of the relative stability of the initial assignments of cases to clusters using a "confirmatory k-means" procedure. Operationally, the centroids (i.e., group means) for each descriptor are obtained from the initial hierarchical procedure. These centroids are used to define initial target cluster centers for a k-means clustering, or partitioning, procedure. The k-means procedure then assigns occupations to clusters based on these initial cluster centers. Finally, the initial hierarchical solution and the k-means solution are compared to identify the number of occupations that are classified differently. Given a good initial cluster solution, this test should find little or no change between cluster solutions.

A k-means partitioning analysis is a cluster analysis that is neither hierarchical nor agglomerative. Instead, a k-means procedure begins by identifying the k most diverse cases based on the number of clusters, k, specified a priori. This first set of k cases provides the initial cluster centers to which the other cases are subsequently assigned. In the variation used here (MacQueen, 1967), group centroids from the hierarchical agglomerative clustering analysis are used as the cluster centers for the partitioning analysis. Then, the partitioning analysis will attempt to assign the occupations to groups based on using the target cluster centers. This usually results in most cases being reassigned back into their original groups, although some cases are likely to be assigned to groups other than their original one. Typically, the partitioning analysis is run several times until the number of occupations assigned to each occupational family stabilizes, a process known as "chaining."

Simple Structure

The simple structure provides an index of the relative "fuzziness" or clarity of the assignment of occupations to clusters. Specifically, this index represents the proportion of final clusters where 75% or more of the occupations in each cluster have at least a .75 probability of being a member of its assigned cluster. Operationally, these probabilities are derived from a discriminant classification analysis. The procedure develops optimal linear composites, or classification functions, for each cluster using the set of descriptors, and then creates scores on

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the classification functions for each occupation. Occupations are then assigned to clusters based on whichever of the functions yields the largest value. These function scores are also used to derive the probabilities of cluster membership for each occupation that are used to form this simple structure index.

Mean Squared Error

The mean squared error (MSE) provides an index of the average homogeneity of the clusters comprising each solution, disregarding the separation between clusters. Having homogeneous occupations represented in the same job family is the primary objective of most job classification efforts. Most often, for example, we are interested in knowing which occupations we may treat the same with respect to personnel administration, such as developing training programs and salary administration. Operationally, this index is the error term derived from a mixed-design MANOVA where the set of descriptors serve as a set of repeated measures and the occupational clusters serve as the independent variables. The error term from this MANOVA represents the average variability within the occupational clusters.

Effect Size

The effect size provides an index of the amount, or size, of the separation between the occupational clusters. This index is derived from the same MANOVA that provides the value for Mean Squared Error, and represents the proportion of variance between the clusters relative to the total variance.

Table 14-1 presents the study design depicting the thirty analyses conducted in this investigation. The first column of Table 14-1 contains five different ways that the two descriptor sets might be combined. The remaining columns display the three samples, each with the Ward's and average linkage clustering methods nested under them. Cell entries include the number of obtained clusters, number of single occupation clusters, and the values for the four criteria.

Analysis Procedures

This section briefly outlines the analytic process followed in addressing the research questions. For each of these steps, particular attention is given to the information provided at that step. The specific procedures will not be described in detail as they can be found elsewhere by the interested reader (e.g., Everitt, 1993; Harvey, 1986; Pearlman, 1980).

Standardized Data

The first step of each analysis was to create two matrices. The first matrix was a dissimilarity matrix of distances based on the z-score transformation of the skills and work activities scores described earlier. This matrix was used for carrying out cluster analysis. The second matrix was a correlation matrix representing the correlations among the occupations across the skills and work activities scores. This matrix was used to carry out the q-factor analyses described in the next section.

Determine Number of Clusters

The number of clusters to extract was determined in two ways. For the 1,122 analysts data, number of clusters was determined by conducting a q-factor analysis on the 1,122 x 1,122 correlation matrix of occupations created during data standardization. Q-factor analysis represents a class of principal components or factor analyses in which the cases (i.e., occupational units) are factored, as opposed to the variables. With q-factor analysis, the number of potential groups in the data can be identified prior to clustering using the same factor identification methods of traditional factor analyses. Here, the eigenvalue greater than one rule (see Gorsuch, 1983) served as the guideline for setting the number of clusters to extract. Recent

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research supports the viability of this overall approach for determining number of clusters. For example, Monte Carlo results suggests that the use of q-factor analysis to identify the number of groups helps to improve classification results, particularly using Ward's method (Colihan & Burger, 1995).

For the 29 analysts data and 29 incumbent data, the number of clusters was determined by examining the dendrograms. Dendrograms are "tree-structured" graphical representations that display the formation of clusters at each stage. They may be displayed together with rescaled clustering coefficients that represent the distance between clusters that are combined at each stage. Hence, large increases in clustering coefficients indicate that very dissimilar elements and/or clusters have been formed. Determining the number of clusters proceeds by examining the dendrogram for these large increases, represented by longer distances in the tree-structured diagram.

Hierarchical Agglomerative Clustering

Once the number of clusters was determined, clustering analyses were conducted for each of the 30 analyses comprising the cells of Table 14-1. Each analysis provided initial clusters, as well as "seed points" (e.g., cluster centroids) for the next step.

K-Means Clustering

After identifying the initial clusters, the k-means procedure reclassified all occupations into their optimal occupational family. This procedure is often necessary because hierarchical agglomerative clustering procedures suffer from the flaw that individual cases clustered early in the procedure may not end up being optimally classified. Information used to calculate the percentage, or alternatively, the number of cases correctly reclassified comes from comparing the initial hierarchical cluster solution to the reclassified k-means cluster solutions by cross-tabulation.

Discriminant/MANOVA Analyses

Finally, the resulting clusters from the k-means were used in discriminant and MANOVA analyses to obtain additional indices for evaluating the clustering results. Specifically, this process provides indicators for simple structure of the cluster solution, effect size, and mean squared error.

Results/Discussion

The overall purpose of this analysis was to examine the utility of the new cross job descriptors from the O*NET content model in creating job families. The measures of basic and cross functional skills, and GWAs served as these job descriptors. As noted earlier, these broad skills and work activities measures were appropriate for two reasons. First, these measure encompass those aspects of job performance--worker attributes and job duties--most often used for the creation of job families (Pearlman, 1980). The skills measure worker attributes and the GWAs measure types of job functions and/or duties. Second, these measures were designed specifically for making comparisons across jobs and occupations.

Table 14-1 presents the results of this study in terms of the quality of the cluster solutions. In the following sections, these results will be discussed with respect to the three study comparisons made in these analyses:

- different variable sets (e.g., uses of job descriptor data),
- different clustering procedures, and
- different samples.

Tables 14-2 through 14-4 present cluster-solution convergence information which parallels the above-noted comparisons.

All of the results will be illustrated with examples from the analyses. The resulting job families based on the 29 incumbent data and the 29 analysts data are shown at the end of this chapter. Figures 14-1 through 14-10 present the incumbent-based job families across the various descriptor usage and clustering procedure conditions. Similarly, Figures 14-11 through 14-20 present the analysts-based job families. Figure 14-21 presents a segment of a job family solution based on the 1,122 analyst data.

Variable Set Comparisons

The first comparison concerned various ways to use the job descriptors. The set of descriptors were used either alone (e.g., skills only) or in combination. The different variations of combining the descriptors included using them all together or in a two-stage process whereby clustering occurred on skills (GWAs) first and then GWAs (skills) second. As shown in Table 14-1, using the descriptors in a two-stage approach provided better results across the set of criteria. In general, the two-stage approaches had higher percentage of correct reclassification rates and higher effect size estimates. The MSE estimates for the two-stage approaches were also lower than when skills and GWAs were combined in clustering.

These results are particularly pronounced with the sample of 1,122 occupations rated by occupational analysts. Here, the reclassification rates generally increased when going from using the descriptors in isolation to using them in the two-stage approach. This illustrates that the two-staged approaches provide a better initial cluster solution that requires relatively less readjustment with the confirmatory k-means procedure. The effect size estimates also improved in the two-staged approach, indicating greater cluster differentiation. As for the MSE, using GWAs only actually produced the smallest MSE estimates using the 1,122 analysts data. However, given that using GWAs alone yielded a lower effect size when compared to the two-stage approaches, it is evident that the cluster solution based on GWAs did not increase cluster differentiation despite producing low within-cluster variability. Finally, this pattern of results also occurred with the smaller sample of analysts' and incumbents' ratings, although it is more pronounced in the larger analysts sample.

In making comparisons among different ways to use job descriptor data, it is clear that each of the five variable set approaches examined in this study provides a means for producing clearly defined job families based on the statistical criteria. Although the two-stage approaches yielded better results across the statistical criteria, the other approaches yielded excellent results in an absolute sense. Hence, if the purpose for forming job families dictated a need to utilize skills or GWAs alone, the respective O*NET measures would still produce clearly differentiated job families. For example, Figure 14-3 shows five interpretable job clusters obtained from analyses using the 46 basic and cross-functional skills. The first cluster consists of occupations best classified as managerial in nature. Computer programmers, which are relatively distinct from the remaining occupations, form the second cluster. The third cluster consists of a variety of public service jobs. The fourth cluster consists of occupations involving material handling and transportation. Finally, the fifth cluster consists of occupations involving heavy equipment use, maintenance, and repair.

Figure 14-9 presents results from the two-stage analysis obtained by clustering GWAs within each of the five skill-based clusters described above (see Figure 14-3). As shown in Figure 14-9, the four skill-based clusters with more than one occupation were further partitioned to yield 11 final clusters. These final clusters represent a differentiation of each original skill-based cluster into groups relatively homogenous with respect to work activities. For example, the fourth skill cluster in Figure 14-3 combined occupations involving material handling and transportation.

This cluster was partitioned in Figure 14-9 into one cluster of occupations involving material handling (cluster 8, Figure 14-9) and a second cluster of occupations involving transportation (cluster 9, Figure 14-9).

Clustering Procedure Comparisons

The second comparison concerned the specific agglomerative clustering procedure used for these data. As shown in Table 14-1, there are comparisons of Ward's method to the within-groups average linkage method across the other factors in the study design. Each of these clustering procedures share a similar heuristic for forming the clusters. Namely, they seek to ensure within-cluster homogeneity, although each approaches this objective differently. Ward's is based on minimizing within-cluster variability, whereas within-groups average linkage is based on minimizing distance from the cluster centroid.

Overall, both clustering procedures adequately differentiated the occupations. Looking across Table 14-1, the Ward's procedure tended to produce better defined job families, especially for the 1,122 analysts data, in that the MSE was generally smaller and the effect sizes larger, particularly with the 1,122 analysts data. Hence, the job families were more homogeneous within clusters, as well as better differentiated between clusters. There were exceptions, however, to this pattern of results across both descriptor set and sample. All six exceptions to this pattern occurred with the smaller analysts and incumbents databases.

A second caveat about the agglomerative clustering procedures involves the reclassification rate calculations. Cluster solutions based on Ward's method appear to have required fewer adjustments, as indicated by their higher reclassification rates. These higher classification rates, however, may be due to the relation between Ward's procedure and the MacQueen (1967) k-means procedure. Specifically, both procedures use a variance minimization criteria in which occupations are assigned to clusters such that the variability within the cluster is minimized and the variability between clusters is maximized. This correspondence between these algorithms creates the possibility that mathematical optimization between these methods partly accounts for the better reclassification rates with Ward's.

Despite these caveats, both Ward's and within-groups average linkage methods resulted in clear occupation differentiation. Inspection of the figures shows that, within variable descriptor sets, the final cluster solutions were similar. For example, Figures 14-11 and 14-12 represent the cluster solutions obtained from analysts' ratings of the 42 GWAs using Ward's and within-groups average linkage methods, respectively. Twenty-seven of the 29 occupations were classified consistently across the two methods (see Cluster Solution Convergence section).

Sample Comparisons

The final study comparison made in this analysis concerned the quality of the cluster solutions produced across different samples. These comparisons were made primarily on the smaller data sets because they contained ratings on the same 29 occupations. Unlike the previous comparisons, the analysts' and incumbents' ratings produced markedly different results in terms of the statistical criteria of the resulting cluster solutions. As shown in Table 14-1, job families using the 29 common occupations evidenced better scores on the statistical criteria when based on the analysts' ratings. In most instances, the MSE estimates were lower, and the effect size estimates were higher among analysts-based job families. This pattern of results occurs whether comparisons are made on the Ward's or within-groups average linkage based cluster solutions.

Interestingly, the reclassification rates were slightly better for clusters based on the incumbent data, indicating the incumbents' ratings needed less adjustment after the initial classification. However, this latter effect likely reflects the greater number of clusters found when

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using the incumbents' ratings (average number of clusters = 6.7) than when using the analysts' ratings (average number of clusters = 5.1). With only 29 occupations being clustered, extracting more clusters will produce more single occupations clusters or clusters with only few elements. This results in less ambiguity in reclassifying cases using the k-means procedure.

Description of Complete Analysts Data

The last two columns of Table 14-1 show the results from the 10 cluster analyses using the 1,122 analysts data. As noted above, all the descriptors, singularly and combined, provide good differentiation of the occupations using both Ward's and within-groups average linkage clustering methods. In fact, thirty to 37% of the clusters from the two-stage procedures contained only one occupation. Figure 14-21 presents a subset of the final 181 clusters comprising the job family solution based on clustering the 46 basic and cross-functional skills first and the 42 GWAs second. These five clusters are typical of the clusters obtained in the 4 two-stage analyses. Accordingly, the two singleton clusters which are shown (Artificial Breeding Technicians and Engineering Managers) seem sufficiently unique with respect to requisite broad skills and work activities. The remaining three clusters illustrate the unambiguous differentiation that the two-stage approach provides among occupations. For example, occupations in the natural sciences (e.g., Biochemist, Biophysicists) form a separate cluster from manage information systems occupations (e.g., Computer Engineers, Systems Analysts). Thus, the statistical qualities identified in the above comparison hold true with the larger database of occupations.

Cluster Solution Convergence

Based on the above comparisons, it is evident that the various cluster solutions have good statistical properties. In this section, we present some comparisons of these different solutions in terms of their similarities and differences, or convergence. These cluster convergence comparisons paralleled those made above in terms of cluster solution quality (e.g., across variable sets, methods, and samples). We made the convergence assessments on the basis of the Cramer's V statistic, which provides an index of association between two nominal variables (Hays, 1988). This statistic ranges from 0 to 1, with 1 indicating maximal association between nominal variables and 0 indicating complete independence.

The first set of cluster convergence tests involved looking at the extent to which cluster solutions based on different variable sets were associated. Specifically, we made three descriptor set comparisons. First, we compared those cluster solutions based on GWAs only and skills only with each other and the GWAs and skills combined solutions. Second, we compared the GWAs and skills combined solutions to both the two-stage solutions. Note, however, that we did not compare GWAs with the GWAs, then skills two-stage solution or the skills with the skills, then GWAs two-stage solution. These comparison resulted in inflated Cramer's V estimates because of the perfect association between the GWAs (skills) only solution and the first stage of the GWAs (skills), then skills (GWAs) two-stage solution. Finally, we compared the two-stage solutions with each other and the GWAs and skills combined solutions.

As shown in Table 14-2, there was moderate to strong association across the cluster solutions based on different variable sets. The weakest level of convergence occurred when comparing the cluster solutions based on GWAs only and skills only using the 29 incumbent data and the 1,122 analysts data. This degree of divergence is expected given the differences between job attributes (i.e., GWAs) and worker attributes (i.e., skills) on which clustering occurred. For example, the Cramer's V estimate for the GWAs versus skills variable set comparison using the 29 incumbent data was only .59 (Table 14-2). Inspection of the corresponding cluster solutions (Figures 14-1 and 14-3) pinpoint the nature of these differences.

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In the GWAs-based cluster solution (Figure 14-1), Computer Programmers occupied a cluster with occupations performing similar work functions, such as Bookkeepers, Police Patrol Officers, and Office Clerks. Some of the shared GWAs among these occupations might include processing information, analyzing data or information, and interacting with computers. However, Computer Programmers require a distinct set of skills (e.g., programming) from those required of Bookkeepers, Patrol Officers, and/or Office Clerks. The skill-based cluster solution (Figure 14-3) shows that computer programmers were indeed placed into a unique cluster.

A final note of interests concerns the relationship between the two cluster solutions based on the two-stage approaches. As shown in Table 14-2, these solutions show good convergence using solutions based on the smaller databases, but are less associated using the larger analysts database. In the latter instance, the Cramer's V estimate is only .64 for both Ward's and within-groups average linkage solutions. Thus, although the two-stage solutions provided statistically sound clusters, these clusters vary depending on whether skills or GWAs are cluster first. This finding simply parallels the lower convergence between the GWAs only and skills only based solutions.

The second set of cluster convergence tests involved assessing the extent to which cluster solutions based on the Ward's and within-groups average linkage methods converged. Table 14-3 presents the results from these comparisons. As shown, the cluster solutions did not vary greatly as a function of using either method. All Cramer's V estimates equal or exceed the .70 level, indicating above average association among the various solution comparisons. The convergence among cluster solutions tends to be larger in the smaller samples versus the larger analysts sample. One possible explanation for this trend is that a greater number of clusters are being generated among a more diverse set of occupations in the larger database. This creates the opportunity for more variability in the clustering procedures and final cluster solutions.

The final set of cluster convergence analyses compared the cluster solutions based on incumbents' ratings with those based on analysts' ratings, using the 29 occupation data only. As shown in Table 14-4, the incumbents and analysts based solutions tend to converge more when using both GWAs and skills, regardless of whether used together or in a two-staged approach. The greatest level of convergence occurs when using the GWAs and skills together. Inspection of Figures 14-5 and 14-15 illustrate the nature of this convergence. Using the Ward's method, the analyst data resulted in three clusters and the incumbents data resulted in 6 clusters. However, close inspection of these tables reveals that the first 3 clusters in the incumbent solution correspond to the first cluster in the analysts solution, minus Sales Representatives and Packaging and Filling Machine Operators. Similarly, the last cluster from each solution shares all but one element. And by extension, incumbent clusters 4 and 5 (Figure 14-5) largely overlap with analysts cluster 2 (Figure 14-15).

Across all the convergence comparisons in Tables 14-2, 14-3, and 14-4, the overall level of convergence in clustering solutions was quite high. This finding bodes well for the assessment of the stability of clustering solutions based on combinations of basic and cross-functional skills and GWAs.

Conclusion

The results from this study paint a rather straight-forward and enthusiastic picture: The basic and cross-functional skills and GWAs measures from the O*NET content model provide excellent job description data. This finding is robust in that job families based on these job descriptors where both statistically sound and easily interpretable. The overall high level of

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coherence and job differentiation in the job families did not vary substantially across various parameters of clustering known to affect results of job family creation. Furthermore, there is a nigh degree of association between the resulting cluster solutions, particularly those based on both GWAs and skills. Based on these findings, the O*NET job descriptors appear to be accomplishing their objective of allowing cross occupation comparisons.

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Figure 14-1
Twenty-Nine Occupations Clustered on Incumbents' Ratings of 42 Generalized Work Activitites (Ward's Method)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
15005	Education Administrators	4.19	1
61005	Police and Detective Supervisors	3.87	1
19005	General Managers and Top Executives	3.48	1
32502	Registered Nurses	3.16	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.11	1
31305	Teachers, Elementary School	3.09	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.01	2
25105	Computer Programmers	2.99	2
63014	Police Patrol Officers	2.90	2
53905	Teacher Aides and Educational Assistants, Clerical	2.38	2
49011	Salespersons, Retail	2.26	2
55338	Bookkeeping, Accounting, and Auditing Clerks	2.20	2
55347	General Office Clerks	2.16	2
55108	Secretaries, except Legal and Medical	2.10	2
53102	Tellers	1.87	2
55305	Receptionists and Information Clerks	1.46	2
32902	Medical and Clinical Laboratory Technologists	3.13	3
85132	Maintenance Repairers, General Utility	2.85	3
92974	Packaging and Filling Machine Operators and Tenders	2.53	3
87902	Earth Drillers, except Oil and Gas	2.51	3
97111	Bus Drivers, School	2.25	3
65026	Cooks, Restaurant	1.72	3
97102	Truck Drivers, Heavy or Tractor-Trailer	1.32	3
65008	Waiters and Waitresses	2.34	4
49021	Counter and Rental Clerks	2.17	4
65038	Food Preparation Workers	1.94	4
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.83	4
66008	Nursing Aides, Orderlies, and Attendants	1.57	4
49023	Cashiers	1.42	4

Figure 14-2

Twenty-Nine Occupations Clustered First on Incumbents' Ratings of 42 Generalized Work Activitites (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
15005	Education Administrators	4.19	1
61005	Police and Detective Supervisors	3.87	1
19005	General Managers and Top Executives	3.48	1
32502	Registered Nurses	3.16	1
32902	Medical and Clinical Laboratory Technologists	3.13	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.11	1
31305	Teachers, Elementary School	3.09	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.01	1
25105	Computer Programmers	2.99	1
63014	Police Patrol Officers	2.90	1
53905	Teacher Aides and Educational Assistants, Clerical	2.38	1
55338	Bookkeeping, Accounting, and Auditing Clerks	2.20	1
55347	General Office Clerks	2.16	1
55108	Secretaries, except Legal and Medical	2.10	1
53102	Tellers	1.87	1
55305	Receptionists and Information Clerks	1.46	1
92974	Packaging and Filling Machine Operators and Tenders	2.53	2
65008	Waiters and Waitresses	2.34	2
49011	Salespersons, Retail	2.26	2
49021	Counter and Rental Clerks	2.17	2
65038	Food Preparation Workers	1.94	2
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.83	2
65026	Cooks, Restaurant	1.72	2
66008	Nursing Aides, Orderlies, and Attendants	1.57	2
49023	Cashiers	1.42	2
85132	Maintenance Repairers, General Utility	2.85	3
87902	Earth Drillers, except Oil and Gas	2.51	3
97111	Bus Drivers, School	2.25	3
97102	Truck Drivers, Heavy or Tractor-Trailer	1.32	3

Figure 14-3

Twenty-Nine Occupations Clustered on Incumbents' Ratings of 46 Basic and Cross-Functional Skills (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
15005	Education Administrators	4.24	1
19005	General Managers and Top Executives	4.11	1
61005	Police and Detective Supervisors	3.74	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.47	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.42	1
25105	Computer Programmers	4.01	2
32502	Registered Nurses	3.54	3
31305	Teachers, Elementary School	3.52	3
63014	Police Patrol Officers	2.87	3
49011	Salespersons, Retail	2.65	3
53905	Teacher Aides and Educational Assistants, Clerical	2.60	3
55108	Secretaries, except Legal and Medical	2.38	3
55338	Bookkeeping, Accounting, and Auditing Clerks	2.29	3
49021	Counter and Rental Clerks	2.02	3
55347	General Office Clerks	1.93	3
66008	Nursing Aides, Orderlies, and Attendants	1.91	3
49023	Cashiers	1.76	3
55305	Receptionists and Information Clerks	1.69	3
53102	Tellers	1.49	3
65026	Cooks, Restaurant	1.34	3
65008	Waiters and Waitresses	1.31	3
32902	Medical and Clinical Laboratory Technologists	4.08	4
65038	Food Preparation Workers	2.23	4
97111	Bus Drivers, School	2.22	4
97102	Truck Drivers, Heavy or Tractor-Trailer	2.15	4
92974	Packaging and Filling Machine Operators and Tenders	2.11	4
87902	Earth Drillers, except Oil and Gas	4.52	5
85132	Maintenance Repairers, General Utility	3.42	5
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	2.15	5

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Figure 14-4

Twenty-Nine Occupations Clustered on Incumbents' Ratings of 46 Basic and Cross-Functional Skills (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
15005	Education Administrators	4.24	1
19005	General Managers and Top Executives	4.11	1
61005	Police and Detective Supervisors	3.74	1
32502	Registered Nurses	3.54	1
31305	Teachers, Elementary School	3.52	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.47	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.42	1
63014	Police Patrol Officers	2.87	1
49011	Salespersons, Retail	2.65	1
53905	Teacher Aides and Educational Assistants, Clerical	2.60	1
55108	Secretaries, except Legal and Medical	2.38	1
55338	Bookkeeping, Accounting, and Auditing Clerks	2.29	1
97111	Bus Drivers, School	2.22	1
49021	Counter and Rental Clerks	2.02	1
55347	General Office Clerks	1.93	1
66008	Nursing Aides, Orderlies, and Attendants	1.91	1
49023	Cashiers	1.76	1
55305	Receptionists and Information Clerks	1.69	1
53102	Tellers	1.49	1
65026	Cooks, Restaurant	1.34	1
65008	Waiters and Waitresses	1.31	1
25105	Computer Programmers	4.01	2
32902	Medical and Clinical Laboratory Technologists	4.08	3
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	2.15	4
87902	Earth Drillers, except Oil and Gas	4.52	5
85132	Maintenance Repairers, General Utility	3.42	5
65038	Food Preparation Workers	2.23	6
97102	Truck Drivers, Heavy or Tractor-Trailer	2.15	6
92974	Packaging and Filling Machine Operators and Tenders	2.11	6

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Figure 14-5

Twenty-Nine Occupations Clustered on Incumbents' Ratings of 46 Basic and Cross-Functional Skills and 42 Generalized Work Activitites (Ward's Method)

Occupation Code	Occupation Title	Mean Across 42 GWAs and 46 Skills	Cluster
15005	Education Administrators	4.21	1
61005	Police and Detective Supervisors	3.81	1
19005	General Managers and Top Executives	3.80	1
32502	Registered Nurses	3.35	1
31305	Teachers, Elementary School	3.30	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.27	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.24	1
25105	Computer Programmers	3.50	2
32902	Medical and Clinical Laboratory Technologists	3.60	3
92974	Packaging and Filling Machine Operators and Tenders	2.32	3
65026	Cooks, Restaurant	1.53	3
63014	Police Patrol Officers	2.88	4
49011	Salespersons, Retail	2.45	4
49021	Counter and Rental Clerks	2.10	4
65008	Waiters and Waitresses	1.83	4
66008	Nursing Aides, Orderlies, and Attendants	1.74	4
53102	Tellers	1.68	4
49023	Cashiers	1.59	4
53905	Teacher Aides and Educational Assistants, Clerical	2.49	5
55338	Bookkeeping, Accounting, and Auditing Clerks	2.24	5
55108	Secretaries, except Legal and Medical	2.24	5
55347	General Office Clerks	2.04	5
55305	Receptionists and Information Clerks	1.58	5
87902	Earth Drillers, except Oil and Gas	3.51	6
85132	Maintenance Repairers, General Utility	3.13	6
97111	Bus Drivers, School	2.23	6
65038	Food Preparation Workers	2.08	6
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.99	6
97102	Truck Drivers, Heavy or Tractor-Trailer	1.73	6

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Figure 14-6 .

Twenty-Nine Occupations Clustered on Incumbents' Ratings of 46 Basic and Cross-Functional Skills and 42 Generalized Work Activitites (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 42 GWAs and 46 Skills	Cluster
15005	Education Administrators	4.21	1
61005	Police and Detective Supervisors	3.81	1
19005	General Managers and Top Executives	3.80	1
32502	Registered Nurses	3.35	1
31305	Teachers, Elementary School	3.30	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.27	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.24	1
25105	Computer Programmers	3.50	2
32902	Medical and Clinical Laboratory Technologists	3.60	3
63014	Police Patrol Officers	2.88	4
53905	Teacher Aides and Educational Assistants, Clerical	2.49	4
49011	Salespersons, Retail	2.45	4
92974	Packaging and Filling Machine Operators and Tenders	2.32	4
55338	Bookkeeping, Accounting, and Auditing Clerks	2.24	4
55108	Secretaries, except Legal and Medical	2.24	4
97111	Bus Drivers, School	2.23	4
49021	Counter and Rental Clerks	2.10	4
65038	Food Preparation Workers	2.08	4
55347	General Office Clerks	2.04	4
65008	Waiters and Waitresses	1.83	4
66008	Nursing Aides, Orderlies, and Attendants	1.74	4
53102	Tellers	1.68	4
49023	Cashiers	1.59	4
55305	Receptionists and Information Clerks	1.58	4
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.99	5
65026	Cooks, Restaurant	1.53	6
85132	Maintenance Repairers, General Utility	3.13	7
87902	Earth Drillers, except Oil and Gas	3.51	8
97102	Truck Drivers, Heavy or Tractor-Trailer	1.73	9

Figure 14-7
Twenty-Nine Occupations Clustered First on Incumbents' Ratings of 42 Generalized Work Activitites; Second on 46 Basic and Cross-Functional Skills (Ward's Method)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
15005	Education Administrators	4.24	1
19005	General Managers and Top Executives	4.11	1
61005	Police and Detective Supervisors	3.74	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.42	1
32502	Registered Nurses	3.54	2
31305	Teachers, Elementary School	3.52	2
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.47	3
63014	Police Patrol Officers	2.87	3
49011	Salespersons, Retail	2.65	3
53905	Teacher Aides and Educational Assistants, Clerical	2.60	3
55108	Secretaries, except Legal and Medical	2.38	3
55338	Bookkeeping, Accounting, and Auditing Clerks	2.29	3
55347	General Office Clerks	1.93	3
55305	Receptionists and Information Clerks	1.69	3
53102	Tellers	1.49	3
25105	Computer Programmers	4.01	4
32902	Medical and Clinical Laboratory Technologists	4.08	5
92974	Packaging and Filling Machine Operators and Tenders	2.11	5
65026	Cooks, Restaurant	1.34	6
97111	Bus Drivers, School	2.22	7
97102	Truck Drivers, Heavy or Tractor-Trailer	2.15	7
87902	Earth Drillers, except Oil and Gas	4.52	8
85132	Maintenance Repairers, General Utility	3.42	8
49021	Counter and Rental Clerks	2.02	9
66008	Nursing Aides, Orderlies, and Attendants	1.91	9
49023	Cashiers	1.76	9
65008	Waiters and Waitresses	1.31	9
65038	Food Preparation Workers	2.23	10
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	2.15	11

Figure 14-8

Twenty-Nine Occupations Clustered First on Incumbents' Ratings of 42 Generalized Work Activitites; Second on 46 Basic and Cross-Functional Skills (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
15005	Education Administrators	4.24	1
19005	General Managers and Top Executives	4.11	1
61005	Police and Detective Supervisors	3.74	1
31305	Teachers, Elementary School	3.52	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.47	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.42	1
32502	Registered Nurses	3.54	2
63014	Police Patrol Officers	2.87	2
53905	Teacher Aides and Educational Assistants, Clerical	2.60	2
55108	Secretaries, except Legal and Medical	2.38	2
55338	Bookkeeping, Accounting, and Auditing Clerks	2.29	2
55347	General Office Clerks	1.93	2
55305	Receptionists and Information Clerks	1.69	2
53102	Tellers	1.49	2
25105	Computer Programmers	4.01	3
32902	Medical and Clinical Laboratory Technologists	4.08	4
92974	Packaging and Filling Machine Operators and Tenders	2.11	4
49011	Salespersons, Retail	2.65	5
49021	Counter and Rental Clerks	2.02	5
66008	Nursing Aides, Orderlies, and Attendants	1.91	5
49023	Cashiers	1.76	5
65026	Cooks, Restaurant	1.34	5
65008	Waiters and Waitresses	1.31	5
65038	Food Preparation Workers	2.23	6
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	2.15	7
97111	Bus Drivers, School	2.22	8
97102	Truck Drivers, Heavy or Tractor-Trailer	2.15	8
87902	Earth Drillers, except Oil and Gas	4.52	9
85132	Maintenance Repairers, General Utility	3.42	9

Figure 14-9

Twenty-Nine Occupations Clustered First on Incumbents' Ratings of 46 Basic and Cross-Functional Skills; Second on 42 Generalized Work Activitites (Ward's Method)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
15005	Education Administrators	4.19	1
19005	General Managers and Top Executives	3.48	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.11	1
61005	Police and Detective Supervisors	3.87	2
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.01	3
25105	Computer Programmers	2.99	4
32502	Registered Nurses	3.16	5
31305	Teachers, Elementary School	3.09	5
53905	Teacher Aides and Educational Assistants, Clerical	2.38	5
55338	Bookkeeping, Accounting, and Auditing Clerks	2.20	5
55347	General Office Clerks	2.16	5
55108	Secretaries, except Legal and Medical	2.10	5
65026	Cooks, Restaurant	1.72	6
63014	Police Patrol Officers	2.90	7
65008	Waiters and Waitresses	2.34	7
49011	Salespersons, Retail	2.26	7
49021	Counter and Rental Clerks	2.17	7
53102	Tellers	1.87	7
66008	Nursing Aides, Orderlies, and Attendants	1.57	7
55305	Receptionists and Information Clerks	1.46	7
49023	Cashiers	1.42	7
32902	Medical and Clinical Laboratory Technologists	3.13	8
92974	Packaging and Filling Machine Operators and Tenders	2.53	8
65038	Food Preparation Workers	1.94	8
97111	Bus Drivers, School	2.25	9
97102	Truck Drivers, Heavy or Tractor-Trailer	1.32	9
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.83	10
85132	Maintenance Repairers, General Utility	2.85	11
87902	Earth Drillers, except Oil and Gas	2.51	11

Figure 14-10

Twenty-Nine Occupations Clustered First on Incumbents' Ratings of 46 Basic and Cross-Functional Skills; Second on 42 Generalized Work Activitites (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
15005	Education Administrators	4.19	1
61005	Police and Detective Supervisors	3.87	1
19005	General Managers and Top Executives	3.48	1
32502	Registered Nurses	3.16	1
51002	First-Line Supervisors and Manager/Supervisors, Clerical and Adminstrative Support Workers	3.11	1
31305	Teachers, Elementary School	3.09	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	3.01	1
53905	Teacher Aides and Educational Assistants, Clerical	2.38	2
55338	Bookkeeping, Accounting, and Auditing Clerks	2.20	2
55347	General Office Clerks	2.16	2
55108	Secretaries, except Legal and Medical	2.10	2
55305	Receptionists and Information Clerks	1.46	2
63014	Police Patrol Officers	2.90	3
65008	Waiters and Waitresses	2.34	3
49011	Salespersons, Retail	2.26	3
49021	Counter and Rental Clerks	2.17	3
53102	Tellers	1.87	3
49023	Cashiers	1.42	3
65026	Cooks, Restaurant	1.72	4
66008	Nursing Aides, Orderlies, and Attendants	1.57	5
97111	Bus Drivers, School	2.25	6
25105	Computer Programmers	2.99	7
32902	Medical and Clinical Laboratory Technologists	3.13	8
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.83	9
85132	Maintenance Repairers, General Utility	2.85	10
87902	Earth Drillers, except Oil and Gas	2.51	10
92974	Packaging and Filling Machine Operators and Tenders	2.53	11
65038	Food Preparation Workers	1.94	11
97102	Truck Drivers, Heavy or Tractor-Trailer	1.32	12

Figure 14-11

Twenty-Nine Occupations Clustered First on Analysts' Ratings of 42 Generalized Work Activitites (Ward's Method)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
19005	General Managers and Top Executives	4.16	1
15005	Education Administrators	3.88	1
61005	Police and Detective Supervisors	3.77	1
32502	Registered Nurses	3.33	1
25105	Computer Programmers	3.30	1
32902	Medical and Clinical Laboratory Technologists	3.19	1
31305	Teachers, Elementary School	3.13	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.90	1
65026	Cooks, Restaurant	2.44	1
53905	Teacher Aides and Educational Assistants, Clerical	2.22	1
55338	Bookkeeping, Accounting, and Auditing Clerks	1.93	1
63014	Law Enforcement Officers	3.05	2
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.62	2
53102	Tellers	1.92	2
49011	Salespersons, Retail	1.85	2
55108	Secretaries, except Legal and Medical	1.82	2
49021	Stock Clerks, Sales Floor	1.81	2
65008	Waiter/Waitress	1.75	2
55305	Receptionists and Information Clerks	1.74	2
55347	General Office Clerks	1.74	2
66008	Nursing Aides, Orderlies, and Attendants	1.72	2
49023	Cashiers	1.67	2
97111	Bus Drivers, School	1.32	2
85132	Maintenance Repairers, General Utility	2.09	3
97102	Truck Drivers, Heavy and Tractor-Trailer	1.84	3
87902	Earth Drillers, except Oil or Gas	1.70	3
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.52	3
65038	Food Preparation Workers	1.24	3
92974	Packaging and Filling Machine Operators and Tenders	1.23	3

Figure 14-12

Twenty-Nine Occupations Clustered on Analysts' Ratings of 42 Generalized Work Activitites (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
19005	General Managers and Top Executives	4.16	1
15005	Education Administrators	3.88	1
61005	Police and Detective Supervisors	3.77	1
32502	Registered Nurses	3.33	1
25105	Computer Programmers	3.30	1
32902	Medical and Clinical Laboratory Technologists	3.19	1
31305	Teachers, Elementary School	3.13	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.90	1
65026	Cooks, Restaurant	2.44	1
63014	Law Enforcement Officers	3.05	2
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.62	2
53905	Teacher Aides and Educational Assistants, Clerical	2.22	2
55338	Bookkeeping, Accounting, and Auditing Clerks	1.93	2
53102	Tellers	1.92	2
49011	Salespersons, Retail	1.85	2
55108	Secretaries, except Legal and Medical	1.82	2
49021	Stock Clerks, Sales Floor	1.81	2
65008	Waiter/Waitress	1.75	2
55305	Receptionists and Information Clerks	1.74	2
55347	General Office Clerks	1.74	2
66008	Nursing Aides, Orderlies, and Attendants	1.72	2
49023	Cashiers	1.67	2
97111	Bus Drivers, School	1.32	2
85132	Maintenance Repairers, General Utility	2.09	3
97102	Truck Drivers, Heavy and Tractor-Trailer	1.84	3
87902	Earth Drillers, except Oil or Gas	1.70	3
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.52	3
65038	Food Preparation Workers	1.24	3
92974	Packaging and Filling Machine Operators and Tenders	1.23	3

Figure 14-13
Twenty-Nine Occupations Clustered on Analysts' Ratings of 46 Basic and Cross-Functional Skills (Ward's Method)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
19005	General Managers and Top Executives	4.02	1
15005	Education Administrators	3.82	1
25105	Computer Programmers	3.61	1
61005	Police and Detective Supervisors	3.39	1
32902	Medical and Clinical Laboratory Technologists	3.20	1
32502	Registered Nurses	3.05	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.89	1
31305	Teachers, Elementary School	2.79	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.76	1
65026	Cooks, Restaurant	1.94	1
63014	Law Enforcement Officers	2.55	2
66008	Nursing Aides, Orderlies, and Attendants	1.87	2
53905	Teacher Aides and Educational Assistants, Clerical	1.59	2
55338	Bookkeeping, Accounting, and Auditing Clerks	1.57	2
55108	Secretaries, except Legal and Medical	1.53	2
49011	Salespersons, Retail	1.48	2
55305	Receptionists and Information Clerks	1.48	2
55347	General Office Clerks	1.46	2
49023	Cashiers	1.44	2
53102	Tellers	1.42	2
49021	Stock Clerks, Sales Floor	1.36	2
65008	Waiter/Waitress	1.08	2
65038	Food Preparation Workers	.94	2
85132	Maintenance Repairers, General Utility	2.13	3
97102	Truck Drivers, Heavy and Tractor-Trailer	1.58	3
87902	Earth Drillers, except Oil or Gas	1.41	3
92974	Packaging and Filling Machine Operators and Tenders	1.34	3
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.31	3
97111	Bus Drivers, School	1.22	3

Figure 14-14

Twenty-Nine Occupations Clustered on Analysts' Ratings of 46 Basic and Cross-Functional Skills (Within-Group Average Linkage)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
19005	General Managers and Top Executives	4.02	1
15005	Education Administrators	3.82	1
61005	Police and Detective Supervisors	3.39	1
32902	Medical and Clinical Laboratory Technologists	3.20	1
32502	Registered Nurses	3.05	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.89	1
31305	Teachers, Elementary School	2.79	1
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.76	1
63014	Law Enforcement Officers	2.55	1
65026	Cooks, Restaurant	1.94	1
25105	Computer Programmers	3.61	2
66008	Nursing Aides, Orderlies, and Attendants	1.87	2
53905	Teacher Aides and Educational Assistants, Clerical	1.59	2
55338	Bookkeeping, Accounting, and Auditing Clerks	1.57	2
55108	Secretaries, except Legal and Medical	1.53	2
49011	Salespersons, Retail	1.48	2
55305	Receptionists and Information Clerks	1.48	2
55347	General Office Clerks	1.46	2
49023	Cashiers	1.44	2
53102	Tellers	1.42	2
49021	Stock Clerks, Sales Floor	1.36	2
65008	Waiter/Waitress	1.08	2
65038	Food Preparation Workers	.94	2
85132	Maintenance Repairers, General Utility	2.13	3
97102	Truck Drivers, Heavy and Tractor-Trailer	1.58	3
87902	Earth Drillers, except Oil or Gas	1.41	3
92974	Packaging and Filling Machine Operators and Tenders	1.34	3
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.31	3
97111	Bus Drivers, School	1.22	3

Figure 14-15
Twenty-Nine Occupations Clustered on Analysts' Ratings of 42 Generalized Work Activitites and 46 Basic and Cross-Functional Skills (Ward's Method)

Occupation Code	Occupation Title	Mean Across 42 GWAs and 46 Skills	Cluster
19005	General Managers and Top Executives	4.09	1
15005	Education Administrators	3.85	1
61005	Police and Detective Supervisors	3.58	1
25105	Computer Programmers	3.45	1
32902	Medical and Clinical Laboratory Technologists	3.20	1
32502	Registered Nurses	3.19	1
31305	Teachers, Elementary School	2.96	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.89	1
65026	Cooks, Restaurant	2.19	1
63014	Law Enforcement Officers	2.80	2
49008	Sales Representatives, except Scientific and Related Products or	2.69	2
53905	Teacher Aides and Educational Assistants, Clerical	1.90	2
66008	Nursing Aides, Orderlies, and Attendants	1.79	2
55338	Bookkeeping, Accounting, and Auditing Clerks	1.75	2
55108	Secretaries, except Legal and Medical	1.68	2
53102	Tellers	1.67	2
49011	Salespersons, Retail	1.67	2
55305	Receptionists and Information Clerks	1.61	2
55347	General Office Clerks	1.60	2
49021	Stock Clerks, Sales Floor	1.58	2
49023	Cashiers	1.56	2
65008	Waiter/Waitress	1.42	2
85132	Maintenance Repairers, General Utility	2.11	3
97102	Truck Drivers, Heavy and Tractor-Trailer	1.71	3
87902	Earth Drillers, except Oil or Gas	1.56	3
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.41	3
92974	Packaging and Filling Machine Operators and Tenders	1.29	3
97111	Bus Drivers, School	1.27	3
65038	Food Preparation Workers	1.09	3

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Figure 14-16

Twenty-Nine Occupations Clustered on Analysts' Ratings of 42 Generalized Work Activitites and 46 Basic and Cross-Functional Skills (Within-Group Average Linkage)

Occupation Code	Occupation Title	Mean Across 42 GWAs and 46 Skills	Cluster
19005	General Managers and Top Executives	4.09	1
15005	Education Administrators	3.85	1
61005	Police and Detective Supervisors	3.58	1
32902	Medical and Clinical Laboratory Technologists	3.20	1
32502	Registered Nurses	3.19	1
31305	Teachers, Elementary School	2.96	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.89	1
49008	Sales Representatives, except Scientific and Related Products or	2.69	1
65026	Cooks, Restaurant	2.19	1
63014	Law Enforcement Officers	2.80	2
53905	Teacher Aides and Educational Assistants, Clerical	1.90	2
66008	Nursing Aides, Orderlies, and Attendants	1.79	2
55338	Bookkeeping, Accounting, and Auditing Clerks	1.75	2
55108	Secretaries, except Legal and Medical	1.68	2
53102	Tellers	1.67	2
49011	Salespersons, Retail	1.67	2
55305	Receptionists and Information Clerks	1.61	2
55347	General Office Clerks	1.60	2
49021	Stock Clerks, Sales Floor	1.58	2
49023	Cashiers	1.56	2
65008	Waiter/Waitress	1.42	2
65038	Food Preparation Workers	1.09	2
25105	Computer Programmers	3.45	3
85132	Maintenance Repairers, General Utility	2.11	4
97102	Truck Drivers, Heavy and Tractor-Trailer	1.71	4
87902	Earth Drillers, except Oil or Gas	1.56	4
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.41	4
92974	Packaging and Filling Machine Operators and Tenders	1.29	4
97111	Bus Drivers, School	1.27	4

Figure 14-17

Twenty-Nine Occupations Clustered First on Analysts' Ratings of 42 Generalized Work Activitites; Second on 46 Basic and Cross-Functional Skills (Ward's Method)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
19005	General Managers and Top Executives	4.02	1
15005	Education Administrators	3.82	1
61005	Police and Detective Supervisors	3.39	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.89	1
32902	Medical and Clinical Laboratory Technologists	3.20	2
32502	Registered Nurses	3.05	2
31305	Teachers, Elementary School	2.79	2
65026	Cooks, Restaurant	1.94	2
53905	Teacher Aides and Educational Assistants, Clerical	1.59	2
25105	Computer Programmers	3.61	3
55338	Bookkeeping, Accounting, and Auditing Clerks	1.57	4
63014	Law Enforcement Officers	2.55	5
66008	Nursing Aides, Orderlies, and Attendants	1.87	5
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.76	6
55108	Secretaries, except Legal and Medical	1.53	7
49011	Salespersons, Retail	1.48	7
55305	Receptionists and Information Clerks	1.48	7
55347	General Office Clerks	1.46	7
49023	Cashiers	1.44	7
53102	Tellers	1.42	7
49021	Stock Clerks, Sales Floor	1.36	7
65008	Waiter/Waitress	1.08	7
97111	Bus Drivers, School	1.22	8
65038	Food Preparation Workers	.94	9
97102	Truck Drivers, Heavy and Tractor-Trailer	1.58	10
87902	Earth Drillers, except Oil or Gas	1.41	11
92974	Packaging and Filling Machine Operators and Tenders	1.34	11
85132	Maintenance Repairers, General Utility	2.13	12
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.31	12

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Figure 14-18

Twenty-Nine Occupations Clustered First on Analysts' Ratings of 42 Generalized Work Activitites; Second on 46 Basic and Cross-Functional Skills (Within-Group Average Linkage)

Occupation Code	Occupation Title	Mean Across 46 Skills	Cluster
19005	General Managers and Top Executives	4.02	1
15005	Education Administrators	3.82	1
61005	Police and Detective Supervisors	3.39	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.89	1
32902	Medical and Clinical Laboratory Technologists	3.20	2
32502	Registered Nurses	3.05	2
31305	Teachers, Elementary School	2.79	2
65026	Cooks, Restaurant	1.94	2
25105	Computer Programmers	3.61	3
63014	Law Enforcement Officers	2.55	4
66008	Nursing Aides, Orderlies, and Attendants	1.87	4
53905	Teacher Aides and Educational Assistants, Clerical	1.59	4
55338	Bookkeeping, Accounting, and Auditing Clerks	1.57	4
55108	Secretaries, except Legal and Medical	1.53	4
49011	Salespersons, Retail	1.48	4
55305	Receptionists and Information Clerks	1.48	4
55347	General Office Clerks	1.46	4
49023	Cashiers	1.44	4
53102	Tellers	1.42	4
49021	Stock Clerks, Sales Floor	1.36	4
65008	Waiter/Waitress	1.08	4
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.76	5
97111	Bus Drivers, School	1.22	6
65038	Food Preparation Workers	.94	7
85132	Maintenance Repairers, General Utility	2.13	8
97102	Truck Drivers, Heavy and Tractor-Trailer	1.58	8
87902	Earth Drillers, except Oil or Gas	1.41	8
92974	Packaging and Filling Machine Operators and Tenders	1.34	8
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.31	8

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Figure 14-19

Twenty-Nine Occupations Clustered First on Analysts' Ratings of 46 Basic and Cross-Functional Skills; Second on 42 Generalized Work Activitites (Ward's Method)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
19005	General Managers and Top Executives	4.16	1
15005	Education Administrators	3.88	1
61005	Police and Detective Supervisors	3.77	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.90	1
32502	Registered Nurses	3.33	2
32902	Medical and Clinical Laboratory Technologists	3.19	2
31305	Teachers, Elementary School	3.13	2
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.62	3
25105	Computer Programmers	3.30	4
65026	Cooks, Restaurant	2.44	5
63014	Law Enforcement Officers	3.05	6
49011	Salespersons, Retail	1.85	6
49021	Stock Clerks, Sales Floor	1.81	6
65008	Waiter/Waitress	1.75	6
53905	Teacher Aides and Educational Assistants, Clerical	2.22	7
55338	Bookkeeping, Accounting, and Auditing Clerks	1.93	7
53102	Tellers	1.92	7
55108	Secretaries, except Legal and Medical	1.82	7
55305	Receptionists and Information Clerks	1.74	7
55347	General Office Clerks	1.74	7
49023	Cashiers	1.67	7
66008	Nursing Aides, Orderlies, and Attendants	1.72	8
65038	Food Preparation Workers	1.24	8
85132	Maintenance Repairers, General Utility	2.09	9
97102	Truck Drivers, Heavy and Tractor-Trailer	1.84	9
87902	Earth Drillers, except Oil or Gas	1.70	9
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.52	9
92974	Packaging and Filling Machine Operators and Tenders	1.23	9
97111	Bus Drivers, School	1.32	10

Figure 14-20

Twenty-Nine Occupations Clustered First on Analysts' Ratings of 46 Basic and Cross-Functional Skills; Second on 42 Generalized Work Activitites (Within-Groups Average Linkage)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
19005	General Managers and Top Executives	4.16	1
15005	Education Administrators	3.88	1
61005	Police and Detective Supervisors	3.77	1
51002	First Line Supervisors and Managers, Clerical/Admin.	2.90	1
63014	Law Enforcement Officers	3.05	2
32502	Registered Nurses	3.33	3
31305	Teachers, Elementary School	3.13	3
49008	Sales Representatives, except Scientific and Related Products or Services and Retail	2.62	4
32902	Medical and Clinical Laboratory Technologists	3.19	5
65026	Cooks, Restaurant	2.44	6
25105	Computer Programmers	3.30	7
53905	Teacher Aides and Educational Assistants, Clerical	2.22	8
55338	Bookkeeping, Accounting, and Auditing Clerks	1.93	8
53102	Tellers	1.92	8
55108	Secretaries, except Legal and Medical	1.82	8
55305	Receptionists and Information Clerks	1.74	8
55347	General Office Clerks	1.74	8
49023	Cashiers	1.67	8
49011	Salespersons, Retail	1.85	9
49021	Stock Clerks, Sales Floor	1.81	9
65008	Waiter/Waitress	1.75	9
66008	Nursing Aides, Orderlies, and Attendants	1.72	10
65038	Food Preparation Workers	1.24	10
85132	Maintenance Repairers, General Utility	2.09	11
97102	Truck Drivers, Heavy and Tractor-Trailer	1.84	11
87902	Earth Drillers, except Oil or Gas	1.70	11
67005	Janitors and Cleaners, except Maids and Housekeeping Cleaners	1.52	11
92974	Packaging and Filling Machine Operators and Tenders	1.23	11
97111	Bus Drivers, School	1.32	12

Figure 14-21

Final Five Clusters from 1122 Occupations Clustered First on Analysts' Ratings of 46 Basic and Cross-Functional Skills; Second on 42 Generalized Work Activities (Ward's Method)

Occupation Code	Occupation Title	Mean Across 42 GWAs	Cluster
24502B	Artificial Breeding Technicians	1.30	177
13017A	Engineering Managers	4.25	178
24308A	Biochemists	3.04	179
24308C	Biophysicists	2.94	179
24199C	Materials Scientists	2.66	179
27199H	Archeologists	2.47	179
24199A	Geographers	2.12	179
24308F	Geneticists	3.58	179
24308G	Physiologists and Cytologists	3.35	179
24308B	Biologists	3.34	179
24308J	Toxicologists	3.10	179
24308E	Microbiologists	3.07	179
24308D	Botanists	2.91	179
21911P	Coroners	2.69	179
24308H	Zoologists	2.40	179
22127	Computer Engineers	3.56	180
25102	Systems Analysts, Electronic Data Processing	3.30	180
25105	Computer Programmers	3.30	180
21999A	Computer Security Specialists	2.91	180
22514B	Electronic Drafters	2.60	180
25103A	Data Base Administrators	2.35	180
25104	Computer Support Specialists	2.63	180
25199A	Data Communications Analysts	2.57	180
49002	Sales Engineers	3.37	181
49005D	Sales Representatives, Mechanical Equipment and Supplies	2.36	181
49005F	Sales Representatives, Medical	2.20	181
49005B	Sales Representatives, Chemical and Pharmaceutical	2.03	181
49005A	Sales Representatives, Agricultural	1.93	181
49005C	Sales Representatives, Electrical/Electronic	1.85	181
49026	Telemarketers, Door-To-Door Sales Workers, News and Street Vendors, and Related Workers	1.84	181
49005G	Sales Representatives, Instruments	1.80	181

Table 14-1
Criteria Estimates for Cluster Solutions Across Study Designs

	Incumbent Ratings		Analysts Ratings			
	29 Occupations		29 Occupations		1122 Occupations	
Variable sets	Ward's	Avg. Linkage	Ward's	Avg. Linkage	Ward's	Avg. Linkage
GWAs only						
# of clusters	4	3	3	3	41	41
single occupation clusters	0	0	0	0	0	0
% reclassification	96.60	100.00	96.60	93.10	83.10	76.60
simple structure	100.00	100.00	100.00	100.00	100.00	100.00
MSE	10.63	17.04	12.63	8.44	5.84	6.30
effect size	0.58	0.29	0.60	0.74	0.77	0.75
Skills only						
# of clusters	5	6	3	3	45	45
single occupation clusters	1	3	0	0	0	0
% reclassification	100.00	89.70	100.00	100.00	82.70	78.40
simple structure	100.00	100.00	100.00	100.00	100.00	100.00
MSE	25.54	35.35	9.96	15.72	7.96	8.50
effect size	0.49	0.32	0.76	0.62	0.73	0.71
GWAs & Skills						
# of clusters	6	9	3	4	66	66
single occupation clusters	1	7	0	1	0	0
% reclassification	100.00	96.60	89.70	89.70	88.40	77.50
Variable sets						
simple structure	100.00	100.00	100.00	100.00	100.00	100.00
MSE	28.75	12.13	18.49	17.85	9.06	10.89
effect size	0.59	0.85	0.74	0.76	0.83	0.79
GWAs, Skills (2-stage)						
# of clusters	11	9	12	8	176	149
single occupation clusters	4	3	6	4	58	47
% reclassification	100.00	100.00	100.00	100.00	90.10	86.40
simple structure	100.00	100.00	100.00	100.00	100.00	100.00
MSE	19.24	21.73	16.00	13.63	8.53	9.45
effect size	0.79	0.73	0.85	0.85	0.86	0.84
Skills, GWAs (2-stage)						
# of clusters	11	12	10	12	181	160
single occupation clusters	5	7	4	6	67	48
% reclassification	100.00	96.60	100.00	100.00	89.80	87.60
simple structure	100.00	100.00	100.00	100.00	100.00	100.00
MSE	25.56	13.85	12.81	8.27	8.69	9.33
effect size	0.72	0.86	0.87	0.92	0.85	0.84

Note. Avg. = Average; GWAs = generalized work activities; skills = basic and cross-functional skills; MSE = mean squared error.

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Table 14-2
Convergence (Cramer's V) of Cluster Solutions Based on Different Variable Sets

	Incumbent Ratings 29 Occupations		Analysts Ratings 29 Occupations		Analysts Ratings 1122 Occupations	
Variable Set Comparisons	Ward's	Avg. Linkage	Ward's	Avg. Linkage	Ward's	Avg. Linkage
GWAs v. Skills	0.59	0.61	0.75	0.75	0.54	0.52
GWAs v. Combined	0.80	0.75	0.75	0.84	0.72	0.72
Skills v. Combined	0.81	0.93	0.90	0.96	0.70	0.68
GWAs v. Skills, GWAs (2-stage)	0.80	0.88	0.90	0.97	0.78	0.75
Skills v. GWAs, Skills (2-stage)	0.97	0.91	0.96	0.96	0.75	0.69
Combined v. GWAs, Skills (2-stage)	0.91	0.78	0.96	1.00	0.80	0.76
Combined v. Skills, GWAs (2-stage)	0.88	0.94	0.97	1.00	0.77	0.78
Skills, GWAs (2-stage) v. GWAs, Skills (2-stage)	0.86	0.91	0.85	0.96	0.64	0.64

Note. Avg. = average; GWAs = generalized work activities; skills = basic & cross functional skills; combined = skills & GWAs together; v. = versus.

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Table 14-3

Convergence (Cramer's V) of Cluster Solutions Based on Ward's and Within-groups Average Linkage Methods

Variable Sets	Incumbent Ratings 29 Occupations	Analysts Ratings 29 Occupations	 1122 Occupations
GWAs only	0.78	0.92	0.73
Skills only	0.83	0.92	0.70
GWAs & Skills	0.80	0.90	0.68
GWAs, Skills (2-stage)	0.96	0.98	0.74
Skills, GWAs (2-stage)	0.85	1.00	0.74

Note. GWAs = generalized work activities; skills = basic & cross functional skills.

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Table 14-4
Convergence (Cramer's V) of Cluster Solutions Based on Ratings From Incumbents and Analysts on the 29 Occupation Database

Variable Sets	Ward's	Avg. Linkage
GWAs only	0.64	0.50
Skills only	0.79	0.62
GWAs & Skills	0.91	0.93
GWAs, Skills (2-stage)	0.77	0.78
Skills, GWAs (2-stage)	0.81	0.80

Note. GWAs = generalized work activities; skills = basic & cross functional skills.

Chapter 15

Issues in O*NET Applications

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The O*NET database should be useful for many applications. In addition, there are several user groups who should benefit from O*NET. The topic of applications and potential users has been discussed previously in Peterson, Mumford, Borman, Jeanneret, and Fleishman (1995). However, now that data have been gathered on the O*NET descriptors for at least some occupations and initial analyses of these data have been accomplished, we are able to discuss issues regarding applications with more knowledge about the kinds of information actually likely to be available in the O*NET database.

The present chapter begins with a general discussion of the implications of some of the analysis results for likely applications of the O*NET. Next, we briefly review some specific programs that could benefit from the O*NET and discuss implications of the available results for

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these initiatives. Issues in using the O*NET data to generate occupation descriptions are then discussed in some detail. Finally, we provide an example of one such application of the O*NET database.

Implications of the Analysis Results for O*NET Applications

As described in Peterson et al. (1995), the O*NET should provide important job and occupational information for such users as employers, job seekers, career explorers, vocational counselors, and researchers interested in jobs and work. General applications of this information include employers selecting workers, individuals evaluating jobs in relation to what they are qualified for and where training might be needed, students and others exploring career options, dislocated workers trying to identify new job opportunities, educators and trainers developing programs to deliver the most relevant training, and researchers learning about similarities and differences between occupations in terms of their skill, ability, etc., requirements.

In this section, selected analysis results are reviewed with a focus toward examining their impact on O*NET applications. First, the reliability results have implications for many if not all applications. The fact that interrater agreement was generally high for the descriptors means that profiles for occupations have meaning in the sense that they are stable representations of these occupations' requirements. For example, when a search is initiated for the highest level skill requirements for a particular occupation, the answer is likely to be reliable and replicable.

Another positive finding is that almost all of the descriptors have variance across occupations. Only for the work style and occupational value domains were the obtained data somewhat restricted. For example, Dependability (Work Styles Descriptor #12) scores were uniformly high for the 35 occupations in the sample. However, for most of the other descriptors across the domains, variance in the scores across occupations provides differentiation that is a prerequisite for many applications.

The discriminant function analysis demonstrated this differentiation in a more definitive way. Results of these analyses showed that almost all descriptors contributed to differentiation between occupations. The only exception to this finding was, once again, some of the work style and occupational value descriptors (e.g., Dependability). The fact that descriptor scores vary substantially across occupations is very important, especially for exploring career options relative to several occupations and learning about similarities and differences between jobs/occupations.

Some of the intended applications of the O*NET information require the hierarchical feature of the content model. Consider, for example, a student exploring the skill requirements of several occupations with which he/she is unfamiliar. As a first sweep, the student may want to enter O*NET at the higher level of the skills taxonomy and then later explore more in depth at the lower level after eliminating some occupations from consideration. A strong case could be made for using the hierarchical models in this manner if the exploratory factor analysis results supported the hierarchies; i.e., the empirical factors were aligned with the higher-order categories. This was largely true of the GWAs where the 3-factor solution represented two of the four highest-order categories and the third factor reflected a composite of the other two categories. In many of the other domains, the factor structure did not entirely reproduce the higher-order category systems, but for most domains the results are not inconsistent with the content model. That is, descriptors from the same content model category generally load most highly on the same factor. We must keep in mind that these factor analysis results are based on very small numbers of occupations (Ns ranging from 30 to 37 for each domain). A larger N may yield factor solutions more similar to the proposed hierarchical systems. In addition, many of the domains in the content model contain more specific, second-order categories, and a much larger N is needed to test these more detailed taxonomies. Finally, the higher-order taxonomies for some domains are not solely intended to capture past empirical findings, but to incorporate conceptual and developmental notions, notably in the skills domain.

An even stronger case for these hierarchies could be made by conducting confirmatory factor analyses (CFA). Unfortunately, CFA is quite sensitive to sample size, and, again, the N here is very low. An attempt was made to conduct CFA for the content model hierarchies in several domains, and these analyses generally did not converge, probably due to the small number of occupations currently available. When the number of occupations represented in the sample is larger, CFA can be used within each domain to test the hypothesis that lower-order descriptors load on the intended higher-order categories and not on other higher-order categories. In addition, larger sample sizes should allow tests of the more detailed, second-order categories.

In order to provide more targeted, although preliminary, empirical evidence concerning support for the content model, we conducted somewhat simplistic confirmatory analyses. For each content domain, we intercorrelated all of the descriptors across occupations and identified those correlations in this matrix that involved descriptors from the same second-order category in the content model hierarchy. These within-category correlations were then converted using Fisher's r to z transformation, averaged, and the resulting average z-scores were converted back to standard correlation coefficients. This mean correlation <u>within</u> second-order categories was then compared with the mean correlation <u>across</u> second-order categories. The latter correlation was simply the average (again using an r to z transformation) of all of the remaining correlations, that is, those that involved descriptors from different second-order categories. Table 15-1 presents the results of these analyses. In addition to the mean correlations, this table also shows

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the minimum and maximum correlation obtained, both within and between categories, for each domain. This confirmatory analysis was not attempted for organizational context, work context, or training, licensure, and experience, because the content model hierarchies in these areas are based on conceptual similarities among the descriptors rather than expected empirical relationships.

Table 15-1 shows that, overall, the analyses support our hierarchical models in almost all domains. Correlations between descriptors within higher level categories were substantially higher than correlations between descriptors across higher level categories, except for the skills and occupational values domains. In the latter two cases these correlations were close to equal. The largest difference is for abilities. The descriptors in the ability domain have a very strong base of past research and theory. In addition, the conceptual differences between the various second-order categories in the ability domain are substantial. These categories include Verbal Abilities; Fine Manipulative Abilities; and Flexibility, Balance and Coordination. Table 15-1 also shows support for the hierarchical structure of the second-order categories for generalized work activities, work styles, and knowledges.

For the skills domain, the average within and between correlations are virtually identical. This could be due to the fact that this domain is not as clearly hierarchically structured as the other domains, as previously mentioned. There is a great deal of interdependence among skills that are assigned to different second-order categories. Table 15-1 does show that the intercorrelations among skills are generally high, both within and between second-order categories, so the aggregation of skills to a higher level is clearly supported, but it may be that we need to re-examine the current organization of skills, or otherwise carefully consider how we form aggregates here. Results for occupational values are also not supportive of the a priori

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taxonomy. The O*NET occupational values taxonomy is based on previous factor analytic work in this area that focused on worker traits, so it is not completely surprising that the factor structure appears to differ for the O*NET data, where the focus is on occupational characteristics/requirements.

Although in most domains the mean within-higher-order category correlations were substantially higher than those across higher-order categories, the within-category correlations are not uniformly high. For example, Repairing and Maintaining Mechanical Equipment and Interacting with Computers, both part of the Performing Complex/Technical Activities category in the GWA domain, correlate -.26. Accordingly, it does not appear appropriate to have these two descriptors in the same higher-order category. Perhaps descriptor membership in the higher-order categories can be reconfigured somewhat to conform better to the correlation matrix. Again, however, we hesitate to make major changes to the content model based on data from just 29 occupations. Given the general support for the content model hierarchies that has been obtained in the current analyses, the content model seems to provide a good starting point for implementing a hierarchical structure in the O*NET database. It is likely that this system can and should be refined when data on more occupations become available.

Relatively high empirical correlations of descriptor scores within higher-order categories is especially important for aggregation strategies that involve computing sums or means across descriptors. This may not be the best strategy for every domain. Certainly, for some categories in skills, this would not seem appropriate (e.g., resource management). If the aggregation strategy selected is "single highest descriptor within a category," for example, correlations are less important. These issues are carefully considered below.

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Many of the applications of O*NET will involve data from multiple domains (e.g., abilities and skills). For example, in selection applications, matches between person attributes and the job requirements will likely need to include skills, abilities, and perhaps knowledges and work styles. Fortunately, the across domain analysis results show considerable coherence as well, even with the small N. Accordingly, information about individual occupations across domains should make sense, and applications requiring the use of more than one domain should thus be well served.

The very high correlations between the level and importance rating scales may have implications for some O*NET applications. Essentially, data from one scale--level or importance--provides quite definitive information about the other, although this varies somewhat across occupations. This allows the options of foregoing either level or importance at some point in the future, but not without some loss of information.

Overall then, the data analysis results are supportive of most foreseeable applications of O*NET. The reliability findings are probably most important, suggesting that information about occupations on the O*NET reflect stable, accurate data. Discriminant function analysis results are also very important. They indicate that occupations can be differentiated using O*NET descriptors, which in turn means that applications requiring identification of differences between occupations in skill, ability, GWA, etc., requirements should be successful. Some questions remain, however, concerning the optimal hierarchical structure of the content model domains. There is some empirical support for the hypothesized structures within domains, but CFA results using larger numbers of occupations confirming these hierarchical systems would provide better evidence. It is likely that some refinement of these structures will be necessary in the future, but the present structures seem sufficient for the near future.

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Highlights of Implications for Specific Applications

Another way to discuss the implications of the analysis results for applications associated with O*NET is to review several general areas of policy initiatives and the occupational data needs for each of these initiatives. For each of these initiatives, the relevant aspects of the O*NET are described, and the implications of analysis results available to date are discussed.

Educational Policy and Skill Standards

A need for this area is an occupational framework for developing skills standards. The content model is clearly responsive to this need. A comprehensive set of skill descriptors are included for describing occupational skill requirements, as well as descriptors depicting a wide variety of work activities. Data collected using these descriptors have been shown to be highly reliable, especially if data are collected from 30 incumbents per occupation. These descriptors have also been shown to differentiate between occupations in sensible ways. Thus, it is likely that this information can be used to generate occupational clusters highly appropriate for the development of occupational skill standards.

School-To-Work

Efforts in this area focus on building a school-to-work transition system for the 75 percent of our young people who do not go on to complete a four-year post-secondary education. These state-led efforts will build upon existing programs to prepare students to meet high academic and occupational standards, and create linkages to the labor market system. These efforts require the skill requirements of occupations to help build curricula for schools. Again, the O*NET will be responsive to this need, with the skill taxonomy descriptors providing the relevant data. In addition to demonstrating appropriate psychometric properties, data collected using the skill descriptors demonstrates meaningful patterns of correlations with generalized

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work activities, abilities and other descriptors, providing support for the construct validity of these measures. Accurate data concerning the skill requirements of a broad sampling of occupations will provide a good foundation for efforts to prepare students for the workplace and to facilitate a smooth transition from school to work.

Dislocated Workers and One-Stops

Work in this area seeks to consolidate and improve an array of existing programs targeted at laid-off workers. Resources and incentives have been provided for states and local communities to create One-Stop Career Centers where employers and workers will have easy access to job and training information, post-secondary professional and technical education, adult basic education, job matching, and counseling services. The Centers will be overseen by a workforce investment board. The One-Stop Career Centers, proposed as part of the Workforce Security Act, will provide laid-off workers with job-search assistance, labor-market information, and training to enable these workers to take control of their careers, allowing them to move into new occupations. In this case, the need is for job and occupational information to help dislocated workers find new jobs. The O*NET can help with part of this requirement by providing them with detailed information about skills, abilities, etc., needed for different occupations. Through either formal or informal means these workers can match their qualifications to the occupational requirements.

High-Performance Workplaces

The O*NET can make several contributions to efforts to build high-performance workplaces. First, the content model provides a comprehensive description of high-performance business practices, which has a strong foundation in research and theory, as well as demonstrated links to other attempts to define high-performance or high-involvement workplaces. Data concerning these aspects of the organizational context were collected from both organizational representatives (e.g., personnel managers) and incumbents in the targeted occupations. Organizational representative data were collected from over 600 organizations; these data provide an excellent source of information concerning the relationships among these high-performance practices, their relationships with other frequently studied aspects of organizations, and the extent to which these practices are used in the workplaces sampled. These analyses revealed that business practices identified as high-performance do tend to covary across organizations. This comprehensive and empirically-based description of the high-performance practices used in workplaces can provide a foundation for future research and applications.

In addition, high-performance workplaces have been described as using data to make organizational decisions and employing state of the art business practices. O*NET's dynamic and flexible occupational information database is ideally suited to support these activities.

Although certainly not exhaustive of important workplace initiatives, we believe the O*NET is clearly responsive to the needs of these kinds of programs. Applications related to the content model should be invaluable for helping to make these programs successful. While more data are needed before this potential is realized, results to date suggest that O*NET will benefit all of these initiatives substantially.

Issues in Describing Occupations

There are many ways the O*NET might be used to describe occupations. For example, profiles of means in tabular or graphic form, either within a particular domain or across domains would provide a comprehensive picture of the skill, ability, GWA, etc. requirements for a job. For many applications, however, this characterization will be cumbersome, with too much information to digest. If we could provide a less detailed description, for example showing only

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the highest level or most important requirements, the information might be more palatable to some users. However, there are several available options for selecting these descriptors: (1) we might present a certain set of descriptors from a single domain or a subset of the domains; (2) we might include all domains and simply list the descriptors with the highest level ratings or perhaps the most important descriptors from each domain; and (3) we could set a cutoff on the level or importance scales and list all descriptors with means above that cutoff. (This last approach might result in no descriptors at all or several descriptors from each domain, for a given occupation.) Other approaches, perhaps using scores aggregated from the lowest level, could also be employed.

Using Raw or Standardized Means

One important issue, regardless of which approach is taken is whether to use raw mean ratings within each occupation or to standardize the mean scores for each descriptor across the occupations, and then use these standardized scores to rank order the descriptors within an occupation. The descriptors that emerge as highest level, most important, etc., are likely to be different with these two procedures. This is because there are substantial descriptor effects, with some descriptor means considerably higher than others. As an example, the Communicating With Supervisors, Peers, or Subordinates GWA domain level scale has a mean of 4.14 across the 35 occupations, whereas, the Specifying Equipment scale mean is .87. Thus, the Communicating descriptor will tend to be high in the rank order for many of the occupations. This is appropriate for applications that require a depiction of the highest level, most important, etc., descriptors in an absolute sense. For other applications, standardized scores might be preferred. That is, when we want to obtain a picture of the highest level descriptors relative to other occupations, for example, using the standardized scores to generate the rank ordering will be appropriate. Note, though, that the standardized score method is very sensitive to the number and nature of the occupations included in the sample.

To provide preliminary information concerning the relative merits of using raw and standardized scores in generating occupation descriptions, we computed means of both the raw and standard scores on all of the content model level descriptors for four occupations with a relatively large N and selected to reflect a wide range of types of occupations: (1) General Managers and Top Executives (N = 147); (2) Registered Nurses (N = 97); (3) General Office Clerks (N = 264); and (4) Maintenance Repairers, General Utility (N = 110). We used the level scales rather than importance, because they are most likely to be the retained scale should either level or importance be eliminated. Standard scores were computed by adjusting scores for each descriptor to have a mean of zero and a standard deviation of one across all 29 occupations included in these analyses. Accordingly, at this point, we had, for each content model domain, the descriptors rank ordered in relation to level means by raw scores and by standard scores for the four occupations.

These analyses demonstrate that the way descriptors are rank ordered substantially effects the outcome of that ranking. One aspect of these findings is that for some of the domains, when raw scores are used, the same descriptor appears near the top of the list for all of the occupations. For example, with GWAs, Establishing Relationships is ranked first for the Nurses and General Clerks, third for the Repairers, and fourth for the Managers. In the abilities domain, Managers and Nurses are described very similarly, with Problem Sensitivity, Speech Clarity, Written Expression, and Oral Expression near the top of both lists. For work styles, Dependability is top or second on the list for all four of the occupations. Finally, for work context, Social Interaction is near the top for the four occupations. This phenomenon is not evident when standard scores

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Table 13-2 (continued)
Intercorrelations of Factor-Based Composites Across Domains

Composites by Domain	1	2	3	4	5	6	7	8	9	10	11	12	13
Abilities													
21. Physical	-.49	-.12	.69	.80	.71	-.03	-.09	-.42	.39	.02	-.26	.06	-.14
22. Psychomotor	-.33	-.07	.65	.80	.30	-.01	.14	-.23	.41	-.05	-.14	.21	-.04
23. Dexterity	-.32	-.19	.65	.54	.29	-.16	.43	-.15	.43	-.06	-.22	.26	-.18
24. Vision/Hearing	-.23	.06	.55	.69	.20	-.03	.11	-.11	.49	.08	-.03	.18	-.01
25. Cognitive	.72	.54	-.17	-.05	-.46	.47	.30	.51	.12	.25	.80	.47	.66
26. Math	.46	.18	-.26	-.19	-.38	.21	.46	.32	-.30	.03	.46	.41	.45
27. Spatial	.40	.46	.31	.43	-.09	.42	.36	.27	.32	.25	.60	.47	.55
28. Speech	.43	.54	-.36	-.24	-.31	.14	.18	.57	.22	.47	.50	.01	.30
29. Attention	.26	.23	.19	.20	-.28	.12	.62	.41	.27	.14	.39	.37	.31
30. Memory	.55	.45	-.21	-.09	-.43	.21	.40	.46	.12	.36	.52	.26	.34
Work Styles													
31. Surgency/Achievement Orient.	.68	.64	-.02	.07	-.14	.74	-.14	.29	-.04	.18	.73	.28	.72
32. People Orientation	-.01	.42	-.22	-.20	-.02	.23	-.23	.23	.27	.35	.10	-.51	-.03
33. Detail Orientation	.15	-.09	-.06	-.22	-.18	.08	.22	.00	.05	-.25	.19	.09	-.01
Occupational Values													
34. Individual Accomplishment	.65	.59	-.06	.08	-.19	.60	-.26	.26	.10	.19	.80	.27	.63
35. Structure	.14	.08	-.09	-.31	-.09	.01	.26	.46	-.09	-.06	.24	.10	.24
36. Social Comfort	.38	.38	-.20	-.22	-.12	.12	.11	.37	-.26	.40	.37	.00	.33
37. Career Advancement	.34	.55	-.04	.24	.15	.66	-.15	.07	-.01	.29	.55	.15	.65
38. Stability	.34	.55	.06	.40	-.12	.47	-.10	.25	.41	.08	.60	.15	.52

Table 13-2 (continued)
Intercorrelations of Factor-Based Composites Across Domains

Composites by Domain	14	15	16	17	18	19	20	21	22	23	24	25	26
Knowledges													
14. Arts and Humanities	(.80)												
15. Science and Technology	.51	(.79)											
16. Law Enforcement	.60	.29	(.89)										
17. Clerical	.17	-.05	.09	(.96)									
18. Medicine	.44	.54	.34	.00	(.87)								
19. Business Administration	.17	.10	.08	.08	.09	(.89)							
20. Food Production	.41	.63	.16	-.23	.25	-.10	(.57)						
Abilities													
21. Physical	.27	.42	.43	-.56	.18	-.26	.47	(.92)					
22. Psychomotor	.27	.38	.51	-.35	.24	-.32	.26	.84	(.92)				
23. Dexterity	.15	.35	.33	-.19	.48	-.36	.34	.66	.78	(.81)			
24. Vision/Hearing	.41	.36	.62	-.26	.31	-.25	.24	.77	.94	.72	(.92)		
25. Cognitive	.56	.32	.43	.41	.43	.47	-.19	-.18	.01	.03	.15	(.92)	
26. Math	.34	.43	.06	.35	.35	.42	.07	-.32	-.20	-.02	-.12	.71	(.85)
27. Spatial	.64	.56	.66	.13	.58	.29	.07	.32	.45	.45	.54	.77	.54
28. Speech	.49	.01	.37	.38	.23	.48	-.10	-.14	-.01	.04	.21	.73	.46
29. Attention	.42	.37	.46	.35	.53	.11	-.03	.15	.42	.61	.51	.70	.54
30. Memory	.40	.13	.34	.37	.22	.39	-.13	-.18	.06	.11	.24	.78	.59
Work Styles													
31. Surgency/Achievement Orient.	.36	.21	.27	-.07	.20	.43	-.02	-.16	-.09	-.23	-.07	.47	.33
32. People Orientation	.29	-.13	.27	.00	.17	.21	.19	.01	-.07	-.13	.04	-.04	-.18
33. Detail Orientation	-.05	.08	-.05	.29	.26	-.09	.07	-.25	-.22	.02	-.24	.08	.24
Occupational Values													
34. Individual Accomplishment	.34	.01	.19	.21	.03	.35	-.33	-.24	-.21	-.37	-.15	.46	.08

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are employed. As would be expected, standardizing has the effect of emphasizing differences between occupations.

To illustrate, Table 15-2 summarizes the extent to which the ten descriptors with the highest mean level scale ratings overlap across pairs of occupations--that is, the number of these "top ten" descriptors that are identical. Table 15-2 presents this information for both raw and standardized descriptor scores. As mentioned above, for GWAs there is a great deal of overlap in the occupation descriptions that would be generated for these four occupations using the raw descriptor data. Between three and six of the top ten descriptors overlap across the various pairs of occupations. The overlap is much less extensive for the standardized data, ranging from zero to three across pairs of occupations. Results are similar for skills, abilities, knowledges, and work context. For the work style and occupational value domains the differences across the raw versus standardized data are much smaller. However, these latter two domains contain fewer descriptors (e.g., there are only 17 work styles descriptors), so considerable overlap in the top ten would be expected simply by chance.

Overall, we can see that using the standardized scores in the job descriptions makes these four occupations look substantially more unique than when raw scores are used. This is desirable, in that the four occupations were selected to represent a wide range of job content. Accordingly, the standardized scores appear to be most appropriate for this type of job description application.

Using a Fixed Number of Descriptors or a Cutoff Score

Table 15-3 provides data relevant to decisions concerning whether a fixed number of descriptors should be used in each occupation description or a particular cutoff score should be used to identify the descriptors to be included. Recall that there are two general approaches that could be taken here. One is to simply list a certain number of descriptors for each domain that

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have the highest level ratings (e.g., the top five or the top ten). The second is to select a cutoff score on the level scale and then list all descriptors with means above that cutoff. The latter approach has some appeal because it allows for control over the average level of descriptors that would be included in occupation descriptions. Table 15-3 shows how many descriptors would be selected for describing each of the four example occupations if a cutoff score of five on the seven-point level scale was used, and the number that would be selected if a cutoff score of four was used. This table shows that there are systematic differences in the numbers of descriptors that would be included in the resulting descriptions across occupations. A parallel set of analyses was conducted using the standardized descriptor scores. Results showed a very similar pattern to those for the raw data and are not presented here. Table 15-3 also shows that the numbers of descriptors chosen using these absolute cutoffs varies systematically across domains. If this approach is taken, it is likely that different cutoff scores will need to be used for different domains.

In order to illustrate the extent to which choosing a set number of descriptors (e.g., ten) would lead to occupation descriptions based on descriptors with systematically different mean level ratings, Table 15-4 presents the mean level rating of the tenth descriptor (i.e., the descriptor with the tenth highest mean level rating) for each domain for each of these four occupations. The differences in these level means across occupations are generally quite large. For example, the tenth highest skills level rating for Managers and Executives is 5.2, while for clerks the tenth highest descriptor was rated only 2.8. Again, these results vary by domain. For example, for work styles the average level of the tenth highest descriptor is much more similar across occupations than for skills.

The analyses presented to this point have focused on only four occupations. To obtain some preliminary information concerning the extent to which these results are likely to generalize to other occupations, we conducted this same set of analyses, for the GWA domain only, for all 29 occupations for which data are currently available. The mean number of GWA descriptors that would be selected using a cutoff of five or greater on the level scale across all 29 occupations is 2.45, and the number per occupation ranges from 0 to 20. For a cutoff of four or greater on the level scale the mean number selected across occupations would be 7.24, and the number per occupation ranges from 0 to 28. The mean level score of the tenth GWA descriptor (i.e., the GWA descriptor with the tenth highest level scale mean) across all 29 occupations is 3.32, and the means for individual occupations range from 5.5 (for Education Administrators) to 1.8 (for Truck Drivers). Thus, the results for the four selected occupations appear to be reasonably representative of those for the 29 occupations currently available.

Using Single or Multiple Domains

The discussion so far has focused on selecting descriptors from within a single domain to describe occupations. Another important issue is the extent to which considering more than one domain simultaneously will affect the results, and whether this approach would provide more or less appropriate data for certain applications. It could be argued that important information is overlooked when data from the various content domains are viewed independently. For example, if we choose the top five descriptors from each content domain to describe each occupation, differences in the relative importance of the various content domains across occupations would not be captured. It is possible that abilities, in general, are more appropriate for describing the highest level or most important requirements for some occupations, whereas for other occupations skills are generally more appropriate. For example, one theory would be that for

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higher level occupations, such as Managers and Executives, skills will be relatively more important than abilities.

There are two ways this issue can be addressed. First, we could simply make an overall assessment of the importance or appropriateness of descriptors from each domain for describing a particular occupation. For example, the level scores for descriptors within each domain could be averaged within each occupation. This would provide an overall indication of the level of descriptor scores for a particular domain for each occupation. These could even be used to generate percentile ratings that essentially indicate the importance of that domain for a given occupation, relative to all other occupations. Another way to examine this would be to count the number or percentage of descriptors in a particular domain for a particular occupation above a certain level. These overall assessments of the importance of each domain could then be compared with those for other domains.

Another way to address this issue is to rank order descriptors from two or more domains simultaneously and then determine the extent to which descriptors at the top of the list tend to represent different domains for different occupations. Again this could be done using either raw or standardized descriptor information. To the extent that there are overall differences in the average level ratings across domains, this will be reflected in the joint rankings, so standardized data are arguably more appropriate for this purpose. In order to provide some preliminary information concerning how occupation descriptions might differ if we consider more than one domain simultaneously, we chose three pairs of domains--skills and abilities; skills and knowledges; and work styles and abilities--and rank ordered the standardized descriptors simultaneously for these pairs within each of the four occupations. Table 15-5 summarizes the results. These findings suggest that there are systematic differences across occupations in the

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importance of the various content domains for describing occupation requirements. For example, of the top ten skill and ability descriptors for Managers and Executives, all ten are skills, whereas for General Clerks all of the top ten are abilities. The other two occupations have a mix of skills and abilities in the top ten.

Summary

In general, the analyses described here show that the O*NET descriptors can be used to generate sensible occupation descriptions. Each of the approaches to generating these occupation descriptions has merit, but no single approach emerged as superior. Standardized data generally led to more interesting and conceptually appealing occupation descriptions, but raw data are still likely to be most appropriate for at least some purposes. For example, educators may be more interested in the descriptors rated to have the highest level requirements in an absolute sense, because issues in this area are not generally related to differentiating between occupations but rather identifying the aspects of educational curricula that could enhance performance in the workplace. For these applications, the finding that some activities are required at a relatively high level across a wide variety of occupations could be viewed as highlighting those activities and related worker requirements that are important to include in educational curricula regardless of students' occupational plans. Applications related to placement or career search decisions are likely to benefit most from information concerning the relative descriptor levels across occupations, that is, standardized data. Comparisons of occupation descriptions generated using a level scale cutoff score versus an absolute number of descriptors per domain did not reveal that either method was clearly superior. A combination of these two approaches is likely to be best for many purposes, and an example of how these approaches might be combined is presented

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next. In addition, there are large differences across domains, and it is likely that decision rules used to generate occupation descriptions will necessarily vary by domain.

Using O*NET to Generate Occupation Descriptions: An Example Application

Any application of the O*NET data must begin by clearly articulating the purpose of the application and the needed information, and identifying the content domain or domains that are relevant for this purpose. The O*NET contains over 300 descriptors, and focusing on only the most relevant aspects of the content domain will be more efficient and effective for many applications. In addition, even within a particular content domain only a subset of variables may be relevant for some purposes. For example, each GWA descriptor has both frequency and level data, and the training, education, licensure, and experience domain contains a variety of different types of information. Finally, our previous discussion of issues in generating occupation descriptions suggests a variety of other issues that may need to be considered for a particular application. Most importantly, users must determine whether absolute or relative occupation description information is most appropriate for a given purpose.

We now demonstrate what is likely to be a commonly used application--generating written occupation descriptions for internal human resources users. For purposes of illustration, we will employ a particular set of decision rules to generate these descriptions. The decision rules actually used in practice will likely vary according to the specific application. For this illustration we: (1) use standard scores rather than raw scores to emphasize the differences between occupations; (2) have at least one descriptor per domain represented in the content model; (3) include three or four descriptors if they have very close to the same mean standard scores (4) attempt to minimize, however, the number of descriptors included (a very long occupation description may not be desirable); (5) include the operational definitions of the descriptors to provide a richer description of the occupation requirements; and (6) include the four most frequently performed occupation-specific tasks. Figure 15-1 shows how the occupation descriptions might actually look for four example occupations.

Conclusions

The potential applications of O*NET are many. The contributions of this database to personnel selection, job seeking, learning about jobs and occupations, targeted training program development, certification of competency and mastery, and research on occupations and the workplace can be tremendous.

Preliminary data on between 30 and 37 occupations are promising with respect to O*NET applications. Reliability results are especially encouraging. Findings to date demonstrate that job incumbents can provide reliable information about their occupations. This in turn means that the database can be used with confidence. The discriminant function analysis results are also encouraging. The content model descriptors accomplish what they were intended to accomplish—they differentiate between occupations. These two sets of results, in particular, indicate that the applications we foresee, and probably those that will emerge later, should be successfully accomplished.

A variety of issues related to using the O*NET to describe occupations were discussed in this chapter, and preliminary analyses exploring the merits of various approaches to occupation description are presented. Additional analyses are needed to clarify some of these issues, but the purpose of any given application will always be a critical factor in decisions concerning which approach is best. Finally, we were able to demonstrate how the O*NET database might be used to generate written occupation descriptions for use in human resource management. It is our

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belief that O*NET should be an enormously important national resource for dealing with problems related to occupations, the workplace, and productivity.

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Reference

Peterson, N. G., Mumford, M. D., Borman, W. C., Jeanneret, P. R., & Fleishman, E. A. (1995). Development of prototype Occupational Information Network (O*NET) content model (Vols. 1-2). Salt Lake City, UT: Utah Department of Employment Security.

Figure 15-1
Example Job Descriptions for Four Occupations

Job Description: General Manager & Top Executive

General Description

Top and middle managers whose duties and responsibilities are too diverse and general in nature to be classified in any functional or line area of management and administration. These managers generally work through departmental or subordinate executives.

Critical Tasks

Consults with staff to assist in making decisions and coordinating activities.

Directs and coordinates activities of workers to ensure continuing operations, maximize returns on investments, and increase productivity.

Interprets, and explains policies, rules, regulations, and laws to organizations and individuals.

Establishes and maintains a record keeping system for the organization.

Work Activity Requirements

Monitoring and Controlling Resources - Monitoring and controlling resources and overseeing the spending of money.

Guiding, Directing, and Motivating Subordinates - Providing guidance and direction to subordinates, including setting performance standards and monitoring subordinates.

Staffing Organizational Units - Recruiting, interviewing, selecting, hiring, and promoting persons in the organization.

Work Context Description

Private work area.

Setting where you have influence.

Setting where the impact of your decisions is high.

Setting where you have high decision latitude.

Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: General Manager & Top Executive (continued)

Knowledge Requirements

Administration and Management - Knowledge of principles and processes involved in business and organization planning, coordination, and execution.

Personnel and Human Resources - Knowledge of policies and practices involved in personnel/human resource functions.

Economics and Accounting - Knowledge of economic and accounting principles and practices, the financial markets, banking, and the analysis and reporting of financial data.

Skill Requirements

Management of Financial Resources - Determining how money will be spent to get the work done, and accounting for these expenditures.

Systems Evaluation - Looking at many indicators of system performance, taking into account their accuracy.

Identification of Downstream Consequences - Determining the long-term outcomes of change in operations.

Management of Personnel Resources - Motivating, developing, and directing people as they work , identifying the best people for the job.

Ability Requirements

Fluency of Ideas - The ability to come up with a number of ideas about a given topic.

Originality - The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.

Inductive Reasoning - The ability to combine separate pieces of information, or specific answers to problems, to form general rules or conclusions.

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Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: General Manager & Top Executive (continued)

Work Style Requirements

Leadership Orientation - Job requires a willingness to lead, take charge and offer opinions and direction.

Analytical Thinking - Job requires analyzing information, and using logic to address work or job issues and problems.

Initiative - Job requires being willing to take on responsibilities and challenges.

Achievement/Effort - Job requires establishing and maintaining personally challenging achievement goals, and exerting effort toward task mastery.

Occupational Value Requirements

Authority - Provide direction and instruction to others.

Social Status - Are looked up to by others in organization and community.

Creativity - Get to try out own ideas.

Compensation - Are well paid in comparison to others.

Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: Registered Nurse

General Description

Administer nursing care to ill or injured persons. Licensing or registration required. Include administrative, public health, industrial, private duty, and surgical nurses.

Critical Tasks

Observes, evaluates, and records patient data.

Administers injections, medications, and treatments.

Consults with other medical professionals on policy and patient care.

Counsels and provides support for patients and families.

Work Activity Requirements

Assisting and Caring for Others - Providing assistance or personal care to others.

Teaching Others - Identifying educational needs and developing (or having others develop) formal training programs or classes.

Documenting/Recording Information - Entering, transcribing, recording, storing, or maintaining information in either written form or by electronic/magnetic recording.

Work Context Description

Works around diseases/infections.

Consequences of errors are great.

Special uniform is required.

Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: Registered Nurse (continued)

Knowledge Requirements

Medicine and Dentistry - Knowledge of the information and techniques needed to diagnose and treat injuries, diseases, and deformities.

Biology - Knowledge of plant and animal living tissue, cells, organisms and entities, including their functions, interdependencies, and interactions with each other and the environment.

Therapy and Counseling - Knowledge of information and techniques needed to rehabilitate physical and mental ailments, and to provide career guidance including alternative treatments, rehabilitation equipment and its proper use, and methods to evaluate treatment effects.

Skill Requirements

Science - Using scientific methods to solve problems.

Social Perceptiveness - Being aware of others' reactions and understanding why they react the way they do.

Operation Monitoring - Watching gauges, dials, or other indicators to make sure a machine is working properly.

Ability Requirements

Problem Sensitivity - The ability to tell when something is wrong or is likely to go wrong.

Inductive Reasoning - The ability to combine separate pieces of information, or specific answers to problems, to form general rules or conclusions.

Arm-Hand Steadiness - The ability to keep the hand and arm steady while making an arm movement or while holding the arm and hand in one position.

Speech Recognition - The ability to identify and understand the speech of another person.

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Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: Registered Nurse (continued)

Work Style Requirements

Concern for Others - Job requires being sensitive to others' needs and feelings, and being understanding and helpful to others on the job.

Adaptability/Flexibility - Job requires being open to change (positive or negative) and to considerable variety in the workplace.

Self-Control - Job requires maintaining composure, keeping emotions in check, controlling anger, and avoiding aggressive behavior even in very difficult situations.

Social Orientation - Job requires preferring to work with others rather than alone and being personally connected with others on the job.

Persistence - Job requires persistence in the face of obstacles on the job.

Occupational Value Requirements

Social Service - Get to do things for other people.

Security - Have steady employment.

Social Status - Are looked up to by others in the organization and community.

Achievement - Get a feeling of accomplishment on the job.

Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: General Office Clerk

General Description

Perform duties too varied and diverse to be classified in any specific office clerical occupation. Clerical duties may be assigned in accordance with the office procedures of individual establishments and may include a combination of bookkeeping, typing, stenography, office machine operation, and filing.

Critical Tasks

Operates office machines, such as photocopier, fax, and personal computer.

Answers telephone, responds to requests, delivers messages, and runs errands.

Communicates with customers, employees, and other individuals to disseminate or explain information.

Compiles, copies, sorts, and files records of office activities, business transactions, and other activities.

Work Activity Requirements

Interacting with Computers - Controlling computer functions by using programs, setting up functions, writing software, or otherwise communicating with computer systems.

Processing Information - Compiling, coding, categorizing, calculating, tabulating, auditing, verifying, or processing information or data.

Documenting/Recording Information - Entering, transcribing, recording, storing, or maintaining information in either written form or by electronic/magnetic recording.

Work Context Description

Work station requires sitting.

Uses computer and telephone to communicate.

Knowledge Requirements

Clerical - Knowledge of administrative and clerical procedures and systems such as word processing systems, filing and records management systems, stenography and transcription, forms design principles, and other office procedures and terminology.

Skill Requirements

Operation and Control - Controlling operations of equipment or systems.

Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: General Office Clerk (continued)

Ability Requirements

Wrist-Finger Speed - The ability to make fast, simple, repeated movements of the fingers, hands, and wrists.

Work Style Requirements

Attention to Detail - Job requires being careful about detail and thorough in completing work tasks.

Occupational Value Requirements

Activity - Are busy all the time.

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Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: Maintenance Repairer, General Utility

General Description

Perform work involving two or more maintenance skills to keep machines, mechanical equipment, or structure of an establishment in repair. Duties may involve pipefitting, boilermaking, insulating, welding, machining, machine and equipment repairing, carpentry, and electrical work. May also include planning and laying out of work relating to repairs; repairing electrical and/or mechanical equipment; installing, aligning, and balancing new equipment; and repairing buildings, floors, or stairs. These workers are generally found in small establishments where specialization in maintenance work is impractical.

Critical Tasks

Installs new or repaired parts.

Inspects and tests machinery and equipment to diagnose machine malfunctions.

Cleans and lubricates shafts, bearings, gears, and other parts of machinery.

Dismantles and reassembles defective machines and equipment.

Work Activity Requirements

Repairing and Maintaining Mechanical Equipment - Fixing, servicing, aligning, setting up, adjusting, and testing machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles.

Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment - Providing documentation, detailed instruction, drawings, or specifications to inform others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used.

Operating Vehicles, Mechanized Devices, or Equipment - Running, maneuvering, navigating, or driving vehicles or mechanized equipment, such as forklifts, passenger vehicles, aircraft, or water craft.

Inspecting Equipment, Structures, or Materials - Inspecting or diagnosing equipment, structures or materials to identify the causes of errors or other problems or defects.

Work Context Description

Climbs ladders, scaffolds, poles, etc.

Works in high places.

Wears production or maintenance worker clothes.

Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: Maintenance Repairer, General Utility (continued)

Knowledge Requirements

Mechanical - Knowledge of machines and tools, including their designs, uses, benefits, repair, and maintenance.

Building and Construction - Knowledge of materials, methods, and the appropriate tools to construct objects, structures, and buildings.

Skill Requirements

Repairing - Repairing machines or systems using the needed tools.

Installation - Installing equipment, machines, wiring, or programs to meet specifications.

Equipment Maintenance - Performing routine maintenance and determining when and what kind of maintenance is needed.

Troubleshooting - Determining what is causing an operating error and deciding what to do about it.

Operation Monitoring - Watching gauges, dials, or other indicators to make sure a machine is working properly.

Ability Requirements

Static Strength - The ability to exert maximum muscle force to lift, push, pull, or carry objects.

Control Precision - The ability to quickly and repeatedly make precise adjustments in moving the controls of a machine or vehicle to exact positions.

Gross Body Equilibrium - The ability to keep or regain one's body balance or stay upright when in an unstable position.

Work Style Requirements

Analytical Thinking - Job requires analyzing information, and using logic to address work or job issues and problems.

Innovation - Job requires creativity and alternative thinking to come up with new ideas for and answers to work-related problems.

Independence - Job requires developing one's own ways of doing things, guiding oneself with little or no supervision, and depending on oneself to get things done.

Figure 15-1 (continued)
Example Job Descriptions for Four Occupations

Job Description: Maintenance Repairer, General Utility (continued)

Occupational Value Requirements

Variety - Have something different to do every day.

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Table 15-1
Comparison of Correlations Within and Between Second Order Categories by Content Domain

	Descriptors From the Same Category			Descriptors From Different Categories		
Content Domain	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Generalized Work Activities	.61	-.26	.88	.43	-.65	.95
Knowledges	.58	-.07	.88	.40	-.23	.95
Skills	.67	.39	.74	.64	-.21	.97
Abilities	.79	.13	.95	.26	-.41	.88
Work Styles	.69	.27	.83	.42	-.47	.84
Occupational Values	.27	-.26	.88	.24	-.65	.95

Note. N = 29.

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Table 15-2
Overlap in Top Ten Descriptors Across Occupations for Raw and Standardized Scores

	Occupations Compared					
Content Domain	Mgr./Exec. & Nurse	Mgr./Exec. & Clerk	Mgr./Exec. & Mnt. Rep.	Nurse & Clerk	Nurse & Mnt. .Rep	Clerk & Mnt. Rep.
Generalized Work Activities:						
Raw Scores	3	4	5	5	3	6
Standardized Scores	3	0	0	1	0	1
Knowledges:						
Raw Scores	3	9	3	4	4	3
Standardized Scores	3	2	0	1	1	1
Skills:						
Raw Scores	4	4	3	9	2	2
Standardized Scores	1	0	1	2	1	3
Abilities:						
Raw Scores	8	6	4	8	5	4
Standardized Scores	4	1	0	1	0	0
Work Styles:						
Raw Scores	8	7	7	9	7	8
Standardized Scores	7	5	6	5	4	5
Occupational Values:						
Raw Scores	9	8	8	9	9	8
Standardized Scores	6	2	6	4	4	5
Work Context:						
Raw Scores	5	5	4	6	7	6
Standardized Scores	1	1	0	0	0	0

Note. Occupation titles are abbreviated: Mgr./Exec. = General Managers & Top Executives; Nurses = Registered Nurses; Clerks = General Office Clerks; Mnt. Rep. = Maintenance Repairers, General Utility. Numbers in this table represent the extent to which the ten descriptors with the highest level ratings overlap across pairs of occupations--that is, the number of these "top ten" descriptors that are identical. For example, the "3" in the upper left-hand corner indicates that Mgr./Exec. and Nurse have three of their top ten Generalized Work Activities in common using raw scores.

Table 15-3
Number of Descriptors Included in Job Descriptions Based on Two Level Scale Decision Rules

Content Domain and Decision Rule	Numbers of Descriptors Included: Managers/ Executives	Nurses	General Clerks	Maintenance Repairers
Generalized Work Activities:				
5 or above	5	3	0	0
4 or above	22	10	3	7
Knowledges:				
5 or above	0	1	1	0
4 or above	6	4	1	1
Skills:				
5 and Above	19	6	0	3
4 and Above	33	18	1	9
Abilities:				
5 and Above	7	9	0	0
4 and Above	18	19	5	18
Work Styles:				
5 or above	17	17	9	9
4 or above	17	17	17	17
Occupational Values:[a]				
4.5 or above	2	1	0	0
4 or above	8	6	5	3

[a]Occupational Values are rated on a 1 to 5 scale.

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Table 15-4
Mean Level Scale Ratings for theTenth Highest Descriptor in Each Domain for Each Occupation

Content Domain	Managers/ Executives	Nurses	General Clerks	Maintenance Repairers
Generalized Work Activities	4.5	4.0	3.0	3.8
Knowledges	3.2	3.3	1.5	2.1
Skills	5.2	4.7	2.8	3.9
Abilities	4.8	4.8	3.5	4.2
Work Styles	5.6	5.9	4.9	4.9
Occupational Values[a]	4.0	3.8	3.6	3.7

[a]Occupational Values are rated on a 1 to 5 scale.

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Table 15-5
Composition of Top Ten Descriptors for Pairs of Domains Rank Ordered Simultaneously

	Occupation			
Domain Pair	Managers/ Executives	Nurses	General Clerks	Maintenance Repairers
Skills and Abilities	10 skills	6 skills 4 abilities	10 abilities	7 skills 4 abilities
Skills and Knowledges	8 skills 2 knowledges	3 skills 7 knowledges	3 skills 7 knowledges	7 skills 3 knowledges
Abilities and Work Styles	8 abilities 2 work styles	9 abilities 1 work style	7 abilities 3 work styles	10 abilities

Note. Based on standardized descriptor data.

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Chapter 16

Occupation-Specific Descriptors:

Approaches, Procedures, and Findings

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The intent of this chapter is to describe a set of procedures that might be used to gather occupation-specific information and organize this kind of descriptive data in terms of the broader cross-occupation variables described in Chapters 3 through 11. In this chapter, we present the results obtained in a series of pilot studies intended to assess the feasibility of applying the suggested procedures. First, though, we consider what is perhaps the most commonly used kind of occupation-specific descriptor--job tasks (McCormick, 1979a).

Virtually all of the foregoing chapters have focused on analyses of measures that might be used to describe most occupations. This kind of cross-occupation descriptive system provides the foundation for a system intended to answer questions about a number of occupations. These cross-occupation descriptors, however, do not and, in fact, cannot address all of the various types

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of descriptors used to describe people's jobs. More specifically, these taxonomies of cross-occupation descriptors do not provide occupation-specific information--such as the tasks and occupation-specific skills--that only apply to a single occupation or to a narrowly defined job family.

Many questions can be answered without referring to occupation-specific information (Pearlman, 1993). But as McCage (1994) points out, occupation-specific information may be required to answer other important questions. For example, occupation-specific information may be necessary to specify training requirements, develop position descriptions, and undertake the redesign of jobs.

The various applications of occupation-specific information clearly argue for inclusion of certain types of occupation-specific descriptors in a comprehensive occupational information system such as O*NET. The inclusion of occupation-specific information, however, raises a host of issues. As illustrated in the history of the Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1991) and the concerns voiced by the Advisory Panel for the DOT (APDOT, 1993), occupation-specific information often is collected in a patchwork fashion. Further, by its very nature, this kind of descriptive information is difficult to embed within a broader organizing structure. Finally, collection of occupation-specific descriptive information is resource intensive.

These and other considerations suggest that it may be difficult and perhaps not especially useful to include occupation-specific information in the O*NET. At least over the short run there seems to be some truth to this proposition. Certainly, there is little point in collecting volumes of occupation-specific information until the various cross-occupation descriptors have been used to identify a coherent and reasonably parsimonious set of occupations and job families. Once that

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has been done, however, and once a viable framework for collecting occupation-specific descriptors has been constructed, then this more specific type of descriptive data should be included in a truly comprehensive occupational information system.

Occupation-Specific Tasks

Background

As Fleishman and Quaintance (1984) point out, a variety of techniques might be used to generate descriptive information about the activities being performed on a particular job. One might, for example, describe occupations in terms of performance errors. Alternatively, the work people do in their jobs can be described through qualitative ethnographic procedures. Still another approach to the description of occupational activities flows from recent work on the role of cognition in performance. In this instance, activities are described in terms of the differences observed in the knowledge structures characterizing experts and novices in a particular field of endeavor (Camara, 1992).

Each of these techniques used to describe the requirement of a given job have their unique strengths and weaknesses. Further, it should be apparent that these techniques all provide somewhat different information about the nature of performance on a certain job. By the same token, however, these techniques all share a common starting point in that they begin with an attempt to define the nature of the activities people are performing on their jobs.

As a result, the definition and description of work activities provides a basis for virtually all job analysis efforts. The procedure most commonly used to define and describe these activities is task analysis. At a general level, task analysis represents a way of framing or organizing job activities. As McCormick (1979a) points out, fundamentally, a task is an action

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applied to some object under certain conditions. The starting point for attempts to describe a specific occupation is, therefore, definition of the tasks to be performed on the occupation.

A variety of procedures have been used to identify the tasks performed in an occupation and to obtain descriptive information about the nature of requisite job tasks. Tasks are sometimes identified by having occupational analysts watch people perform the work. At other times, individual interviews or panel meetings with incumbents or supervisors are used to define tasks. A third approach is to use existing task inventories (McCormick, Jeanneret, & Mecham, 1972), which have usually themselves been developed through one of the two just-mentioned methods. Generally, these task lists are used to identify the more important or frequently performed tasks (Friedman, 1990; Harvey & Lozada-Larsen, 1988). Often, however, these task lists, inventories, and questionnaires request other types of information about the nature of task performance, such as learning difficulty, criticality, or degree of discretion (Mumford, Weeks, Harding, & Fleishman, 1987).

Although a variety of procedures may be used to identify requisite tasks in an occupation, the most common procedure is to convene a meeting of subject matter experts (SMEs). In SME meetings, a group of five to seven incumbents, or their supervisors, are called together. These SMEs are then asked to describe the activities performed on the job at hand. This unstructured recall approach will elicit usable task statements. However, to attain comprehensive coverage of the tasks performed in an occupation, it often is necessary to conduct a number of meetings. As a result, this technique often becomes unduly time consuming and expensive (C. Walker, personal communication, April 1995). Alternatives such as critical incident analysis or observation of job performance also, unfortunately, suffer from much the same problem.

This task identification problem is important with respect to the development of the occupational classification and information system. Even with a well developed classification system, there still are likely to be a relatively large number of job families and occupations within these families where detailed information will be needed concerning the underlying work activities. In the following section, we review four potential techniques for collecting occupation-specific information about the tasks that are performed, all of which might provide a more economical and efficient basis for the collection of this descriptive information.

Approaches

General Task Inventories

One approach to efficient collection of task data is the general, cross-occupation task inventory. Two advantages of this approach are that it is relatively fast and it is inexpensive. Perhaps the most frequently used general job analysis inventory of this sort is the Position Analysis Questionnaire (PAQ; McCormick, Jeanneret, & Mecham, 1972). Cunningham (1988) and Harvey (1991) have also contributed general inventories. More recently, the American College Testing Program has developed a general task survey under the auspices of the U.S. Department of Labor (American College Testing, 1994).

There is evidence that these kinds of general cross-occupation task surveys can provide meaningful descriptions of activities performed in a number of occupations (McCormick, Jeanneret, & Mecham, 1972). On the other hand, by virtue of their focus (i.e., tasks appearing in multiple occupations), they necessarily give less attention to the specific activities occurring in a given occupation (Levine, 1983). As a result, it is questionable whether this approach will provide a truly comprehensive description of tasks that make a given occupation unique. This potential shortcoming of generic surveys in turn limits their value in defining occupation-specific

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skills and knowledges. They may have greater value, however, in identifying intermediate work activities of the sort described by Cunningham, Drewes, and Powell (1995).

Available Task Inventories

A second technique that could be used to obtain information about tasks relies on the use of existing job analysis inventories. Prior efforts have provided task analysis data for a number of occupations. Conceivably, an effort might be initiated in which a library is built up over time that describes the tasks identified in earlier job analysis efforts. When attempting to describe a particular occupation, relevant task inventories would be drawn from this library. These task lists would be reviewed, and then used as the basis for developing task inventories tailored to the job at hand that would presumably extend across locations or establishments.

This approach clearly would reduce the amount of effort needed to generate an initial set of task statements. However, a substantial amount of work would be required to develop the kind of library needed to make this approach feasible. Available task analysis inventories would have to be rewritten so that task statements were written at a common level of detail that would indeed permit generalization across establishments. Further, arrangements would have to be made to obtain what in many areas would be proprietary data. Finally, available task inventories are likely to be available only for a relatively select sample of occupations--typically occupations in which performance is of sufficient importance to the organization to warrant an expensive and time consuming job analysis effort. As a result, other techniques would still be required for identifying the tasks occurring on other occupations not covered by the available task inventories.

Even if these difficulties could be overcome, one problem remains: The lists of tasks would probably be deficient. There are at least three reasons for this potential deficiency: (1) some of the inventories would be based on relatively old job analyses and important changes in the occupations may have occurred since the inventories were developed; (2) some of the inventories would be based on job analyses that were performed for specific purposes, resulting in inventories focusing only on some parts of the examined occupations; and (3) the inventories would be based on job analyses that vary greatly in quality and comprehensiveness.

Activity Analysis

A third approach for generating occupation-specific tasks in rapid, cost effective fashion has been suggested by Prien (1994). This approach is based on the notion that all occupations involve a limited set of common activities, such as installing, repairing, writing, tracking, or supervising. These common activities, or action verbs, might be used as a basis for generating tasks by applying the following procedures. First, a general taxonomy of action verbs would be identified, such as those proposed by Prien (1994) or Edwards (1989). Second, a group of SMEs would be asked to review this activity list and check the activities they perform in their occupation. Third, a second group of SMEs would be presented with each of these activities and for each activity they would be asked to list all objects of the activity, providing modifications as necessary. Thus, in the case of electricians, incumbents might list "install switches," "install wiring," and "install control boxes."

The procedures described above would, at least in theory, result in a set of task statements consistent with McCormick's (1979b) definition of a task as an activity occurring in relation to some object. Further, it is possible that this procedure, if coupled with an expert system, might be used to generate tasks "on-line" or through telephone interviews. Thus, an activity-based approach to task generation would seem to warrant further consideration.

We use the word "consideration" quite intentionally. Although this activity-based approach to task generation has some attractive features, it has not been widely applied.

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Moreover, it may prove difficult to obtain a comprehensive list of activity statements and create procedures for identifying synonyms within a list of activity statements. Additionally, any activity-based approach may implicitly downplay the specific objects and the unique behavioral demands associated with a given set of tasks.

Generalized Work Activities

A fourth approach that might be used to generate task statements has been suggested by Mumford and his colleagues (Clifton, Connelly, Reiter-Palmon, & Mumford, 1991; Connelly, Reiter-Palmon, Clifton, & Mumford, 1991; Gilbert, Connelly, Clifton, Reiter-Palmon, & Mumford, 1992; Mumford, Threlfall, Costanza, Baughman, & Smart, 1992; Reiter-Palmon, et al., 1990). In this approach, a panel of SMEs is presented with a list of generalized work activities (GWAs), like those described in Chapter 6. Initially, panel members are asked to reach a consensus regarding the GWAs for their occupations. Finally, within each of the retained GWAs, panel members are asked to list the specific tasks occurring on their occupation.

This approach differs from more traditional approaches in the process used to elicit tasks. Rather than being asked a global question, "What do you do on your job?," panel members are asked a series of more specific questions referring to the tasks performed under a given dimension or GWA. By using recall in relation to GWAs, tasks can be generated far more rapidly. Typically, the research cited above showed that a one-day panel meeting with five or six SMEs is sufficient to obtain 90% to 95% coverage of the occupation's relevant tasks.

Perhaps the most important characteristic of this approach is that it allows tasks to be generated quickly with good coverage of the relevant domain. Two other characteristics of the approach also make it attractive. First, it can be easily extended to capture contextual influences on performance as well as duties and tools. Second, it allows tasks to be generated and organized within broader GWAs, thereby providing a system for identifying tasks that explicitly integrates these tasks into a broader taxonomic structure. In terms of resources required, this approach should be more expensive and time-consuming than the general task inventory, but less expensive than the library approach.

Procedures and Findings

Our discussion of job analysis procedures suggests a two-step approach to the development of a task database for inclusion in O*NET. Initially, for the purposes of the prototype, a variant of the Available Task Inventories approach described above was used. Subsequently, however, the GWA approach might be employed or, alternatively, an activity analysis approach. Both approaches are described below.

A Modified Available Task Inventories Approach

A variation on this library-based task generation procedure was employed for the prototype O*NET. The current Dictionary of Occupational Titles (DOT) provides a short list of major tasks to be performed in each occupation included in the DOT. Thus, it is possible to identify a set of tasks by abstracting core tasks included in those occupations subsumed under a given OES occupation.

This work was performed by the North Carolina Occupational Analysis Field Center (OAFC). The OAFC began by identifying those DOT occupations associated with each of the 80 OES occupations targeted in the initial O*NET data collection effort. This initial clustering served to convert DOT occupations into the broader OES occupational structure. Next, a text analysis program was used to abstract tasks from the relevant DOT occupational descriptions.

Once the tasks occurring within a cluster of DOT occupations had been identified, they were presented to analysts at the OAFC field centers. These experienced occupational analysts then edited the identified tasks for clarity, generality, brevity, and accuracy. Additionally, a second panel of occupational analysts reviewed the resulting list of task statements for generality and comprehensiveness, adding to or correcting the initial task list to ensure that the task list was reasonably comprehensive and that the tasks were written to a common level of specificity.

This procedure resulted in the identification of 7 to 30 relatively broad task statements for each of the 80 targeted OES occupations. The task lists were then used to create occupation-specific task rating questionnaires. One of these questionnaires is presented in Figure 16-1. As shown in Figure 16-1, job incumbents were asked to read each task statement and identify those tasks relevant to the performance of their job. If incumbents indicated that a task is relevant, they were asked to (a) rate the frequency with which they perform this task and (b) rate the importance of this task with respect to performance of the job. Importance and frequency ratings are used in part because they have been shown to provide unique descriptive information and in part because the simultaneous collection of multiple ratings contributes to reliability (McCormick, 1979b). It is of note that frequency ratings were collected on an absolute, rather than a relative, scale.

The tasks shown in Figure 16-1 represent a modified version of the Available Task Inventories notion described earlier in this chapter. In a more elaborate version, the initial task lists would come from multiple sources (i.e., not just the DOT task lists). They would stem from a review of prior job analysis programs, including the job analysis work conducted by (a) the Department of Defense, (b) the Office of Personnel Management, and (3) those research institutes, consulting firms, and employers willing to share proprietary data. The process would include a careful review of the quality of each job analysis and its resulting task list. The tasks list(s) that are judged of sufficient quality would be (1) edited for clarity and a common level of specificity, (2) reviewed, (3) and edited again as necessary. It is important to note that this procedure would likely result in occupation-specific task rating questionnaires with a greater number of tasks per occupation (e.g., 100 - 200), and at a more specific level than tasks derived from the DOT.

Bearing these caveats in mind, the results obtained in the O*NET initial data collection do provide support for the potential value of the archival approach. Job incumbents were asked to complete, in addition to between one and five of the questionnaires described in the other chapters of this report, an occupation-specific task questionnaire (Figure 16-1 provides an example). Table 16-1 presents the interrater agreement coefficients obtained for task frequency and importance ratings. In addition to the observed interrater agreement coefficients, estimates for 1 and for 30 raters are also presented. The interrater agreement coefficients, reflecting the degree of consistency across judges in their task ratings within an occupation, are uniformly high, ranging from .80 to .98 for the frequency rating and .77 to .97 for the importance rating, for 30 incumbents. The occupations with the lowest reliabilities--Stock Clerks and Packaging and Filling Machine Operators--may be those with the least consistency in task demands across, or even within, organizations.

Table 16-2 presents interrater agreement coefficients where task ratings were scored in three ways: (1) using the full frequency and importance scales, as in Table 16-1; (2) using only relevant responses on the frequency and importance scales (<u>not relevant</u> responses set to missing); and (3) dichotomously (relevant/not relevant). While, predictably, the relevant-only and dichotomous rescoring yielded lower reliabilities than the full scale scoring, the reliabilities for these two rescorings are very similar to full-scale scoring and surprisingly high. With the exception of incumbents in the Packaging and Filling Machine Operators occupation, a large number of whom indicated that the tasks on the occupation-specific questionnaire were not

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relevant for their jobs, the relevant-only reliabilities for the frequency scale ranged from .74 to .99 and the relevant/not relevant reliabilities ranged from .66 to .99. This finding provides strong support for the inclusion of the not relevant response option.

Additional evidence bearing on the meaningfulness of these descriptions might be obtained by considering the relationships observed between the frequency and importance ratings. In accordance with the results obtained in earlier studies (Harvey, 1990), the task frequency and importance ratings yielded the expected positive relationship. As reported in Table 16-3, across occupations, the correlations between task frequency and importance ratings ranged from .55 to .92, with a median correlation of .78. These results suggest that incumbents are differentiating between the frequency and importance scales. The relatively short length of the occupation-specific task questionnaires, the greater job relevance of the questions, and the fact that incumbents may have had prior experience with similar job analysis instruments, all may have contributed to increased engagement with the rating tasks on the task questionnaires and, consequently, well-differentiated frequency and importance ratings.

Although the judges clearly could agree with respect to how well these ratings described their jobs and could differentiate between the frequency and importance aspects of the task ratings, these results do not provide a great deal of evidence bearing on the meaningfulness of these ratings in describing people's jobs. One way to assess the meaningfulness of this descriptive data is by examining these task ratings with respect to the nature of certain occupations.

Table 16-4 presents the means and standard deviations of incumbents' frequency and importance ratings for two of the 29 occupations examined here--General Managers and Top Executives, and Police Patrol Officers. The results for these two occupations are fairly typical and illustrate the types of rating patterns evidenced in these data. For General Managers and Top

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Executives, for example, crucial job duties, such as "Directs and coordinates activities of workers to ensure continuing operations, maximize returns on investments, and increase productivity" (Importance: M = 4.05, SD = 1.02) and "Consults with staff to assist in making decisions and coordinating activities" (Importance: M = 4.00, SD = .82) tended to receive relatively high mean importance ratings. Mean frequency ratings also provide some evidence for the meaningfulness of this descriptive information. For example, it is hardly surprising that Police Patrol Officers tended to spend more time on the task "Patrols specific area on foot, horseback, or motorized conveyance" (Frequency: M = 5.75, SD = 1.75) than on "Expedites processing of prisoners, prepares and maintains records of prisoner bookings, and maintains record of prisoner status during booking and pre-trial process" (Frequency: M = 0.86, SD = 1.70).

Somewhat more compelling evidence for the meaningfulness of these tasks might be obtained by comparing those descriptions with other, independent measures of people's job activities. Accordingly, tasks for ten occupations were classified into the GWAs. The initial assignments were made by a single judge, but were confirmed by other occupational analysts. The assignments are reported in Figure 16-2. This figure also presents the correlations of task and GWA ratings and the percentage agreement in relevant/not relevant classification. The generally low correlations between the frequency ratings for the tasks and corresponding GWAs, and between the importance ratings, are most likely due to a difference in level of specificity between the descriptors. For example, a task classified into a GWA might nevertheless constitute a very small part--or a very specialized application--of that GWA. The percentage agreement between the ratings of the tasks and GWAs in terms of whether that descriptor is relevant for the job is more indicative of the consistency of the ratings. In fact, these percentages tended to be quite substantial, with the majority of task-GWA pairs showing at least a 70% agreement.

These findings provide some evidence for the potential meaningfulness of task statements generated using this archival approach. On the other hand, however, it should be recognized that archival data may at times grow dated. Further, this approach may not yield viable data when our concern is new or rapidly changing jobs. Thus, there is a need for alternative strategies that might be used in generating occupational tasks.

The GWA Approach

The procedures sketched out above are most appropriate when existing task inventories are available. However, a different approach will need to be applied when available up-to-date task lists are not available. As noted above, the most attractive approach for generating these new task lists is to use a cued recall approach where the GWAs provide a basis for task generation.

Broadly speaking, this approach is based on the earlier work of Mumford and his colleagues (Mumford & Supinski, 1995; Mumford, Threlfall, Costanza, Baughman, and Smart, 1992; Reiter-Palmon, et al., 1990), although the general techniques (e.g., using SME panels) are broadly applied in job analysis. This task generation procedure requires a group of five to six SMEs. Typically, these SMEs are incumbents or supervisors who have at least six months experience in a job. It generally is useful when forming SME panels to select panel members who have different backgrounds and somewhat different career histories (Campion, 1992; Landy & Vasey, 1991). Additionally, panel members should be good performers who hold roughly similar positions in the organization (Landy & Vasey, 1991). It may also be desirable to select panel members to represent different organizations, if this is possible, when there is a need to obtain task data that extend across organizations. Alternatively, multiple panel meetings could be conducted. The panel meetings should be scheduled to occur over a day and a half. However, all requisite exercises typically can be completed in a single day.

The procedures used to generate task statements in these meetings are quite straightforward. First, each subject matter expert is asked to review the definition of each GWA and determine whether this type of activity is performed on their job. Second, panel members are asked to reach a consensus decision concerning the concerning the approximately 10 to 15 GWAs that represent the most important components of job performance. Panel members are asked to (1) identify the major subcategories of activities falling under this general dimension and (2) then specify the specific tasks falling under each subcategory. Figure 16-3 provides the instructions given for the task generation portion of the exercise. Essentially, those instructions ask each panel member to list the major kinds of tasks they perform under each GWA and then list the more discrete tasks subsumed under a given area.

After panel members have generated their lists of activities and specific tasks under each GWA, one panel member is asked to read aloud one task type and the associated tasks he or she generated. Other panel members then review these task statements for relevance, comprehensiveness, and clarity, recommending any necessary changes. This procedure is repeated round-robin, until panel members feel that all work activities falling under a given GWA have been exhausted, and then the group moves to the next GWA. Throughout this process, occupational analysts take notes, writing down the task statements proposed by panel members. After the end of the meeting, or meetings, those notes are used to develop the final task list.

Typically, these procedures provide a rather detailed description of people's jobs, yielding 150 to 400 tasks, depending on the complexity of the job. Figure 16-4 provides an illustration of the kind of tasks generated using this technique. The interrater agreement coefficients obtained when incumbents were asked to assess the frequency with which these tasks are performed on

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their job and the importance of these tasks were similar to those obtained for the archival tasks described earlier. In some applications of this method, a sample of five occupations, including sales representatives, managers, finance analysts, telecommunications repair technicians and telecommunications systems operators, the median interrater agreement coefficient for frequency rating was .88 for samples of twenty judges (Mumford & Supinski, 1995; Mumford, Threlfall, Costanza, Baughman, & Smart, 1992; Reiter-Palmon, et al., 1990). For importance ratings, the median interrater agreement coefficient was .91.

These interrater agreement coefficients are noteworthy for two reasons. First, the tasks resulting from the "top-down" GWA approach apparently provide reasonably reliable descriptions of people's job activities. Second, it appears that this procedure is a reasonably flexible one in the sense that it yields viable task statements across a range of occupations including sales representatives and technicians as well as managers and financial analysis.

These observations about the reliability of task ratings bring to the fore a new question: Is there reason to suspect that this procedure yields task ratings that provide a meaningful description of people's jobs? One piece of evidence bearing on the meaningfulness of these task statements has been provided by a series of "comprehensiveness" tests that were part of the studies cited above. In those tests, three to five subject matter experts were asked to review the lists of tasks obtained using these procedures and identify any additional tasks needed to ensure a comprehensive description of people's jobs. Although this comprehensiveness test often results in the addition of a few tasks, the number of tasks added was relatively small and in no case resulted in more than a 3% increase in the number of tasks identified. Thus, it appears that this procedure in fact yields the sort of tasks which provide a comprehensive description of people's jobs.

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Another way one might assess the meaningfulness of the descriptive information provided by these procedures is by examining the ability of these task ratings to capture cross-position and cross-site differences in the nature of the work being done. For example, in the Reiter-Palmon, et al. (1990) study it was found that the resulting task statements accurately identified changes in work load associated with new shipping and pricing procedures. The Mumford and Supinski (1995) study contrasted the tasks required in emerging and diminishing telecommunications positions. As might be expected based on the changes in technology occurring in the telecommunications field, tasks associated with "black box" technology were found to be more important and more frequently performed in emerging as opposed to diminishing positions.

Taken as a whole, these studies have provided some compelling evidence for the reliability and validity of task statements formulated using this top-down GWA task generation procedure. This task generation procedure, however, has been found to display two other noteworthy characteristics. First, it appears to provide an unusually efficient basis for task generation. Typically, two one-day meetings are sufficient to obtain a set of comprehensive, detailed task statements. This greater efficiency of the cued recall strategy being used in task generation, of course, greatly reduces the cost, as well as the time, needed to obtain occupation-specific tasks. Second, because tasks are generated and organized in terms of the GWAs, it becomes possible to integrate occupation-specific tasks into a larger taxonomy (i.e., the GWA portion of the O*NET taxonomy). The GWAs also provide a basis for organizing task data in a more user-friendly format. Finally, as indicated in the following sections, this framework for task generation is an unusually flexible one, allowing it to be extended to incorporate elements of an activity analysis approach permitting the "on line" identification of job tasks through an artificial intelligence system.

The fundamental notion underlying activity analysis is that tasks can be identified and structured with respect to their two key components. In other words, tasks can be defined with respect to the action being taken--a verb--and the thing being manipulated in this action--an object (Gael, 1983). At a general level, it is difficult to dispute this argument; certainly, verbs and objects, along with object and verb modifiers, represent the key linguistic components of any task statement. On the other hand, lists of verbs and objects have proven of limited value simply because there are so many verbs and objects used to describe work activities in the English language.

On the other hand, however, the generalized work activities strategy for task generation suggests a way that one might employ these general characteristics of job tasks in using activity analysis to develop task inventories. Any given generalized work activity--for example, operating heavy equipment--will have associated with it a limited set of verbs, (e.g., drive, control) and objects (e.g., trucks, shovels). Thus, by organizing verbs and objects in terms of the associated generalized work activities, it might be possible to use this information in developing an automated job analysis system intended to facilitate task analysis efforts (see, for example, Appendix 16-A).

Such a system might operate as illustrated in Figure 16-5. Task generation would be done by presenting a generalized work activity along with a list of (1) the verbs most frequently associated with this generalized work activity and (2) the objects most frequently associated with this generalized work activity. Incumbents would be asked to review this initial list and add any new verbs or objects associated with a generalized work activity held to be relevant to describing their jobs. Next, they would begin constructing task statements by matching particular verbs with particular objects to create a prototype job task (e.g., drive trucks). After a prototype task had been constructed through these verb-object matches, the incumbent would then be asked to modify the object statement (drive trucks to parcel pickup sites) or the verb statement (drive delivery trucks to parcel pickup sites). The resulting task statements obtained from 10 to 15 incumbents would be written out or stored in a computer. Subsequently, these tasks would be sorted by generalized work activity, verbs, and objects, to help analysts prepare a consolidated list (Task Editing in Figure 16-5).

To test this approach to task list generation, we developed computer programs to generate and edit task statements. These programs are part of a larger set of occupational analysis computer tools currently being developed and tested. In recent usability tests, employees used the task generation software to create occupation-specific task lists. Figure 16-6 illustrates typical task statements sampled from these lists. An initial pilot test of the task editing program showed that it is an effective tool for integrating lists of tasks from multiple incumbents. Expert review of such an edited task list indicated that the task generation and editing procedures yielded a comprehensive list of tasks at the appropriate level of detail. Based on this work and past studies employing the GWA approach (e.g., Mumford & Supinski, 1995), we predict that more extensive analyses of task lists generated in this manner will support its utility. Preliminary evidence shows that the combination of the GWA approach to task generation and the use of computer-based job analysis tools not only provides valid task lists, but also provides significant gains in efficiency and cost-effectiveness.

Summary

At this point, it should be apparent that the attention given to occupation-specific descriptors involved a careful examination of alternative procedures for identifying and describing requisite job tasks. In fact, substantial effort seemed called for, in part because task data provides the essential piece of information needed to identify and understand virtually all other occupation-specific descriptors. Further, occupation-specific data, particularly task descriptions, represent a cornerstone of many personnel interventions, including training, job redesign, and human factors analysis.

Unfortunately, however, it has traditionally proven difficult to apply task descriptions in an effective fashion across large numbers of occupations. In fact, this problem might be attributed to the high cost of obtaining occupation-specific information, particularly task descriptions. In part however, the number of tasks involved in most jobs and the use of multiple ratings make it difficult to apply this information, because the resulting data cannot be readily organized within a broader structure that facilitates various applications.

The approaches described above, particularly task generation based on the generalized work activities are expressly intended to address this issue. In fact, the results obtained in these initial efforts are promising. Not only can the generalized work activities be used to organize task data, it appears that the availability of this organizing structure allows us to gather comprehensive, reliable, and valid task data in less time and at a lower cost than more traditional procedures. Further, at least in some cases, further gains in efficiency might be obtained using automated systems, based on a combination of the generalized work activity and activity analysis strategies. Thus, there is good reason to suspect that the cross-occupation model may provide the infrastructure needed for the timely and efficient collection of occupation-specific information.[1]

Occupation-Specific Skills and Knowledges

As noted elsewhere, both in this report and in the broader literature, a variety of procedures has been used to define occupation-specific skills. In some cases, an occupational skill is defined as practiced task performance. In other cases, occupation-specific skills are defined in terms of broad basic capacities.

In the case of occupation-specific knowledges, the situation is somewhat less ambiguous. Most would agree that knowledge represents an organized set of facts and principles pertaining to the characteristics of objects lying in some domain (Fleishman & Mumford, 1989). Further, a variety of techniques, including expert-novice comparisons (Chi, Glaser, and Farr, 1988) and think-aloud protocols (Barsalou, 1991), are available for identifying relevant knowledge structures. Although the evidence indicates that these techniques can be effectively used to identify requisite knowledges, they also are relatively time consuming. In fact, the time involved in applying these techniques is such that it would effectively prohibit use of this approach in defining occupation-specific knowledges across a range of occupations.

Given the importance of occupation-specific skills and knowledges in assessment, selection, training design, and re-skilling, techniques are needed that will permit cost effective collection of this information. Thus, in this section, we sketch out a set of general procedures that might be used to identify occupation-specific skills and knowledges.

[1] A more fully-developed version of this kind of system implemented with computer assistance is described in Appendix 16-A.

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Skills and Knowledges

Before proceeding to the procedures that will be used to identify occupation-specific skills and knowledges, it would be prudent to consider exactly what is meant by the terms skills and knowledges. As described in Chapter 3, skills have been defined in a variety of different ways. One way to define skills is as a general set of activities or procedures required for performance in some domain (Campbell, McCloy, Oppler, & Sager, 1992). Depending on the breadth of the domain, skills can be defined at a number of different levels. Further, there may be a number of different types of skills. For example, basic skills might reflect activities needed to learn various tasks. Cross-functional skills might represent general activities or procedures called for in domains that extend across occupations.

Occupation-specific skills represent still another kind of skill. In this case, the domain is some subset of the occupation's tasks that calls for a common set of activities. In the case of electricians, installation, a common job activity, might be applied in three distinct types of task domains: (1) outside wiring installation; (2) inside wiring installation; and (3) installation of lighting fixtures. Accordingly, occupation-specific skills may be defined as a general activity (e.g., installation, repair) as applied to a similar set of tasks calling for related procedures.

Occupation-specific knowledges are less difficult to define. Knowledge, generally speaking, is held to reflect an organized set of facts and principles pertaining to the characteristics of objects lying in some domain. In this sense, knowledge, particularly expert knowledge, can be viewed as a principle-based organization of relevant material within a given task domain. Thus, the principles needed to work with or apply a given skill in performing a set of related tasks may be said to reflect an occupation-specific knowledge.

Procedures for Defining Occupation-Specific Skills and Knowledges

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Given the foregoing definition of occupation-specific skills and knowledges it becomes possible to envision a four-step process for identifying them. First, the core tasks for an occupation must be identified. As discussed earlier in this chapter, the GWA and general Available Task Inventories and GWA/Activity Analysis techniques are used to identify tasks. Second, tasks reflecting a common set of basic and cross-functional skill requirements would be specified. Third, within a given task set, where tasks are drawn from a common skill, tasks involving similar or related procedures would be identified. Fourth, the knowledges needed to perform a given set of procedurally related tasks would be identified. Figure 16-7 illustrates these four basic steps.

The general procedures sketched out in Figure 16-7 are intended, in part, to address a crucial problem identified by Stevens and Campion (1994). They found that SMEs typically group tasks together based on content similarity rather than underlying skill and knowledge requirements. Accordingly, we would not ask occupational members or SMEs to identify occupation-specific skills directly. Instead, an occupational analyst would review the task statements generated by these SMEs and assign tasks to the most relevant basic and cross-functional skills (represented by the second box in Figure 16-7). Then, SMEs would define occupation-specific skills by only looking at those tasks held to represent instances of one basic or cross-functional skill at a time (the third box in Figure 16-7).

This set of procedures displays three desirable characteristics. First, SMEs are presented with task sets already defined in terms of basic and cross-functional skills, making it possible for them to identify occupation-specific skills. Second, occupation-specific skills are identified in terms of basic and cross-functional skills, making it possible to link occupation-specific skills to a broader cross-occupation structure. Third, because occupation-specific skills are viewed as occupation-specific instances of broader skills, the tasks assigned to an occupation-specific skill can be used in conjunction with task survey data to obtain scale scores reflecting the importance, time spent, learning difficulty, and performance of each skill.

These procedures, however, are based on three key assumptions. The first major assumption is that tasks can be organized into subsets based on the kinds of activities called for. Thus, one might group all installation tasks together. Within this subset of tasks, however, there will be a set of lower-order groupings or task groups which represent unique occupation-specific procedures. It also is assumed that these lower-order task groupings will not only share certain procedures but they will also share common knowledge requirements.

In the following sections, we describe the procedures introduced in Figure 16-7 in some detail. We begin with the second step inasmuch as the procedures for identifying tasks have already been described in the previous section examining procedures for identifying job tasks.

Organize Tasks

To generate task sets organized by a common basic or cross-functional skill requirement, an occupational analyst would be asked to link the tasks to basic cross-functional categories. For example, the task of installing heavy outdoor wiring would be assigned to the Installation cross-functional skill. This sorting of tasks into basic and cross-functional skill categories need not be solely based on judgment. In fact, research currently being performed by the first three authors of this chapter intended to identify verbs commonly associated with basic and cross-functional skills can be used to guide this sorting process.

The output of this sorting operation would be several sets of tasks. Each set would contain 7 to 30 tasks, all of which shared a cross-functional or basic skill requirement. Based

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upon our experience, roughly five to 15 task sets will be required to adequately cover the tasks involved in a given job.

Identify Occupation-Specific Skills and Knowledges

Once tasks have been sorted into the basic and cross-functional skills, they provide a basis for identifying the occupation-specific skills and knowledges. The results of the task sort are used to construct the stimulus material needed to identify occupation-specific skills. Figure 16-8 illustrates the rating sheets used in this exercise.

In this exercise, incumbents or supervisors are asked to review the tasks subsumed under a given basic or cross-functional skill (e.g., the 27 tasks shown in Figure 16-8 are grouped under the cross-functional skill of Installation). As they review this task list, they are asked to identify groups of tasks where "learning one task would help you learn the other tasks included in the group." Each such group of tasks defines an occupation-specific skill. Thus, occupation-specific skills are defined in terms of transfer and associated learning requirements. After identifying those groups of tasks having common learning requirements, the subject matter experts are asked to assign labels to each of the groups and to rate the difficulty of learning each task in the group.

Typically, in conducting this skill generation exercise, it is necessary to use incumbents or supervisors because they have adequate familiarity with the job and pattern of skill development on the job. Moreover, because this exercise requires some breadth of understanding, and a relatively high degree of abstract thinking, supervisors, as opposed to incumbents, appear to provide the most appropriate group for acquiring this information.

This information may be collected either in subject matter expert meetings, or through computer assisted, individualized administration of the skill generation exercise. When the panel meeting procedure is used, it is generally desirable to administer this exercise to two panels, each

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containing four to five subject matter experts, with panel members being asked to review the occupation-specific skills proposed by other panel members in a "round-robin" review conducted after initial generation of the occupation-specific skills. When skills are being generated by individual subject matter experts, it is desirable to obtain responses from a somewhat larger pool of subject matter experts to compensate for the lack of peer review and feedback.

Earlier, we noted that skills, the procedural component of performance, are associated with knowledges, the declarative component. Thus, one way that occupation-specific knowledges might be identified is to capitalize on this implicit association, using skills as a basis for identifying knowledges. This might be accomplished by asking supervisors to indicate the concepts or principles required to be able to master the tasks subsumed under a given occupation-specific skill, as they defined it. Alternatively, they might be asked to indicate the things one needs to know to perform the general kinds of activities reflected in a given skill. Typically, subject matter experts have simply been asked to list the knowledges associated with a certain occupation-specific skill, as shown in the bottom part of Figure 16-8, based on the proposition that many knowledges will extend across the tasks included in a given skill. However, at times it may prove useful to have subject matter experts indicate those individual tasks, from among those involved in the occupation-specific skill, where this knowledge is viewed as essential to good performance.

This procedure for identifying occupation-specific knowledges, like the skill identification procedure, will generate a number of potential knowledge labels. Thus, in identifying occupation-specific knowledges as well as occupation-specific skills, it is generally desirable to have subject matter experts review and edit the knowledges being proposed. Generally, however, it will also be necessary for an occupational analyst to review and edit the resulting list of occupation-specific knowledges and skills to remove redundancies. This review process should, of course, be organized in terms of the basic and cross-functional skills that provided a framework for initial identification of the occupation-specific skills and knowledges

Field Test Results

The availability and validity of the descriptive information obtained using these procedures was assessed in the telecommunications occupations within a large organization (Mumford & Supinski, 1995). The first occupation, telecommunications technician, involved the installation, repair, and maintenance of telecommunications equipment. The second occupation, telecommunications systems analyst, involved the operation and control of automated telecommunications systems. Occupation-specific skills and knowledges were identified in a set of two independent panel meetings, conducted using supervisors on each of the targeted occupations. Prior to conducting these meetings, 104 analysts and 437 technicians had been asked to rate the frequency, importance, learning difficulty, and their own performance with respect to each of the tasks occurring on their job.

Some initial evidence for the reliability of the descriptive information resulting from these procedures was obtained by contrasting the skills identified in the two panels. Here, an analyst developed a consolidated list of skills and then identified equivalent occupation-specific skills proposed by at least three members of both groups. Overall, 86 occupation-specific skills were identified for technicians, while 103 occupation-specific skills were identified for the analysts. Of these skills, 57% were proposed by members of both technician panels, while 63% were proposed by members of both analyst panels. Similar results were obtained for the occupation-specific knowledges. Here, 60% of the technician knowledges and 59% of the analyst knowledges proposed by members of one panel were proposed by members of the other panel.

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Another way one might look at the reliability of the descriptive information provided by these procedures is to assess whether tasks linked to a skill share something in common. To address this issue, an occupational analyst reviewed assignments of tasks to the occupation-specific skills in both panels and, based on this information, assigned tasks to the relevant occupation-specific skills. Figure 16-9 presents the tasks assigned to the technicians' physical troubleshooting skill and the analysts' technology planning skill. Subsequently, these tasks were used to form skill scales by aggregating the frequency, importance, learning difficulty, or performance scores obtained for each task incorporated under a skill. Interrater agreement coefficients were then obtained for skill scales on each of these descriptors by drawing 20 judges at random from the pools of analysts and technicians who completed the task survey. In the case of technicians, it was found that the median interrater agreement coefficient was .78, while the median interrater agreement coefficient obtained for the analysts was .82.

Taken as a whole, the evidence obtained in this study indicates that the procedures described above allow for reasonably accurate, reliable descriptions of the occupation-specific skills and knowledges required on a job. Apparently, independent panels produce similar lists of skills and knowledges. Further, at least in the case of skills, where direct linkages to relevant tasks could be identified, it was found that these skills reflected tasks that displayed substantial common variance. Nonetheless, it should be recognized that these findings provide relatively little evidence bearing on the meaningfulness of the resulting descriptive information.

Figure 16-10 presents some illustrative skills identified for the technician and analyst jobs, while Figure 16-11 presents some illustrative knowledges involved in each job. As may be seen, the nature of these skills and knowledges is, generally speaking, consistent with the known characteristics of these occupations. For example, both occupations were found to involve

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technical writing. Hardware repair and media repair, however, were unique to the technician job, while system parameter programming and diagnostic programming were unique to the analyst job. Thus, the nature of the similarities and differences observed among the occupation-specific skills and knowledges obtained on these jobs provides some initial evidence for those procedures.

Somewhat more compelling evidence for the meaningfulness of the descriptive information obtained using those procedures was provided by the additional analyses. In the first set of analyses, managers were asked to identify incumbents working in growth positions that involved the use of new technologies. The scores of incumbents in emerging jobs were compared to the scores of incumbents in more traditional positions using the skill scales developed by aggregating performance ratings of the tasks assigned to the relevant skills. Emerging technician positions apparently required better performance with respect to media installation, software fault isolation, system fault isolation, and test equipment application--findings consistent with the use of more complex "black box" technology in the emerging technician positions. In the case of systems analysts, similar technical skills were required in both emerging and diminishing positions. However, perhaps due to increased sophistication of telecommunications systems, emerging positions required better problem-solving skills, such as gathering information about technology, generating system ideas, evaluating system ideas, status monitoring, and feedback monitoring.

Another way one might look for evidence about the usefulness of these procedures is by contrasting the profile of ratings obtained for a certain type of occupation-specific skill (e.g., problem solving skills) across the emerging and diminishing positions. Figure 16-12 presents the profile correlations obtained for the emerging and diminishing positions within the occupations

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of technicians and analysts with respect to the indices of importance, time spent, performance, and learning difficulty derived from ratings of the tasks assigned to a given occupation-specific skill. Among technicians, the importance, time spent, and learning difficulty of skills in the emerging and traditional positions were quite similar. What differed was the performance profile for technical, basic, and social skills. Among analysts, the most clear-cut finding was that different, negatively related profiles of problem solving skills were required in the two types of positions--a result attributable to the emphasis on abstract thinking required by new telecommunications control systems.

These analyses show how data gathered using these procedures can be applied to identify changing job requirements. This information might, of course, prove of some value in both reengineering and retraining efforts. For example, technicians may need better performance on "black box" technology to cope with emerging changes, while analysts may need to acquire a different type of more abstract, deductive, problem solving skills. More centrally, however, these findings indicate that the procedures used to identify occupation-specific skills and knowledges are capable of adequately capturing known changes in job demands--a finding pointing to the construct validity of the resulting information.

Although the findings obtained in this initial field test argue for the reliability and validity of the descriptive information obtained using these procedures, three points should be borne in mind. First, the procedures identify the content or nature of occupation-specific skills and knowledges, but they tell us relatively little about the structure and strategies involved in job performance. Thus, this descriptive information may need to be supplemented, using techniques such as expert review comparisons or think-aloud protocols, if there is a need to identify the processes shaping performance. Second, these procedures are, of course, not the only approach that might be used to identify occupation-specific skills and knowledges. For example, in one variation on this approach, computer-assisted expert system tutorials are employed rather than panel meetings. Alternatively, knowledges might be identified using the general cross-occupation taxonomy presented earlier, rather than basing knowledge definition on the associated skills. Third, this is an initial attempt on only two, related jobs that both require relatively well-educated workers. No doubt these procedures may evolve and almost certainly will need to be modified for occupations having less well-educated workers. Nonetheless, the procedures sketched out above do apparently allow one to initially define occupation-specific skills and knowledges within the common language organizing framework provided by the cross-occupation descriptors--an important, perhaps essential, characteristic for a viable occupational information system.

Tools

Up to this point, we have focused on the types of procedures that might be used to identify job tasks and the occupation-specific skills and knowledges needed to perform job tasks. However, these are not the only kinds of occupation-specific information that have been or might be used to describe people's jobs. Another kind of occupation-specific information commonly used to describe people's jobs are the tools used in performance tasks. The term <u>tools</u>, although apparently unambiguous, has often been defined in a different way. Sometimes tools refers solely to physical equipment, while at other times this category is extended to include any machines, equipment, software, or job aids used to perform job tasks.

In developing the O*NET occupational information system, we used the more encompassing definition of tools. More specifically, tools were viewed as any hand tool, machine, piece of equipment, software, or job aid that was used in performing requisite job tasks. Thus, a word processing computer program would be viewed as a tool used by secretaries, just as

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a blow torch would be a tool used by a welder. This broader definition was applied primarily because it provides a more comprehensive definition of the things needed to perform job tasks, while incorporating recent changes in technology and covering a broader range of jobs.

It is not at all difficult to identify the hand tools, equipment, machines, software, and job aids that are used in a given occupation. Observation, records, and documentary material can all be used. A simpler and more straightforward strategy, however, is simply to ask incumbents or supervisors to list the tools, equipment, machines, software, and job aids used regularly--more than once a month--on their jobs. Although this listing strategy cannot describe exactly how a given tool is applied, which requires observation and/or a review of relevant manufacturer's specifications, it does permit reliable identification of the tools used on the job.

The problem with identifying tools as so broadly defined, however, is that it may prove difficult to tie tools to a broader set of cross-occupation variables. Without some linkage back to the broader cross-occupation variables, it becomes difficult to include information about tools in a comprehensive occupational information system. Further, unorganized lists of tools make it difficult to determine the nature and conditions of tool use. Thus, some framework is required for identifying tools.

Three plausible procedures are available for gathering information about tools, all based on the premise that tools should be identified and linked to specific variables used to describe people's jobs. Thus, one might have incumbents list the tools required (a) to perform particular job tasks, (b) to accomplish the tasks subsumed under a more general work activity or (c) to execute a particular occupation-specific skill. Generally, it is too time consuming for incumbents to list all tools associated with each task involved in a job. Thus, tool lists based on generalized

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work activities or occupation-specific skills appear to provide a more appropriate strategy for collecting this descriptive information.

As part of a current project by the first three authors of this chapter, the feasibility of generating tool lists using occupation-specific skills--and, thus, derivatively broader basic, and cross-functional skills--as an organizing structure are being examined. Here, after generating occupation-specific skills, as described in the section above, incumbents working on electrical engineering jobs were asked to review the tasks performed when applying a skill. They were then asked to list the tools (i.e., equipment, machines, software, and job aids) involved in skilled performance on the set of tasks. In a prior review, it was found that this straightforward procedure resulted in a comprehensive list of tools proving particularly useful in identifying software and job aids involved in skilled performance. Further, by linking tools to skills, the resulting information could be readily used in designing skill-based training programs.

Although the results obtained in this initial effort argue for the utility of identifying and organizing tools in terms of occupation-specific skills, in some cases it may prove more appropriate to generate and organize tool lists based on generalized work activities. Listing tools required to perform the tasks subsumed under a generalized work activity places less burden on subject matter experts, requiring the development of fewer lists. By the same token, however, this procedure makes it more difficult to link tools to specific job content and may result in a less comprehensive definition of software and job aids involved in executing relevant job tasks.

Conclusions

In this chapter we described a number of methods for collecting O*NET occupation-specific information. The first was a modified version of the Available Task Inventories approach. This approach consists of using task lists from the DOT to generate occupation-

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specific task rating questionnaires for the 80 occupations in the O*NET prototype. This is considered to be a good interim solution for including occupation-specific information in the prototype. These broad task statements provide a relatively fast, low cost mechanism for collecting occupation-specific information. Further, they provide an explicit linkage between the new O*NET and the old DOT.

However, there are a number of reasons why this solution is less attractive for the collection of task data once development moves beyond the prototype stage. First, our modified version of the approach creates a list of only 7 to 30 tasks per occupation. A per occupation task list of this size does not generate a sufficient number of tasks at a sufficient level of detail to support many applications, such as training program design, nor does it provide an adequate basis for identifying occupation-specific skills and knowledges. Additionally, this modified version suffers from all of the disadvantages inherent in the fully elaborated Available Task Inventories approach. For example, the approach is completely dependent on the availability and quality of existing job analyses. Some of the task lists from these analyses already are out-of-date, some were developed for specific purposes resulting in task lists that only focus on some parts of the occupation, and the lists are likely to vary greatly in quality and comprehensiveness.

Because of these disadvantages, we recommend that after the prototype data collection, the GWA approach should be used to collect O*NET occupation-specific information. This approach certainly does not represent the only set of procedures that might be used to generate task information. For example, in many cases, some combination of the generalized work activities approach and the action/object linking approach appears promising, at least for jobs where the work force is well educated and used to working with software or other types of decision aids. Nonetheless, the GWA approach or some variation of it does have some attractive features vis-à-vis the O*NET.

By explicitly linking the generation of these tasks to broader cross-occupation taxonomies, as reflected in the GWAs, the proposed procedures should serve to facilitate organization of relevant occupation-specific information in terms of a broader, more comprehensive taxonomic structure. Further, there is some reason to suspect that the kind of hierarchically structured job analysis procedures described here will serve to ensure more rapid and cost-effective collection of occupation-specific descriptive information.

The availability of a cross-occupation organizing framework is of some importance, not only in the identification of job tasks, but also in the identification of occupation-specific skills and knowledges, as well as the definition of requisite tools. With regard to tools, there is, of course, little problem in identifying the relevant descriptors. This information has traditionally proven difficult to use because it could not be organized in terms of, and integrated with, other kinds of job descriptors, particularly cross-occupation descriptors. The procedures presented in this chapter, however, show how those kinds of occupation-specific descriptors can be identified and organized in terms of the cross-occupation variables, thereby facilitating use of this descriptive data in a comprehensive occupational information system.

By collecting and organizing information about tools within a broader framework, it becomes possible to apply this kind of descriptive information in new ways. For example, one might ask the question, "What are the tools most commonly used when installing electrical equipment across all jobs or within a family of jobs?" This information is clearly of some real value to trainers and educators.

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The methods sketched out above also appear capable of addressing a number of practical problems. For example, it is expected that skills boards will seek to identify the occupation-specific skills and knowledges required in various occupations. Not only do the procedures sketched out above provide a systematic framework for defining these skills and knowledges, but they also explicitly link skill requirements to the tasks to be performed in the occupation. This should facilitate the work of the skills boards, while providing a relatively economical method for the identification of occupation-specific skills that possess some reliability and validity.

The skills boards, however, do not represent the only area where occupation-specific information is needed. In training, for example, there often is a need for the kind of occupation-specific information provided by those procedures. Trainers need to know what occupation-specific skills and knowledges must be developed. Further, these skills and knowledges must be developed within the context of requisite tasks. The procedures described above would, of course, provide trainers with this background information, thereby contributing to the design, delivery, and evaluation of training courses.

In addition to these applications of occupation-specific information, the type of information provided by these procedures might be used to address a number of other issues. First, this kind of occupation-specific information might be used to provide guidelines for person assessment. Second, it might be used in job redesign efforts. Third, it might prove useful in designing wage and compensation systems based on skill requirements.

Certainly, we have not described all of the potential applications of this kind of occupation-specific information. A number of other applications might, of course, be envisioned. Further, in many cases, effective application of these various kinds of occupation-specific descriptors may require the collection of additional, more detailed types of information. Still,

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development programs, for example, may need to collect information about the processes and procedures involved in skill application through techniques such as error analysis, think-aloud protocols, or expert-novice comparisons. It should be recognized that many of these procedures, although promising, are still under development. Thus, provisions and extensions of those procedures can be expected as further work progresses. Even bearing this caveat in mind, however, we believe that extension of the O*NET cross-occupation framework to the identification of occupation-specific descriptors makes an important point. There is no inherent conflict between the cross-occupation approach employed in the O*NET content model and the more traditional occupation-specific approach commonly used in job analysis. Instead, the cross-occupation structure may facilitate the identification and organization of more specific types of descriptive information, thereby making it possible to obtain more comprehensive, up-to-date information which can be used more efficiently to address a number of new concerns.

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Appendix 16-A

A Method of Identifying Occupation-Specific Tasks, Skills, Knowledges, and Tools

As part of a project for a large U.S. Department of Defense agency, the American Institutes for Research is developing, testing, and implementing a computer-based method of collecting occupation-specific information that is structured by the O*NET's content model. The method relies on five computer modules that incumbents and occupational analysts use to generate and consolidate occupation-specific information. Below is a brief description of each computer module.

1. Task Generation

Participants: Twenty-four incumbents representing a particular occupation.

Activity: This computer module helps incumbents develop individual lists of tasks that describe the occupation. The program starts by providing a brief tutorial that describes the structure of task statements, explaining that the essence of a task is a verb and an object (e.g., "load boxes"), and that task statements can be made more specific by adding object modifiers and statement qualifiers. For example, "Load wooden boxes onto trucks." Next, the module presents each incumbent with the titles and definitions of O*NET's Generalized Work Activities (GWAs). The incumbent must select between 6 and 12 GWAs that represent the majority of work activities carried out on their job. The module then helps the incumbent generate tasks for each of the selected GWAs, one GWA at a time. This task generation process starts by presenting the incumbent with brief lists of verbs and objects that are commonly associated with the selected GWA

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and allows the incumbent to (1) create task statements using pairs of existing verbs and objects, (2) create and pair their own verbs and objects, and (3) develop complete task statements for that GWA by adding object modifiers and statement qualifiers as necessary to the verb/object pairs. This process is repeated until the incumbent has generated tasks for each of the selected GWAs.

Outcome: The output of this computer module, administered to approximately 24 incumbents, is a list of occupation-specific task statements for each incumbent in a particular occupation.

2. Task Editing

Participants: An occupational analyst and a content specialist. A content specialist is an individual who has considerable awareness of the industry and family of occupations related to the target occupation.

Activities: This computer module helps the occupational analyst and the content specialist (i.e., the "job analysis pair") edit the task lists generated by the approximately 24 incumbents into a consolidated list of occupation-specific tasks. Basically, the job analysis pair uses the module to carry out such editing as choices eliminating inappropriate and redundant tasks and clarifying language.

Outcome: The output of this computer module is a list of occupation-specific tasks that are used in subsequent modules to generate other occupation-specific information. This list of tasks is also used directly to develop an occupation-specific task survey where incumbents rate tasks' (1) relevance to the occupation, (2) frequency of performance, (3) importance to performance, and (4) difficulty.

3. Task/Skill Linkage or Task Clarification

Participants: The job analysis pair referred to in the Task Editing module (i.e., an occupational analyst and a content specialist).

Activity: This computer module helps the job analysis pair link each task output from the task editing module to relevant Basic and Cross-Functional Skills from the O*NET content model using a simple point and click procedure. The job analysis pair is presented with each task and the titles and definitions of the Basic and Cross-Functional Skills. They then link each task to the skills that are judged to be most critical to performance of the task. The module sets an upper limit, stipulating that no more than five skills can be linked to a task.

Outcome: The output from this computer module is a linkage between each task and relevant Basic and Cross-Functional Skills. This linkage is a required input to the next computer module, which presents incumbents with each relevant Basic and Cross-Functional Skill and its associated tasks.

4. Occupation-Specific Skill, Knowledge, and Tool Identification

Participants: The same 24 incumbents who completed the first computer module.

Activity: The primary purpose of this computer module is to help each incumbent independently identify occupation-specific skills, knowledges, and tools. Sequentially, the program presents the title and definition of each Basic and Cross-Functional Skill that was linked to tasks in the task/skill linkage

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module. The Basic or Cross-Functional Skill is presented, accompanied by a list of all the tasks that were linked to it. First, the incumbent is asked to rate each task in terms of how long it takes to master it, on a scale that spans from 0-3 months to more than 8 years. Next, the incumbent is required to use a point and click procedure to organize the tasks linked to a particular Basic or Cross-Functional Skill into smaller groups of tasks. The instructions indicate that these smaller groups of tasks should be tasks that are "learned together." The incumbent is required to provide a label for each of these small groups of tasks. These small groups of tasks and their labels are used in the subsequent module to identify occupation-specific skills. Finally, for each small group of tasks, the incumbent is asked to list the kinds of knowledge and tools that are necessary for performing these tasks.

Outcome: The output of this computer module, administered to approximately 24 incumbents, are labeled groups of tasks for each incumbent that define preliminary occupation-specific skills, with the knowledge and tools necessary for their performance.

5. <u>Occupation-Specific Skill, Knowledge, and Tool Editing</u>

Participants: The job analysis pair referred to originally in the Task Editing module (i.e., an occupational analyst and a content specialist).

Activities: This computer module helps the job analysis pair edit the information provided by the approximately 24 incumbents who individually completed the Occupation-Specific Skill, Knowledge, and Tool Identification module. This computer module analyzes the preliminary occupation-specific skills generated by all of the incumbents and suggests a single integrated list of occupation-specific skills for the occupation. The module helps the job analysis pair (1) work with and edit this suggested list into a single list of occupation-specific skills for the occupation, and (2) edit the knowledges and tools and assign them to appropriate occupation-specific skills.

Outcome: The output of this computer module is a final list of occupation-specific skills for a particular occupation. Each occupation-specific skill is accompanied by (1) a title, (2) relevant tasks, and (3) relevant knowledges and tools.

Summary

This appendix is a description of a computer-based method that is currently being employed for identifying occupation-specific tasks, skills, knowledges, and tools. Occupation-specific information is an important part of the O*NET content model; however, it is often very expensive and time consuming to collect. The method proposed here was designed to provide valid occupation-specific information while minimizing the time and financial resources required to collect it.

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Figure 16-1
Example Occupation-Specific Tasks Questionnaire

Instructions for Making Task Ratings

In this questionnaire you will be presented with a list of tasks. A task is an action or set of actions performed together to accomplish an objective. This list of tasks will be specific to the job you are describing.

For each task, please make the following three ratings: **RELEVANCE, FREQUENCY,** and **IMPORTANCE.**

(1) **RELEVANCE.** If the task is NOT RELEVANT at all to performance on the job, mark through the "0" in the NOT RELEVANT column. Carefully read the task before deciding whether it is RELEVANT or NOT RELEVANT to this job. If you select the "0" in the NOT RELEVANT column, however, there is no need to complete the IMPORTANCE and FREQUENCY ratings described below. If the task is part of this job, rate IMPORTANCE and FREQUENCY.

(2) **FREQUENCY.** (Do not complete if NOT RELEVANT was selected.) Ask yourself, "How often is this task performed on this job?" For example, "Interact with potential customers" is a task that an employee in one job might perform only "once per week or less," but an employee in another job might perform "hourly or more often."

Rate the FREQUENCY with which a task is performed by marking through the appropriate number, from 1 (indicating that the task is performed once per year or less often) to 7 (indicating that the task is performed hourly or more often) on the FREQUENCY scale.

(3) **IMPORTANCE.** (Do not complete if NOT RELEVANT was selected.) Ask yourself, "How important is this task to performance on this job?" For example, "Develop objectives and strategies to guide the organization" might be very important for an employee in one job, but less important for another job. For the second job, however, "Provide performance feedback to subordinates" might be very important.

Rate the IMPORTANCE of the task for performance on the job by marking through the appropriate number, from 1 (indicating that the task is of no importance) to 5 (indicating that the task is extremely important) on the IMPORTANCE scale.

The first two tasks show how "Frequency" and Importance" differ. An employee in a particular job indicates that "Land a plane under emergency conditions" occurs only "once per year or less," but, the task is an "extremely important" part of the employee's job. In contrast, the employee indicates that task 2 is performed, "several times per day," but is less important than task 1. Finally, task 3 is not part of this job, so the employee indicates this by selecting the "Not Relevant" circle.

[three completed examples were included here]

Turn the page to begin the Tasks Questionnaire.

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Figure 16-1 (continued)
Example Occupation-Specific Tasks Questionnaire

Task	Not Relevant	Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often	Not important	Somewhat important	Important	Very Important	Extremely important
		Frequency							Importance				
1 Observes, evaluates, and records patient data.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
2 Reviews diagnostic tests.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
3 Conducts laboratory tests.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
4 Aids physician and other health care professionals during treatment and examination of patients.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
5 Performs physical examinations.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
6 Administers injections, medications and treatments.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
7 Cleans and sterilizes instruments and equipment.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
8 Consults with other medical professionals on policy and patient care.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
9 Supervises and coordinates activities of nursing personnel.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
10 Develops standards and procedures for providing nursing care.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
11 Provides nursing orientation, teaching, and guidance to staff.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
12 Identifies problems and instructs and advises personnel in infection control procedures.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
13 Investigates infection control problems and follows up with persons exposed to infection and diseases.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
14 Administers anesthetics.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
15 Provides instruction in health education and disease prevention	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤

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Figure 16-1 (continued)
Example Occupation-Specific Tasks Questionnaire

Task	Not Relevant	Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often	Not important	Somewhat important	Important	Very Important	Extremely important
16 Provides first aid.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
17 Assesses community health care needs.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
18 Provides employee health services within industrial organization.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
19 Plans and participates in school health program.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
20 Participates in surveys and research studies.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
21 Counsels and provides support for patients and families.	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
Additional Relevant Tasks Please write in additional relevant tasks and provide a rating													
22 ____________	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
23 ____________	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
24 ____________	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤
25 ____________	⓪	①	②	③	④	⑤	⑥	⑦	①	②	③	④	⑤

32502 Registered Nurses

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Figure 16-2
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS	GENERALIZED WORK ACTIVITIES	Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
19005 GENERAL MANAGERS AND TOP EXECUTIVES (n =42)				
1. Directs organizations charged with administering and monitoring regulated activities to interpret and clarify laws and ensure compliance with laws	34. Coordinating the work and activities of others	.08	.19	52
2. Interprets, and explains policies, rules, regulations, and laws to organizations and individuals	26. Interpreting the meaning of information for others	.19	.33	71
3. Develops policies and procedures to ensure that objectives of organizations are met	13. Developing objectives and strategies	.31	.33	88
4. Directs and coordinates activities of workers to ensure continuing operations, maximize returns on investments, and increase productivity	34. Coordinating the work and activities of others	.43	.27	90
5. Consults with staff to assist in making decisions and coordinating activities	27. Communicating with supervisors, peers, or subordinates	.46	.33	100
	34. Coordinating the work and activities of others	.63	.47	98
6. Establishes and maintains a record keeping system for the organization	None			
7. Negotiates contracts and agreements with federal and state agencies and other organizations	32. Resolving conflicts and negotiating with others	-.01	.21	64
8. Prepares budget for funding and implementing programs	42. Monitoring and controlling resources	.53	.65	76

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS	GENERALIZED WORK ACTIVITIES	Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
9. Participates in activities to promote business and expand services	28. Communicating with persons outside the organization	.28	.34	69
10. Provides technical assistance in conducting conferences, seminars, and workshops	39. Providing consultation and advice to others	.32	.08	67
11. Plans and organizes community service to maintain cooperative working relationships among public and organization participants	28. Communicating with persons outside the organization	.20	.17	40
12. Prepares and presents reports relating to operational trends and program objectives	13. Developing objectives and strategies	-.09	.23	74
	26. Interpreting the meaning of information for others	.25	.55	86
13. Monitors testing, hiring, training, and evaluation of staff personnel	41. Staffing organizational units	.58	.35	74
14. Delivers speeches and writes articles at meetings or conventions to promote services, and exchange ideas	28. Communicating with persons outside the organization	.07	.36	64
15. Evaluates research findings to formulate policies, recommend improvements for personnel actions, programs, or business services	12. Updating and using job-relevant knowledge	.12	.17	67
	13. Developing objectives and strategies	-.10	.27	57
16. Analyzes legislation and public policy and recommends changes to promote and support interests of general population and special groups	9. Analyzing data or information	.06	-.08	31
	13. Developing objectives and strategies	-.04	.07	36
17. Prepares and submits reports concerning activities, expenses, and other items affecting services	25. Documenting and recording information	-.01	.12	55

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS	GENERALIZED WORK ACTIVITIES	Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
18. Conducts or directs investigations or hearings, and testifies in court, before review board, or legislature to resolve complaints and law violations	28. Communicating with persons outside the organization	.04	.26	38
19. Presides over or serves on board of directors, management committees, or other governing boards	34. Coordinating the work and activities of others	.24	.42	60
20. Convenes groups of experts for program to select sites, construct of buildings, and provide equipment and supplies	34. Coordinating the work and activities of others	.29	.54	31
32502 REGISTERED NURSES (n = 25)				
1. Observes, evaluates, and records patient data	25. Documenting and recording information	.31	.16	84
2. Reviews diagnostic tests	9. Analyzing data or information	.19	.11	76
3. Conducts laboratory tests	None			
4. Aids physician and other health care professionals during treatment and examination of patients	30. Assisting and caring for others	.09	-.16	76
5. Performs physical examinations	6. Judging the qualities of objects, services, or persons	.18	..42	68
	30. Assisting and caring for others.	.31	.21	64
6. Administers injections, medications and treatments	None			
7. Cleans and sterilizes instruments and equipment	None			

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Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
8.	Consults with other medical professionals on policy and patient care	27.	Communicating with supervisors, peers, or subordinates	.18	.01	92
9.	Supervises and coordinates activities of nursing personnel	34.	Coordinating the work and activities of others	.73	.74	92
10.	Develops standards and procedures for providing nursing care	13.	Developing objectives and strategies	.32	.62	80
11.	Provides nursing orientation, teaching, and guidance to staff	36.	Teaching others	.02	.09	72
12.	Identifies problems and instructs and advises personnel in infection control procedures	2.	Identifying objects, actions, and events	.18	.25	72
		36.	Teaching others	-.04	.10	76
13.	Investigates infection control problems and follows up with persons exposed to infection and diseases	10.	Making decisions and solving problems	.44	.38	80
14.	Administers anesthetics	30.	Assisting and caring for others	.18	.23	12
		17.	Handling and moving objects	.28	.01	44
15.	Provides instruction in health education and disease prevention	36.	Teaching others	.29	.24	84
16.	Provides first aid	30.	Assisting and caring for others	.02	-.04	88
17.	Assesses community health care needs	3.	Monitoring processes, materials, or surroundings	.27	.22	56
		33.	Performing for or working directly with the public	.09	.06	48
18.	Provides employee health services within industrial organization	30.	Assisting and caring for others	.01	.13	44

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
19.	Plans and participates in school health program	13.	Developing objectives and strategies	.01	.20	24
		33.	Performing for or working directly with the public	.25	.15	36
20.	Participates in surveys and research studies	None				
21.	Counsels and provides support for patients and families	26.	Interpreting the meaning of information for others	-.25	.07	68
		30.	Assisting and caring for others	.16	.00	76
49011 SALESPERSONS, RETAIL (n = 18)						
1.	Tickets, arranges, and displays merchandise to promote sales	31.	Selling or influencing others	-.15	.06	67
2.	Describes merchandise and explains use, operation, and care of merchandise to customers	36.	Teaching others	.44	.27	89
3.	Demonstrates use or operation of merchandise	36.	Teaching others	.60	.25	83
4.	Recommends, selects, and obtains merchandise based on customer needs and desires	33.	Performing for or working directly with the public	.17	.28	.83
5.	Fits or assists customers in trying on merchandise	33.	Performing for or working directly with the public	-.14	.05	33
6.	Repairs or alters merchandise	None				
7.	Rents merchandise to customers	33.	Performing for or working directly with the public	a	a	17

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Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
8.	Estimates and quotes trade-in allowances	5.	Estimating the characteristics of materials, products, events, or information	-.32	.33	39
9.	Estimates quantity and cost of merchandise required, such as paint or floor covering	5.	Estimating the characteristics of materials, products, events, or information	-.05	-.13	39
10.	Sells or arranges for delivery, insurance, financing, or service contracts for merchandise	31.	Selling or influencing others	.52	.35	56
11.	Prepares sales slip or sales contract	25.	Documenting and recording information	.16	.12	61
12.	Estimates cost of repair or alteration of merchandise	5.	Estimating the characteristics of materials, products, events, or information	-.39	-.39	33
13.	Computes sales price of merchandise	8.	Processing information	.28	.02	72
14.	Maintains records related to sales	25.	Documenting and recording information	.33	.26	61
15.	Greets customers	33.	Performing for or working directly with the public	.10	.50	83
16.	Wraps merchandise	33.	Performing for or working directly with the public	-.16	-.09	33
17.	Totals purchases, receives payment, makes change, or processes credit transaction	33.	Performing for or working directly with the public	-.08	-.09	78
		8.	Processing information	.34	.14	72

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Figure 16-2 (continued)

Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
18.	Inventories stock	25.	Documenting and recording information.	.49	.02	56
19.	Requisitions new stock	None				
20.	Cleans shelves, counters, and tables	17.	Handling and moving objects	-.14	.00	67
21.	Accepts and processes returned merchandise	8.	Processing information	.09	-.13	61
		33.	Performing for or working directly with the public	.09	.00	67
51002	**FIRST LINE SUPERVISORS, MANAGERS/SUPERVISORS, CLERICAL AND ADMINISTRATIVE SUPPORT OCCUPATIONS (n = 59)**					
1.	Plans, prepares, and revises work schedules according to budget allotments, customer needs, problems, departmental work-loads, and statistical forecasts	34.	Coordinating the work and activities of others	.19	.24	.78
2.	Directs workers in such activities as maintaining files, compiling and preparing reports, computing figures, or moving shipments	15.	Organizing, planning, and prioritizing work	.35	.35	92
3.	Reviews records and reports pertaining to such activities as production, operation, payroll, customer accounts, and shipping	8.	Processing information	.29	.27	80
4.	Verifies completeness and accuracy of subordinates' work, computations, and records	3.	Monitoring processes, materials, or surroundings	.22	.03	78
5.	Consults with supervisor and other personnel to resolve problems and expedite work	27.	Communicating with supervisors, peers, or subordinates	.32	.40	98

Figure 16-2 (continued)

Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
6.	Interviews, selects, and discharges employees	41.	Staffing organizational units	.25	.61	85
7.	Trains employees in work and safety procedures and company policies	36.	Teaching others	.46	.37	88
8.	Evaluates subordinate job performance and conformance to regulations, and recommends appropriate personnel action	38.	Coaching and developing others	.42	.49	95
9.	Prepares, maintains, and compiles reports and information required by management or government agencies	25.	Documenting and recording information	.30	.28	73
		28.	Communicating with persons outside the organization	-.07	.30	83
10.	Inspects equipment for defects and notifies maintenance personnel or outside service contractors for repairs	4.	Inspecting equipment, structures, or materials	.67	.49	75
11.	Requisitions or purchases supplies	None				
12.	Assists subordinates to facilitate productivity or overcome difficult aspects of their work	38.	Coaching and developing others	.56	.67	97
13.	Examines and recommends changes in procedures to save time, labor, and other costs and to improve quality control and operating efficiency	3.	Monitoring processes, materials, or surroundings	.26	.35	73
14.	Oversees, coordinates, or performs activities associated with shipping, receiving, distribution, and transportation	15.	Organizing, planning, and prioritizing work	-.05	-.10	25

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
15.	Plans layout of stockroom, warehouse, or other storage areas considering turnover, size, weight, and related factors of items stored	15.	Organizing, planning, and prioritizing work	-.01	-.04	17
16.	Identifies and handles discrepancies or errors	10.	Making decisions and solving problems	-.08	.01	81
17.	Analyzes financial activities of establishment or department and assists in planning budget	42.	Monitoring and controlling resources	.38	.46	75
18.	Resolves complaints and answers customer questions regarding services and procedures	28.	Communicating with persons outside the organization	.02	.23	80
19.	Computes figures, such as balances, totals, and commissions	8.	Processing information	.40	.31	64
55108 SECRETARIES, EXCEPT LEGAL AND MEDICAL (n = 68)						
1.	Greets and welcomes visitors, determines nature of business, and conducts visitors to employer or appropriate person	30.	Assisting and caring for others	.03	.24	90
2.	Answers telephone and gives information to callers, takes messages or transfers calls to appropriate individuals	30.	Assisting and caring for others	.09	.22	90
3.	Opens incoming mail and routes mail to appropriate individuals	30.	Assisting and caring for others	-.05	.02	81
4.	Locates and attaches appropriate file to incoming correspondence requiring reply	40.	Performing administrative activities	-.01	.11	76
5.	Answers routine correspondence	40.	Performing administrative activities	.03	.02	84

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
6.	Composes and distributes notes, correspondence, and reports	40.	Performing administrative activities	.39	.22	94
7.	Takes dictation in shorthand or by machine and transcribes information	25.	Documenting and recording information	-.10	-.01	57
8.	Makes copies of correspondence and other printed matter	40.	Performing administrative activities	.06	.27	93
9.	Files correspondence and other records	25.	Documenting and recording information	.14	.09	79
10.	Compiles and maintains lists and records, using typewriter or computer	8.	Processing information	.11	.19	78
11.	Compiles and types statistical reports, using typewriter or computer	8.	Processing information	.23	.28	76
12.	Records and types minutes of meetings, using typewriter or computer	25.	Documenting and recording information	-.18	-.03	59
13.	Prepares and mails checks	40.	Performing administrative activities	-.01	.02	29
14.	Collects and disburses funds from cash account and keeps records.	42.	Monitoring and controlling resources	.35	.45	65
		8.	Processing information	-.11	-.03	28
15.	Orders and dispenses supplies	40.	Performing administrative activities	-.03	-.12	75
16.	Schedules appointments	14.	Scheduling work and activities	.44	.14	75
17.	Arranges travel schedules and reservations	40.	Performing administrative activities	-.01	.02	68
		14.	Scheduling work and activities	.18	.16	62
18.	Maintains calendar and coordinates conferences and meetings	14.	Scheduling work and activities	.33	.19	71

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
19.	Sends newsletters, promotional material and other information	28.	Communicating with persons outside the organization.	.10	.20	60
20.	Provides customer services such as order placement and account information	33.	Performing for or working directly with the public	.28	.24	46
55347 GENERAL OFFICE CLERKS (n = 84)						
1.	Compiles, copies, sorts, and files records of office activities, business transactions, and other activities	25.	Documenting and recording information	.25	.16	73
2.	Completes and mails bills, contracts, policies, invoices, or checks	40.	Performing administrative activities	.18	.14	63
3.	Completes work schedules	14.	Scheduling work and activities	.31	.36	68
4.	Addresses, stamps, sorts, and distributes mail, packages, and other materials	40.	Performing administrative activities	.45	.44	79
5.	Transcribes dictation and composes and types letters and other correspondence, using typewriter or computer	25.	Documenting and recording information	.25	.11	75
6.	Computes, records, and proofreads data and other information, such as records or reports	8.	Processing information	.23	.18	71
		25.	Documenting and recording information	.31	.28	75
7.	Communicates with customers, employees, and other individuals to disseminate or explain information	33.	Performing for or working directly with the public	.35	.40	71

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
8.	Reviews files, records, and other documents to obtain information to respond to requests	1.	Getting information needed to do the job	.14	.22	80
		8.	Processing information	.38	.40	81
9.	Operates office machines, such as photocopier, fax, and personal computer	19.	Interacting with computers	.38	.36	79
10.	Answers telephone, responds to requests, delivers messages, and runs errands	30.	Assisting and caring for others	.20	.23	87
11.	Orders materials, supplies, and services, and completes records and reports	40.	Performing administrative activities	.15	.29	67
12.	Collects, counts, and disburses money, and completes banking transactions	8.	Processing information	.02	-.03	42
13.	Arranges appointments for customers, staff, or students	14.	Scheduling work and activities	.32	.44	68
14.	Processes payroll	40.	Performing administrative activities	.13	.12	43
63014 POLICE PATROL OFFICERS (n = 23)						
1.	Patrols specific area on foot, horseback, or motorized conveyance	16.	Performing general physical activities	.26	.27	91
2.	Maintains order, responds to emergencies, protects people and property	33.	Performing for or working directly with the public	.25	.52	91
3.	Responds to calls for assistance	30.	Assisting and caring for others	.05	.42	100
4.	Assists motorists with road information	30.	Assisting and caring for others	.24	.22	100

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS	GENERALIZED WORK ACTIVITIES	Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
5. Renders aid to accident victims and other persons requiring first aid for physical injuries	30. Assisting and caring for others	.35	.45	100
	33. Performing for or working directly with the public	-.09	.38	91
6. Reviews facts to determine if criminal act or statute violation is involved	1. Getting information needed to do the job	.27	.16	87
7. Records facts, photographs and diagrams crime or accident scene, and interviews principals and eyewitnesses	25. Documenting and recording information	.10	.33	91
8. Arrests perpetrator of criminal act or submits citation or warning to violator of motor vehicle ordinance	None			
9. Monitors traffic to ensure motorists observe traffic regulations and safe driving procedures	3. Monitoring processes, materials, or surroundings	.44	.22	.74
10. Directs traffic flow and reroutes traffic in case of emergencies	3. Monitoring processes, materials, or surroundings	.13	.46	74
11. Investigates traffic accidents and other accidents to determine causes and to determine if crime has been committed	3. Monitoring processes, materials, or surroundings	.25	.22	61
	10. Making decisions and solving problems	-.12	.20	70
12. Evaluates complaint and emergency request information to determine response requirements	10. Making decisions and solving problems	.14	.41	83
13. Relays complaint and emergency-request information to appropriate agency dispatcher	27. Communicating with supervisors, peers, or subordinates	.17	.22	65

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS	GENERALIZED WORK ACTIVITIES	Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
14. Expedites processing of prisoners, prepares and maintains records of prisoner bookings, and maintains record of prisoner status during booking and pre-trial process	25. Documenting and recording information	-.17	-.23	26
15. Testifies in court to present evidence or act as witness in traffic and criminal cases	28. Communicating with persons outside the organization	.26	.68	91
16. Contacts health and social agencies to refer persons for assistance	30. Assisting and caring for others	.00	.50	96
17. Prepares reports to document activities	25. Documenting and recording information	.20	.37	87
18. Promotes rapport between community residents and police department	28. Communicating with persons outside the organization	.53	.56	96
19. Reports hazards, such as blocked roads or broken street lights	3. Monitoring processes, materials, or surroundings	.34	.24	74
20. Enforces motor vehicle and criminal law	None			
65038 FOOD PREPARATION WORKERS (n = 25)				
1. Cleans, cuts, slices, or disjoins meats and poultry to prepare for cooking	17. Handling and moving objects	-.19	.16	60
2. Cleans and portions, and cuts or peels variety of foods to prepare for cooking or serving	17. Handling and moving objects	-.02	.24	72
3. Butchers and cleans fowl, fish, poultry, and shellfish to prepare for cooking or serving	17. Handling and moving objects	-.25	-.10	36

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
4.	Prepares variety of foods according to customers' orders or supervisors' instructions, following approved procedures	30.	Assisting and caring for others	.35	.12	76
5.	Transfers by hand or hand truck food supplies, equipment, and utensils between storage and work areas	16.	Performing general physical activities	.15	.26	72
6.	Portions and arranges food on serving dishes, trays, carts, or conveyor belts	17.	Handling and moving objects	.19	.49	72
7.	Distributes food to waiters and waitresses to serve to customers	30.	Assisting and caring for others	-.14	.05	44
8.	Serves food to customers	33.	Performing for or working directly with the public	.13	.12	68
9.	Prepares and serves variety of beverages, such as coffee, tea, and soft drinks	33.	Performing for or working directly with the public	.13	.09	64
10.	Requisitions food supplies, equipment, and utensils	None				
11.	Stores food supplies, equipment, and utensils	15.	Organizing, planning, and prioritizing work	.07	.38	68
12.	Distributes food supplies, equipment, and utensils	30.	Assisting and caring for others	.26	.09	64
13.	Stores food in designated containers and storage areas to prevent spoilage	15.	Organizing, planning, and prioritizing work	.32	.44	72
14.	Loads dishes, glasses, and tableware into dishwashing machine.	17.	Handling and moving objects	.11	.10	64

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Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
15.	Scrubs, washes, rinses, and sanitizes large pots and pans by hand.	17.	Handling and moving objects	.38	.29	72
16.	Cleans refrigerators and other kitchen equipment, including work area	16.	Performing general physical activities	.54	.41	84
17.	Removes garbage and trash containers and places or dumps refuse in designated pick-up areas	16.	Performing general physical activities	.36	.17	72
18.	Loads or unloads trucks used in delivering or picking up food and supplies	16.	Performing general physical activities	-.11	-.06	52
19.	Prepares and packages individual place settings	17.	Handling and moving objects	-.34	-.21	32
20.	Sets up banquet tables	16.	Performing general physical activities	.21	.41	52
21.	Stocks serving stations with food and utensils	17.	Handling and moving objects	.51	.40	76
67005 JANITORS AND CLEANERS, EXCEPT MAIDS AND HOUSEKEEPING CLEANERS (n = 30)						
1.	Sweeps, mops, scrubs, and vacuums floors of buildings, using cleaning solutions, tools and equipment	16.	Performing general physical activities	.30	.27	90
2.	Applies waxes or sealers to wood or concrete floors	16.	Performing general physical activities	-.22	.10	67
3.	Cleans or polishes walls, ceilings, windows, building equipment and building fixtures, using steam cleaning equipment, scrapers, brooms and variety of hand and power tools	18.	Controlling machines and processes	.31	.39	73

Figure 16-2 (continued)

Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS	GENERALIZED WORK ACTIVITIES	Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
4. Tends, cleans, adjusts and services furnaces, air conditioners, boilers and other building heating and cooling systems	23. Repairing and maintaining mechanical equipment	.60	.53	73
5. Notifies management personnel concerning need for major repairs or additions to building operating systems	27. Communicating with supervisors, peers, or subordinates	.53	.43	87
6. Gathers and empties trash	16. Performing general physical activities	.14	.09	80
7. Mows and trims lawns and shrubbery, using mowers and hand and power trimmers, and clears debris from grounds	16. Performing general physical activities	-.01	-.07	50
	18. Controlling machines and processes	.12	-.21	47
8. Removes snow and ice from sidewalks, driveways and parking areas using snowplow, snowblower, and snowshovel, and spreads snow melting chemicals	16. Performing general physical activities	.05	.04	60
	18. Controlling machines and processes	.08	.04	63
9. Services and repairs cleaning and maintenance equipment and machinery	23. Repairing and maintaining mechanical equipment	.64	.44	77
10. Performs minor routine painting, plumbing, electrical, and related activities	17. Handling and moving objects	.21	.22	57
11. Mixes water and detergents or acids in container to prepare cleaning solutions, according to specifications	None			
12. Requisitions supplies and equipment used in cleaning and maintenance duties	None			

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
13.	Sets up, arranges, and removes decorations, tables, chairs, ladders, and scaffolding, for events such as banquets and social functions	16.	Performing general physical activities	.13	.03	77
14.	Moves items between departments, manually or using handtruck	16.	Performing general physical activities	.00	-.10	60
15.	Cleans chimneys, flues, and connecting pipes, using power and hand tools	16.	Performing general physical activities	-.30	-.04	27
		18.	Controlling machines and processes	-.14	.03	37
16.	Drives vehicles, such as van, industrial truck or industrial vacuum cleaner	20.	Operating vehicles, mechanized devices, or equipment	-.07	.13	50
17.	Cleans and restores building interiors damaged by fire, smoke or water, using commercial cleaning equipment	18.	Controlling machines and processes	-.06	-.07	47
18.	Sprays insecticides and fumigants to prevent insect and rodent infestation	16.	Performing general physical activities	-.03	-.12	43
19.	Dusts furniture, walls, machines, and equipment	17.	Handling and moving objects	.54	.33	80
85132 MAINTENANCE REPAIRERS, GENERAL UTILITY (n = 25)						
1.	Inspects and tests machinery and equipment to diagnose machine malfunctions	4.	Inspecting equipment, structures, or materials	.30	.20	88
2.	Dismantles and reassembles defective machines and equipment	23.	Repairing and maintaining mechanical equipment	.82	.77	88
3.	Installs new or repaired parts	23.	Repairing and maintaining mechanical equipment	.64	.47	80

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS		GENERALIZED WORK ACTIVITIES		Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
4.	Cleans and lubricates shafts, bearings, gears, and other parts of machinery	23.	Repairing and maintaining mechanical equipment	.62	.47	80
5.	Installs and/or repairs wiring and electrical and electronic components	24.	Repairing and maintaining electronic equipment	.90	.81	88
6.	Assembles, installs, and/or repairs plumbing	23.	Repairing and maintaining mechanical equipment	.24	.24	64
7.	Assembles, installs, and/or repairs pipe systems and hydraulic and pneumatic equipment	23.	Repairing and maintaining mechanical equipment	.60	.39	72
8.	Paints and repairs woodwork and plaster	16.	Performing general physical activities	-.16	-.01	48
9.	Lays brick to repair and maintain physical structure of establishment	16.	Performing general physical activities	.04	-.16	36
10.	Installs machinery and equipment	23.	Repairing and maintaining mechanical equipment	.56	.50	80
11.	Sets up and operates machine tools to repair or fabricate machine parts, jigs and fixtures, and tools	23.	Repairing and maintaining mechanical equipment	.56	.29	56
12.	Operates cutting torch or welding equipment to cut or join metal parts	18.	Controlling machines and processes	.37	.28	64
13.	Fabricates and repairs counters, benches, partitions, and other wooden structures, such as sheds and outbuildings	16.	Performing general physical activities	.15	-.02	44
14.	Estimates costs of repairs	5.	Estimating the characteristics of materials, products, events, or information	.28	.30	60

Figure 16-2 (continued)
Cross-Walk of Occupation-Specific Tasks to Generalized Work Activities

SPECIFIC TASKS	GENERALIZED WORK ACTIVITIES	Correlation of Frequency Ratings	Correlation of Importance Ratings	Percent Agreement on Relevance
15. Records repairs made and costs	25. Documenting and recording information	.30	.28	80
16. Plans maintenance activities	14. Scheduling work and activities	.07	.29	60
17. Accommodates users when machinery or facilities are down for maintenance or repairs	30. Assisting and caring for others	.34	.34	68
18. Sets up signs and barriers to insure the public's safety during maintenance or repair activities	17. Handling and moving objects	.17	-.06	80

Note: n = number of job incumbents who completed both GWA and Task questionnaires.
[a]All task ratings are identical.

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Figure 16-3
<u>Example Instructions for the Generation of Occupation-Specific Skills and Knowledges</u>

SUBCATEGORIES AND TASKS

Now that you have identified broad behavioral categories related to your job, the next step is to break the categories into subcategories, or more specific groups of activities. After breaking categories into subcategories, each subcategory will be further broken down into specific components, or tasks.

Let's say that you identified "self development" as a behavioral category related to your job. The next step would be to describe smaller parts of this category. For example, "participate in training," "keep up with new information," and "self assessment" are all subcategories important to self development. In this way, we may create several subcategories for any given category.

As you identify each subcategory, please list all of the specific tasks performed on your job that fall under that subcategory. A good description of a "task" includes two parts:

1. a specific action (what you do), and
2. the purpose of that action (why you do it)

EXAMPLE:

The subcategory "Keeping up with new information" might include tasks such as:

1. Subscribe to job related publications to obtain new articles.
2. Read newspapers to look for job related information.
3. Attend conferences related to the job.

It is important to list all the tasks that you do, no matter how unimportant you think they are. The purpose of this "category → subcategory → task process" is to generate more detailed information about what you do on the job. After you have listed all possible tasks under a subcategory, move on to identifying the next subcategory.

<u>Note.</u> Adapted from <u>Application of a Model to Develop Occupation-Specific Skills,</u> by M. D. Supinski and E. Supinski, 1995, Washington, DC: American Institutes for Research.

Figure 16-4
Illustrative Tasks for Commercial Sales in the Electrical Products Industry

- Give distributors updated pricing information
- Train new distributor sales representatives about applications of Firm X products, promotional activities, and new products
- Inform distributor of the pricing terms for a particular job
- Fill out SPA reports
- Discuss pricing issues with distributors
- Apply knowledge learned in the past to solve similar or related problems
- Negotiate with pricing department about annual contracts and SPAs
- Go on joint calls with distributor representative in order to assess user's lighting needs and recommend appropriate product for environment
- Respond to requests from immediate management that require immediate attention
- Implement local incentive plan and meet with distributors to explain the plan
- Check report for expiring SPAs to determine which ones to renew
- Receive performance appraisal from manager
- Contact distributor management in order to convince them to allocate time and resources for training or promotional activities
- Contact manager to notify him/her of a problem that cannot be immediately resolved or that cannot be solved by the sales representative alone
- Talk to distributors to find out about solicitation by competitors and prices
- Go over annual reviews with distributor and set mutual goals for the next year
- Train experienced distributor sales representatives about applications of Firm X products, promotional activities, and new products

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Figure 16-5
<u>Automated Job Analysis System</u>

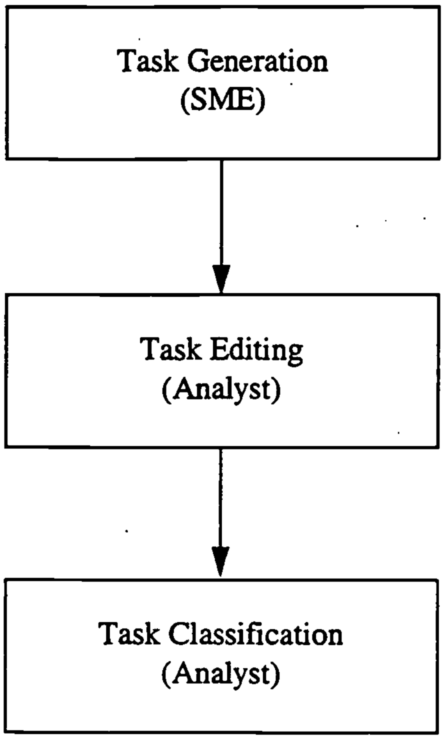

Figure 16-6
<u>Example Task Statements Generated Using Automated Job Analysis System</u>

Judge reports from skill-based systems on computers.
Survey users on skill-based systems.
Survey users of computerized job analysis tools.
Read manuals for skill-based systems.
Read reports on organizational human resources initiatives.
Develop goals for pilot projects.
Record procedures that are used to pilot test systems.
Describe services to supervisors and customers.
Adapt established procedures to adapt to new situations.
Adapt strategies to the project.
Design leadership classes.
Facilitate executive-level and mentoring classes for other employees.
Evaluate programs for teacher certification.

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Figure 16-7
General Procedures for Identifying Occupation-Specific Skills and Knowledges

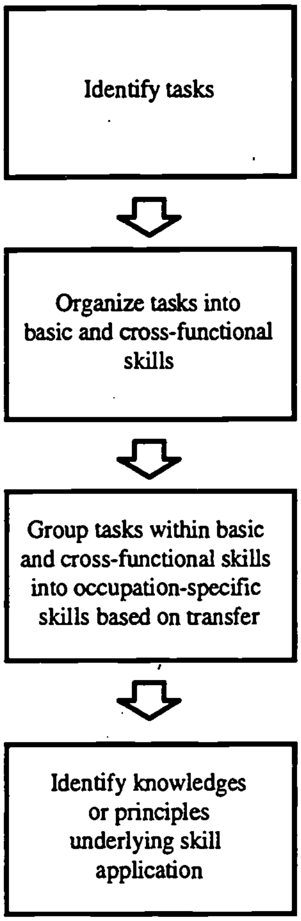

Figure 16-8

Example Skill and Knowledge Rating Exercise

INSTALLATION

1. Climbs ladders or racks to install duct work or run cables
2. Conduct de-installs
3. Configure network equipment based on cable infrastructure.
4. Configure software for work stations
5. Crawl under crawl spaces to install cables
6. Install duct work
7. Install sleepers
8. Install cables and fibers
9. Install circuits (e.g., point to point, packet switched, multiplexers)
10. Install floor tiles
11. Install network infrastructure equipment (e.g. video, voice, data)
12. Install power
13. Install racks
14. Install services (e.g. opscom, tele-conferencing)
15. Make cables and cable connectors
16. Pack and ship equipment and documents
17. Prepare and install test equipment
18. Pull cables
19. Reload and reconfigure software in repairing personal computers
20. Remove components from computer and other equipment.
21. Run conduit for installation
22. Sanitize old computers and dontae to local high schools
23. Use Agency, DOD, OSHA and other safety guidelines
24. Use hand and power tools (e.g., screw driver, hammer, soldering iron)
25. Use installation SOPs (e.g., complete install check list)
26. Use inter-operability standards when connecting networks with other agencies.
27. Use wiring color codes to determine appropriate wiring configuration.

YOUR TASK GROUPS BASED ON COMMON LEARNING REQUIREMENTS

Task Group One: ______________________

Tasks Assigned									By Task Number
Task Difficulty									From 1 low - 15 high

Task Group Two: ______________________

Tasks Assigned									By Task Number
Task Difficulty									From 1 low - 15 high

Task Group Three: ______________________

Tasks Assigned									By Task Number
Task Difficulty									From 1 low - 15 high

YOUR TASK KNOWLEDGES

Task group one knowledges ______________________

Task group two knowledges ______________________

Task group three knowledges ______________________

Note. Adapted from Application of a Model to Develop Occupation-Specific Skills, by M. D. Supinski and E. Supinski, 1995, Washington, DC: American Institutes for Research.

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Figure 16-9
Examples of Tasks Assigned to Occupation-Specific Skills

Skill	Tasks
Physical Troubleshooting (Telecommunications Technician)	Conduct site inspections Follow troubleshooting SOPs Identify sources of transmission systems errors and faults Learn interdependency of systems to increase accuracy of fault isolations Listen to equipment to detect mechanical problems Make necessary adjustments to systems based on analysis from test equipment Use senses of smell and touch to determine if problem exists (e.g., hot cable)
Technology Planning (Telecommunications Analyst)	Create circuit installation plans (e.g., point to point, packet switched, multiplexers) Create installation plan for services (e.g., opscom, tele-conferencing) Decide how to add users to network Develop architecture plan to guide technology upgrades Develop implementation plan for new technology Make decisions regarding changes or additions to technology on network Use software tools to model network topology

Note. Adapted from Application of a Model to Develop Occupation-Specific Skills, by M. D. Supinski and E. Supinski, 1995, Washington, DC: American Institutes for Research.

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Figure 16-10
Examples of Occupation-Specific Skills Identified for Two Occupations

Occupation	Example Occupation-Specific Skills
Telecommunications Technician	Technology Reading Technical Writing Customer Awareness Presenting Technical Recommendations Customer Technical Support System Fault Isolation Hardware Repair Media Repair Architecture Selection Program Budgeting Generating Technical Ideas Operational Review
Telecommunications Analyst	Professional Reading Technical Writing Team Performance Monitoring Technical Support Test Equipment Application Evaluating Test Data System Parameter Programming Diagnostic Programming Network Operations Technical Decision Making Contracting

Note. Adapted from Application of a Model to Develop Occupation-Specific Skills, by M. D. Supinski and E. Supinski, 1995, Washington, DC: American Institutes for Research.

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Figure 16-11
Examples of Occupation-Specific Knowledges Identified for Two Occupations

Occupation	Example Occupation-Specific Knowledges
Telecommunications Technician	Differences Among Phone Systems Location of Circuits Architectural Requirements Resource Constraits Technical Terminology Principles of Grounding Safety Procedures
Telecommunications Analyst	Technical Terminology Data Collection Procedures Training Principles Resource Requirments Evaluation Techniques Customer Requirements

Note. Adapted from Application of a Model to Develop Occupation-Specific Skills, by M. D. Supinski and E. Supinski, 1995, Washington, DC: American Institutes for Research.

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Figure 16-12
Profile Comparisons for Emerging and Diminishing Positions Within Two Occupations

Scale	Importance	Time Spent	Performance	Difficulty
Telecommunications Technician				
Overall	.69	.67	.21	.77
Basic Skills	.72	.72	.11	.87
Technical Skills	.48	.64	.18	.85
Problem Solving Skills	.61	.74	.48	.68
Social Skills	.76	.66	.05	.41
Resource Management Skills	.87	.69	.38	.74
Telecommunications Analyst				
Overall	.46	.32	.04	.22
Basic Skills	.68	.14	.32	.60
Technical Skills	.56	.24	.41	.61
Problem Solving Skills	-.29	-.24	-.45	.38
Social Skills	.88	.24	.28	.48
Systems Skills	.14	.89	.26	.83
Resource Management Skills	.14	.29	.01	-.49

Note. Adapted from Application of a Model to Develop Occupation-Specific Skills, by M. D. Supinski and E. Supinski, 1995, Washington, DC: American Institutes for Research.

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Table 16-1

Reliability of Task Ratings Considering Varying Numbers of Raters: Occupation-Specific Tasks

	Number of Raters on Each Variable						
		Frequency			Importance		
Occupation	n	r_k[a]	r_1[b]	r_{30}[c]	r_k	r_1	r_{30}
15005 Education Administrators	39	.97	.42	.96	.95	.34	.94
19005 General Managers & Top Executives	135	.99	.45	.96	.98	.30	.93
25105 Computer Programmers	18	.87	.27	.92	.86	.25	.91
31305 Teachers, Elementary School	79	.99	.46	.96	.98	.43	.96
32502 Registered Nurses	93	.99	.47	.96	.98	.40	.95
32902 Medical & Clinical Laboratory Technologists	7	.90	.58	.98	.89	.53	.97
49008 Salespersons, Except Scientific & Retail	39	.97	.43	.96	.97	.43	.96
49011 Salespersons, Retail	58	.97	.39	.95	.97	.36	.94
49021 Stock Clerks, Sales Floor	24	.76	.12	.80	.81	.15	.84
49023 Cashiers	68	.97	.34	.94	.97	.31	.93
51002 First Line Supervisors, Clerical/Administrative	165	.99	.32	.93	.98	.27	.92
53102 Tellers	17	.95	.55	.97	.94	.49	.97
53905 Teachers' Aides & Assistants, Clerical	23	.87	.22	.89	.83	.18	.87
55108 Secretaries, Except Legal & Medical	238	1.00	.51	.97	.99	.32	.94
55305 Receptionists & Information Clerks	29	.98	.58	.98	.97	.56	.97
55338 Bookkeeping, Accounting, & Auditing Clerks	87	.98	.37	.95	.98	.33	.94
55347 General Office Clerks	237	1.00	.46	.96	.99	.31	.93
61005 Police & Detective Supervisors	38	.96	.39	.95	.93	.25	.91
63014 Police Patrol Officers	65	.99	.58	.98	.98	.45	.96
65008 Waiters & Waitresses	53	.98	.43	.96	.97	.37	.95
65026 Cooks, Restaurant	13	.89	.38	.95	.87	.34	.94
65038 Food Preparation Workers	69	.97	.30	.93	.96	.27	.92
66008 Nursing Aides, Orderlies, & Attendants	49	.97	.44	.96	.97	.40	.95
67005 Janitors & Cleaners	98	.99	.48	.96	.98	.32	.93
85132 Maintenance Repairers, General Utility	100	.96	.20	.88	.96	.21	.89
87902 Earth Drillers, Except Oil & Gas	16	.95	.53	.97	.94	.48	.97
92974 Packaging & Filling Machine Operators	31	.77	.10	.76	.78	.10	.77
97102 Truck Drivers, Heavy or Tractor Trailer	36	.97	.44	.96	.96	.42	.96
97111 Bus Drivers, Schools	34	.98	.66	.98	.98	.56	.97

Note. Reliability estimates are based on incumbents' ratings of occupation-specific tasks. Decimals are omitted.

[a]Observed reliability estimates were obtained by calculating the interrater reliability across tasks: $r_k = [MS_t - MS_r]/MS_t$] (Crocker & Algina, 1986), where k is the number of judges actually providing ratings.

[b]Single rater estimates of reliability were obtained by calculating the interrater reliability for a single judge across tasks: $r_1 = [MS_t - MS_r]/[MS_t + (k-1)MS_r/1]$.

[c]Estimates of reliability for 30 raters were obtained by calculating the interrater reliability for thirty judges across tasks: $r_{30} = [MS_t - MS_r]/[MS_t + (k-30)MS_r/30]$.

Table 16-2

Reliability of Task Ratings Considering Various Recoding Schemes: Occupation-Specific Tasks

Occupation	Type of Scale and Recoding Scheme Applied				
	Frequency			Importance	
	r_a	r_b	r_c	r_a	r_b
15005 Education Administrators	.97	.95	.95	.95	.85
19005 General Managers & Top Executives	.99	.99	.98	.98	.96
25105 Computer Programmers	.87	.85	.77	.86	.82
31305 Teachers, Elementary School	.99	.99	.97	.98	.98
32502 Registered Nurses	.99	.98	.98	.98	.95
32902 Medical & Clinical Laboratory Technologists	.90	.88	.86	.89	.84
49008 Salespersons, Except Scientific & Retail	.97	.91	.96	.97	.90
49011 Salespersons, Retail	.97	.94	.97	.97	.86
49021 Stock Clerks, Sales Floor	.76	.74	.77	.81	.70
49023 Cashiers	.97	.93	.97	.97	.81
51002 First Line Supervisors, Clerical/Administrative	.99	.98	.99	.98	.92
53102 Tellers	.95	.93	.88	.94	.86
53905 Teachers' Aides & Assistants, Clerical	.87	.92	.66	.83	.87
55108 Secretaries, Except Legal & Medical	1.00	.99	.99	.99	.96
55305 Receptionists & Information Clerks	.98	.88	.97	.97	.84
55338 Bookkeeping, Accounting, & Auditing Clerks	.98	.94	.98	.98	.95
55347 General Office Clerks	1.00	.99	.99	.99	.96
61005 Police & Detective Supervisors	.96	.95	.91	.93	.91
63014 Police Patrol Officers	.99	.99	.98	.98	.97
65008 Waiters & Waitresses	.98	.95	.96	.97	.89
65026 Cooks, Restaurant	.89	.82	.85	.87	.64
65038 Food Preparation Workers	.97	.91	.96	.96	.81
66008 Nursing Aides, Orderlies, & Attendants	.97	.90	.97	.97	.88
67005 Janitors & Cleaners	.99	.98	.98	.98	.93
85132 Maintenance Repairers, General Utility	.96	.93	.95	.96	.91
87902 Earth Drillers, Except Oil & Gas	.95	.91	.95	.94	.78
92974 Packaging & Filling Machine Operators	.77	.21	.76	.78	.42
97102 Truck Drivers, Heavy or Tractor Trailer	.97	.80	.97	.96	.81
97111 Bus Drivers, Schools	.98	.96	.97	.98	.94

Note. Reliability estimates are based on incumbents' ratings of occupation-specific tasks. Reliability estimates stipulated as r_a were calculated using the full eight point scale for frequency, and retaining all of the data for the importance scale. Reliability estimates stipulated as r_b were calculated using a reduced seven point scale for frequency, and excluding the data for the importance scale where the rater marked not relevant. Reliability estimates stipulated as r_c were calculated using a binary coded scale for frequency (relevant/not relevant). Decimals are omitted.

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Table 16-2
Reliability of Task Ratings Considering Various Recoding Schemes: Occupation-Specific Tasks

Occupation	Type of Scale and Recoding Scheme Applied				
	Frequency			Importance	
	r_a	r_b	r_c	r_a	r_b
15005 Education Administrators	.97	.95	.95	.95	.85
19005 General Managers & Top Executives	.99	.99	.98	.98	.96
25105 Computer Programmers	.87	.85	.77	.86	.82
31305 Teachers, Elementary School	.99	.99	.97	.98	.98
32502 Registered Nurses	.99	.98	.98	.98	.95
32902 Medical & Clinical Laboratory Technologists	.90	.88	.86	.89	.84
49008 Salespersons, Except Scientific & Retail	.97	.91	.96	.97	.90
49011 Salespersons, Retail	.97	.94	.97	.97	.86
49021 Stock Clerks, Sales Floor	.76	.74	.77	.81	.70
49023 Cashiers	.97	.93	.97	.97	.81
51002 First Line Supervisors, Clerical/Administrative	.99	.98	.99	.98	.92
53102 Tellers	.95	.93	.88	.94	.86
53905 Teachers' Aides & Assistants, Clerical	.87	.92	.66	.83	.87
55108 Secretaries, Except Legal & Medical	1.00	.99	.99	.99	.96
55305 Receptionists & Information Clerks	.98	.88	.97	.97	.84
55338 Bookkeeping, Accounting, & Auditing Clerks	.98	.94	.98	.98	.95
55347 General Office Clerks	1.00	.99	.99	.99	.96
61005 Police & Detective Supervisors	.96	.95	.91	.93	.91
63014 Police Patrol Officers	.99	.99	.98	.98	.97
65008 Waiters & Waitresses	.98	.95	.96	.97	.89
65026 Cooks, Restaurant	.89	.82	.85	.87	.64
65038 Food Preparation Workers	.97	.91	.96	.96	.81
66008 Nursing Aides, Orderlies, & Attendants	.97	.90	.97	.97	.88
67005 Janitors & Cleaners	.99	.98	.98	.98	.93
85132 Maintenance Repairers, General Utility	.96	.93	.95	.96	.91
87902 Earth Drillers, Except Oil & Gas	.95	.91	.95	.94	.78
92974 Packaging & Filling Machine Operators	.77	.21	.76	.78	.42
97102 Truck Drivers, Heavy or Tractor Trailer	.97	.80	.97	.96	.81
97111 Bus Drivers, Schools	.98	.96	.97	.98	.94

Note. Reliability estimates are based on incumbents' ratings of occupation-specific tasks. Reliability estimates stipulated as r_a were calculated using the full eight point scale for frequency, and retaining all of the data for the importance scale. Reliability estimates stipulated as r_b were calculated using a reduced seven point scale for frequency, and excluding the data for the importance scale where the rater marked not relevant. Reliability estimates stipulated as r_c were calculated using a binary coded scale for frequency (relevant/not relevant). Decimals are omitted.

Table 16-3

Means and Standard Deviations of Correlations Between Frequency and Importance Scales Across Tasks: Occupation-Specific Tasks

Occupation	n[a]	M_r	SD_r
15005 Education Administrators	30	.71	.19
19005 General Managers & Top Executives	20	.77	.09
25105 Computer Programmers	18	.78	.08
31305 Teachers, Elementary School	17	.69	.19
32502 Registered Nurses	21	.80	.10
32902 Medical & Clinical Laboratory Technologists[b]	15	.86	.29
49008 Salespersons, Except Scientific & Retail	17	.71	.19
49011 Salespersons, Retail	21	.86	.17
49021 Stock Clerks, Sales Floor	10	.87	.05
49023 Cashiers	19	.92	.06
51002 First Line Supervisors, Clerical/Administrative	19	.75	.12
53102 Tellers	13	.61	.30
53905 Teachers' Aides & Assistants, Clerical	12	.86	.09
55108 Secretaries, Except Legal & Medical	20	.76	.14
55305 Receptionists & Information Clerks	22	.85	.14
55338 Bookkeeping, Accounting, & Auditing Clerks	21	.85	.07
55347 General Office Clerks	14	.82	.13
61005 Police & Detective Supervisors	20	.63	.12
63014 Police Patrol Officers	20	.55	.19
65008 Waiters & Waitresses	20	.70	.26
65026 Cooks, Restaurant	21	.86	.13
65038 Food Preparation Workers	21	.83	.07
66008 Nursing Aides, Orderlies, & Attendants	18	.85	.10
67005 Janitors & Cleaners	19	.76	.12
85132 Maintenance Repairers, General Utility	18	.78	.10
87902 Earth Drillers, Except Oil & Gas	17	.78	.16
92974 Packaging & Filling Machine Operators	19	.91	.06
97102 Truck Drivers, Heavy or Tractor Trailer	13	.75	.24
97111 Bus Drivers, Schools	13	.58	.25

Note. All correlations were calculated based on the ratings assigned by raters for a given job, task, and scale. Frequency-importance means were calculated by averaging the correlations of the frequency and importance ratings for individual tasks.

[a]Number of correlations averaged (number of tasks), not number of observations on which correlations were calculated.

[b]For this occupation, two tasks received not relevant ratings from all incumbents, so did not contribute to the mean correlation.

Table 16-4

Descriptor Means and Standard Deviations on the Frequency and Importance Scales on Two Occupations: Occupation-Specific Tasks

Occupations/Tasks	Frequency		Importance	
	M	SD	M	SD
19005 GENERAL MANAGERS AND TOP EXECUTIVES (n=135)				
1. Directs organizations charged with administering and monitoring regulated activities to interpret and clarify laws and ensure compliance with laws	2.04	2.12	2.65	1.59
2. Interprets, and explains policies, rules, regulations, and laws to organizations and individuals	3.32	1.90	3.38	1.28
3. Develops policies and procedures to ensure that objectives of organizations are met	2.59	1.36	3.56	1.20
4. Directs and coordinates activities of workers to ensure continuing operations, maximize returns on investments, and increase productivity	4.69	1.62	4.05	1.02
5. Consults with staff to assist in making decisions and coordinating activities	4.77	1.26	4.00	0.82
6. Establishes and maintains a record keeping system for the organization	3.18	2.12	3.09	1.40
7. Negotiates contracts and agreements with federal and state agencies and other organizations	1.50	1.58	2.70	1.49
8. Prepares budget for funding and implementing programs	1.63	1.44	3.32	1.52
9. Participates in activities to promote business and expand services	2.80	1.83	3.10	1.30
10. Provides technical assistance in conducting conferences, seminars, and workshops	1.65	1.17	2.55	1.20
11. Plans and organizes community service to maintain cooperative working relationships among public and organization participants	1.09	1.45	2.02	1.32
12. Prepares and presents reports relating to operational trends and program objectives	2.38	1.23	3.24	1.12
13. Monitors testing, hiring, training, and evaluation of staff personnel	2.65	1.50	3.53	1.23
14. Delivers speeches and writes articles at meetings or conventions to promote services, and exchange ideas	1.12	1.06	2.18	1.18
15. Evaluates research findings to formulate policies, recommend improvements for personnel actions, programs, or business services	1.70	1.25	2.59	1.20
16. Analyzes legislation and public policy and recommends changes to promote and support interests of general population and special groups	0.87	1.10	1.87	1.16
17. Prepares and submits reports concerning activities, expenses, and other items affecting services	2.53	1.38	3.05	1.17
18. Conducts or directs investigations or hearings, and testifies in court, before review board, or	0.60	1.06	1.78	1.28

Table 16-4 (continued)
Descriptor Means and Standard Deviations on the Frequency and Importance Scales on Two Occupations: Occupation-Specific Tasks

Occupations/Tasks	Frequency M	Frequency SD	Importance M	Importance SD
legislature to resolve complaints and law violations				
19. Presides over or serves on board of directors, management committees, or other governing board	1.75	1.53	2.50	1.35
20. Convenes groups of experts for program to select sites, construct of buildings, and provide equipment and supplies	0.58	0.97	1.66	1.13
63014 POLICE PATROL OFFICERS (n=65)				
1. Patrols specific area on foot, horseback, or motorized conveyance	5.75	1.75	3.82	1.07
2. Maintains order, responds to emergencies, protects people and property	5.86	1.14	4.66	0.57
3. Responds to calls for assistance	5.98	1.15	4.31	0.81
4. Assists motorists with road information	4.28	1.10	2.82	0.83
5. Renders aid to accident victims and other persons requiring first aid for physical injuries	3.03	1.15	3.98	1.01
6. Reviews facts to determine if criminal act or statute violation is involved	5.69	1.10	4.52	0.69
7. Records facts, photographs and diagrams crime or accident scene, and interviews principals and eyewitnesses	5.11	1.23	4.40	0.70
8. Arrests perpetrator of criminal act or submits citation or warning to violator of motor vehicle ordinance	5.08	1.20	4.25	0.83
9. Monitors traffic to ensure motorists observe traffic regulations and safe driving procedures	5.26	1.50	3.65	0.91
10. Directs traffic flow and reroutes traffic in case of emergencies	3.48	1.25	3.43	1.00
11. Investigates traffic accidents and other accidents to determine causes and to determine if crime has been committed	3.34	1.52	3.56	1.07
12. Evaluates complaint and emergency request information to determine response requirements	3.00	2.02	3.12	1.36
13. Relays complaint and emergency-request information to appropriate agency dispatcher	2.91	2.07	2.92	1.47
14. Expedites processing of prisoners, prepares and maintains records of prisoner bookings, and maintains record of prisoner status during booking and pre-trial process	0.86	1.70	1.63	1.24
15. Testifies in court to present evidence or act as witness in traffic and criminal cases	2.91	0.72	4.34	0.80

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Table 16-4 (continued)

Descriptor Means and Standard Deviations on the Frequency and Importance Scales on Two Occupations: Occupation-Specific Tasks

Occupations/Tasks	Frequency		Importance	
	M	SD	M	SD
16. Contacts health and social agencies to refer persons for assistance	2.58	1.12	3.09	0.96
17. Prepares reports to document activities	5.29	1.18	4.14	0.97
18. Promotes rapport between community residents and police department	4.94	1.54	3.86	1.12
19. Reports hazards, such as blocked roads or broken street lights	3.75	1.31	3.23	0.96
20. Enforces motor vehicle and criminal law	5.54	1.19	4.31	0.77

Chapter 17

Conclusions and Recommendations

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As we stated in Chapter 2, the initial O*NET data collection effort was not intended to provide a comprehensive description of all jobs in the United States economy, but it was intended to be a prototype for a system that could lead to such a descriptive system. In this report we have focused on the occupational sampling techniques, data collection procedures, and analyses of the taxonomic measures of the O*NET. A companion report, O*NET: An Information System for the Workplace. Designing an Electronic Infrastructure (Rose, Hesse, Silver, & Dumas, 1996) describes the development of the electronic database intended to house and make available O*NET information, as well as associated tools for taking advantage of that information.

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Chapter 15 discusses many of the implications of the data analysis results for possible O*NET applications. Here we provide further summaries and some addtional comments on the results, and discuss possible future directions for the O*NET system.

Review of Analyses

Reliability

The primary statistic computed here was the interrater agreement coefficients. Figure 17-1 summarizes the results for the nine domain questionnaires. It shows the observed coefficients (as extracted from table 5 for most of the questionnaires) which are based on approximately 10 raters per occupation for most domains, and estimates for the case for 30 raters, which was our original view of the desired number of raters within each occupation. The observed coefficients are all at least .70, except for organizational context, occupational values, the dichotomous job-entry rating in skills and the importance scale for work styles. Possible, somewhat differing reasons for these lower than desired results are discussed in the respective chapters, but the major conclusion to be drawn from these results is that the domain questionnaires produce reliable results when completed by incumbents. The estimated coefficients for 30 raters are all .79 or greater, with most in the .90's, illustrating that 30 is a sufficient number. For many of the domains, fewer raters should be sufficient, based on these results. While 30 should be the goal, fifteen seems to be a reasonable number for a minimum number of raters for each questionnaire per occupation. Those questionnaires that showed lower results should be held to higher minimums and possible reasons for the lower results should be pursued and, if possible, corrected.

Figure 17-2 shows similar results for aggregated descriptor scores. Aggregate scores were formed by computing mean values for the descriptors that were categorized into the second-level

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of the domains' hierarchies. As shown, this was not appropriate for some domains. These results mirror those in Figure 17-1, except that the coefficients are generally a bit higher, with a few exceptions. These results certainly support the use of aggregate or higher-level scores for describing occupations.

Both figures show that the level and importance scales used in five domains are approximately equal in terms of reliability. However, this finding must be tempered by the fact that the two scales were administered in sequence, with importance following level. The use of both scales in this way appears to lead to reliable results for both; dropping one or the other might reduce the level of reliability for the retained scale. McCormick (1964) found, years ago, that use of multiple scales tends to increase the reliability of all the scales.

Scale Relationships

Figure 17-3 shows the correlations between scale types, computed in two ways, for those domains where multiple scale ratings were obtained. Level and importance scales were used in five domains and the correlations ranged from .82 to .96 for the across occupations correlations and from .90 to .95 for the across descriptors correlations. These are very high correlations and raise the possibility that redundant information is being obtained. However, the standard deviations of the mean correlations show that there is a considerable amount of variance across occupations in the correlations, when compared to the correlations across descriptors. The standard deviations for the across occupations correlations are .04, .21, .11, .30 and .11 for skills, knowledges, generalized work activities, abilities, and work styles, respectively. Comparable across descriptors correlations are .04, .04, .05, .07, and .05. This means that the relationship between the level and importance scales varies considerably across occupations for four of the five domains, which argues for the retention of both scales. On a practical note, completion of the

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importance scale takes very little time once the descriptor definition has been read and the level rating has been completed. We would argue strongly that the level scale should be retained because of the additional information provided by the level scale anchors. Given these findings, and our belief that the level scale certainly should be retained, there may be relatively little time savings (on the respondent's part) should the importance scale be dropped from further use.

The other scales, job entry requirement in skills and frequency in generalized work activities, show somewhat lower correlations with level and importance than those two scales do with themselves. The job entry correlations range from -.66 to -.74 (lower score = not required at entry), evidently providing some unique information. The frequency scale scores also appear to provide somewhat less redundant information, but its correlations with importance and level scale scores still range from .82 to .91.

Descriptor Relationships

To assess the internal structure of the descriptor variables, correlations were computed for and principal components analysis conducted on, primarily, the mean occupation scores on the level scales. These analyses are perhaps more affected by the number of occupations available to enter the analysis than are many of the other analyses. These analyses are too numerous and complex to be efficiently summarized here, but they generally provided intuitively sensible results within each domain. As discussed in Chapter 15, these analyses were not intended to exactly duplicate the a priori hierarchical structure of the domains, but were expected to be consistent with them, and were, for the most part.

The a priori hierarchical structure was examined more directly in Chapter 15, particularly, Table 15-1. This table showed that the mean within-category correlations were higher than the mean across-category correlations for descriptor scores in each of the six domains for which such statistics could be computed, although just barely so for skills and occupational values. These findings support the use of the category schemes for forming aggregate scores for the O*NET, but with a word of caution for the skills and values domains.

Occupation Differences and Discriminant Analyses

The two kinds of analyses conducted here supported the contention that the O*NET system is useful for differentiating occupations. Comparisons of six occupations across descriptor profiles showed intuitively sensible results, and the discriminant function analyses identified the structure of descriptors within each domain that appeared to be accounting for the differentiation between occupations. In addition, the multivariate analyses of variance using occupations and descriptors as facets showed that the occupation by descriptor interaction was generally statistically significant, again showing that the O*NET data are useful for differentiating occupations.

Convergence With Analysts' Ratings

We completed these analyses for five of the nine content domains, and some of those results are summarized in Figure 17-4. Generally, the pattern of ratings was similar across the two rater types; the correlations of the mean ratings provided by the two raters ranges from .53 to .74. The $\underline{d}^2$ values range from .47 for the five-point importance scale in knowledges to 1.51 for the eight-point level scale in skills. When the square roots of these values are taken, the average differences are all reasonably close to one scale point for the eight point level scales and between a half and one scale point for the five-point importance scale. These do not seem like practically large differences, but it must be kept in mind that these are average values. For some occupations there could be more substantial differences. We conclude, however, based on these findings that there is substantial agreement between the two types of ratings, sufficient to warrant the interim use of analyst ratings in anticipation of the future availability of incumbent ratings.

These findings also raise the possibility of combining the two kinds of ratings for purposes of describing occupations. These data do not seem to preclude such a procedure, nor do they argue for complete substitutability. Furthermore, some of the domains were not rated by analysts because it was judged that the stimulus material provided to analysts would be insufficient for rating those domains. These points support the notion that data from the two sources must be very carefully combined to describe occupations.

Additional Validity Evidence and Other Analyses

Most of the domain chapters (3 through 11) present additional analyses intended to evaluate the construct validity of the measures. In addition, chapters 12 -16 present analyses that further evaluate the meaningfulness and usefulness of the O*NET system. The authors of each of these chapter have drawn their own conclusions and they will not be repeated here. However, some comments are in order.

Chapter 12 discussed the possible sources of variance, both desired and undesired, in occupational analysis ratings and summarized the evidence available on this topic. Many issues are yet to be addressed in this area; some are probably not practically feasible to address in the forseeable future. Nevertheless, this chapter provides a coherent organization of the issues and provides a framework for future efforts.

Chapter 13 discusses the relationships between measures across the O*NET domains. Several approaches for analyzing these relationships were employed; together they provide strong evidence for the construct validity of the O*NET descriptor system. Expected relationships occurred where they should, and did not occur where they were not expected. Future analyses in this area could focus, among other things, on making estimates of scores in one domain from scores in another. Such analyses are of obvious practical use, but are at present limited by the number of occupations for which incumbent analyses are available. This is not a hindrance for the occupational analyst database, however, since data are available for all 1,122 O*NET occupational units on five of the major content domains. A replication of the analyses done using the incumbent data on the analyst data would provide a gauge for the advisability of using the analyst data to provide such estimates.

The analyses presented in Chapter 14 show that the skill and generalized work activities domains are effective in forming occupational clusters. The analyses explored the impact on cluster solutions of type of variable, clustering procedure, and sample (incumbent data or analyst data), as evidenced by various evaluative statistics and the similarity of cluster solutions. Briefly put, different types of variable did produce somewhat different solutions, as one would hope, but, changes in clustering procedure did not seem to have an appreciable effect, within the confines of these investigations. There were some differences between the solutions based on analysts vs. incumbents, but these were not large and became smaller when more descriptors were used to make the clusters.

A number of implications of the findings of these analyses are discussed with regard to particular, possible uses of the O*NET system in Chapter 15, but a primary focus is on the development of methods for forming job descriptions. There are some thorny issues here, but

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they appear to be eminently solvable and are partially dependent on the particular purposes for forming job descriptions.

Chapter 16 presents analyses of occupation-specific data, particularly frequency and importance ratings of tasks. These analyses show that such ratings had high interrater agreement coefficients in general, with 30-rater estimates of .90 or greater for all but four of the 29 occupations. Much of that chapter describes procedures that have been developed and tried out for gathering occupation-specific data within the structure of the O*NET content domain, particularly the generalized work activities and skills.

Comments on Future Directions

The authors of the various chapters have discussed possible avenues for future research and investigation. Some broader comments are made here.

With regard to methods of collecting data, the paramount lesson that has been learned is that multiple methods should be employed. That data collection should be an ongoing O*NET activity is obvious; less obvious is how that activity should be organized and carried out. This is at least as much an organizational issue as it is a technical issue, but some guidance can be offered based on our experiences over the first two years of O*NET development. First, if a variety of approaches are to be used to collect data, then a common set of demographic or identifying information must be collected. While the exact makeup of this set of variables is not fully known, it includes the obvious personal identifiers (race, sex, ethnicity, age), but should also include other information about the organization or establishment in which the respondent is situated. These variables are essential to allow the data to be combined across the methods to yield an accurate description of occupations. Second, some sort of incentives must be found to assist in the collection of data. The most mundane would be direct payment of respondents, but

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this is often not feasible nor even the most effective method of securing cooperation. To collect data, cooperation must often be secured at many levels--the organization housing the occupational incumbents, including home and branch office management, supervisors of incumbent respondents, employer and/or employee associations, unions, supervisors, etc. Each of these entities calls for slightly different approaches to securing cooperation and, thus, different kinds of incentives. As was demonstrated in the prototype data collection, success must be secured at all these levels to insure successful data collection. We believe that the most powerful incentive of all will be a highly useful O*NET system with multiple, tailored applications making use of the O*NET database. These applications provide tangible evidence to users of the "fruits of labor" of their cooperation in data collection. Although the prototype project has moved O*NET a long way toward this goal, much work remains to be done in this arena.

This last comment leads to a recommendation for a possible way to organize the O*NET effort, both research and development and ongoing data collection and product development. Following some private sector models, O*NET representatives could become familiar with data collection methods and procedures <u>and</u> the available O*NET applications. Armed with this knowledge of the benefits of O*NET that could be applied in various settings, they would be in excellent position to recruit cooperation from organizations and employee associations--and would have the knowledge to assist in the technical details of data collection. Furthermore, these representatives might specialize in particular industries or broad occupational groupings, therefore becoming much more knowledgeable in the core activities undertaken in the industry or occupational area of their specialty. These "sales representatives" could, if more detailed knowledge is required, call on a central core of O*NET technical representatives that would be working day-to-day with the details of data collection or with monitoring, cataloguing, and/or developing particular O*NET applications. Collectively, these technical representatives would perform the ongoing research, data quality, and technical control functions necessary to continually update and improve the O*NET system.

Such an organizational scheme is only one possible way to proceed, of course, but it does attempt to combine the working knowledge of the "input" and "output" functions of the O*NET system in a cadre of "sales representatives" so that the benefits of participating in O*NET data collection are tightly coupled with the demand on resources to engage in that participation. As O*NET grows in use, then collections or associations of particular types of users could be formed, perhaps even resulting in an annual convention for O*NET researchers, data providers, and application users.

A comment is in order about occupational unit. A major effort on the part of the Occupational Analysis Field Centers has been the identification of approximately 1122 occupational units, which are an expansion of the Occupational Employment Statistics (OES) set of occupations. These units were identified through a thorough and careful analysis of Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1991) information. The O*NET system presently employs these units as their basic occupational set, and they are also being considered as part of a larger Federal effort to revise the Standard Occupational Classification system. The future may bring additional changes to the makeup of the basic set of occupations. One of the advantages of the O*NET system, with its multiple domains and measures, is its capability of forming alternative groupings of occupations, as demonstrated in Chapter 14, thus allowing the use of such alternative sets for special uses. However, a common set of occupational units with some degree of stability is essential for combining data across different data collection efforts--such as those conducted by the Bureau of Labor Statistics. Therefore, attention to the technical

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and practical utility of the occupational unit scheme used by O*NET, and its coordination with other Federal, state, and private sector data collection efforts is vitally important.

Each content domain and its measures have been separately analyzed and reported on in earlier chapters. Although some domains clearly have stronger results supporting their continued use, collectively, all the domains seem technically sufficient enough for continued inclusion in the O*NET system. Some fine tuning in the makeup of a few of the domains is in order and should be undertaken, but these changes are not viewed as particularly urgent. Once again, the relatively limited number of occupations available for analysis tempers our conclusions in this regard. With more data, it might become more apparent that one or more domains should be drastically revised or dispensed with from a technical point of view. However, it is more likely that such decisions will be driven by the uses to which the data are eventually put, or not put. It must be kept in mind that each of these domains has associated with it a potential set of interested consumers, based on prior user surveys and contacts with potential users throughout this project. As applications are developed and put into use, the usefulness of the various measures in the O*NET system will become more clear. If a domain is clearly useful, but has some technical problems, the first order of business would be to fix the technical problems. On the other hand, a technically adequate domain that finds no user base, even after some amount of time, is clearly a candidate for deletion. Likewise, it may be that candidates for addition to the O*NET content model will become noticed in the same way.

A Final Note

We think a tremendous degree of technical and practical progress has been made on the prototype O*NET project. Indeed, we think the project has resulted in the production of an occupational database that is of some immediate, practical use, perhaps somewhat beyond the initial expectations and hopes of those of us most closely involved in the project. This report, with its companion report (Rose, Hesse, Silver, and Dumas, 1996) and the earlier content model report (Peterson, Mumford, Borman, Jeanneret, and Fleishman, 1995) stand as the primary documentation for the completed work. Much good work has been done, but much remains to be done.

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Figure 17-1
Interrater Agreement Coefficients for Each Scale Type

Questionnaire	Scale	r_k	r_{30}
Skills	Level	.79	.93
	Importance	.79	.93
	Job Entry Requirement	.60	.83
Knowledges	Level	.86	.95
	Importance	.85	.94
Training, Education, Licensure, & Experience	Instructional Program	.78	.92
	Educational Subject Area	.74	.90
	Licensure	.85	.95
	Experience	.79	.93
Generalized Work Activities	Level	.80	.92
	Importance	.78	.92
	Frequency	.74	.90
Work Context		.87	.95
Organizational Context	Across Occupations	.64	.84
	Across Organizations	.45	.79
Abilities	Level	.82	.93
	Importance	.82	.93
Occupational Values		.60	.82
Work Styles	Level	.70	.88
	Importance	.67	.86

Note: r_k is the observed interrater agreement coefficient; r_{30} is the estimated interrater agreement coefficient for 30 raters.

Figure 17-2
Interrater Agreement Coefficients for Aggregate Descriptors for Each Scale Type

Questionnaire	Scale	r_k	r_{30}
Skills	Level	.86	.95
	Importance	.86	.95
	Job Entry Requirement	.69	.88
Knowledges	Level	.85	.94
	Importance	.85	.94
Training, Education, Licensure, & Experience	Instructional Program	n/a	n/a
	Educational Subject Area	n/a	n/a
	Licensure	n/a	n/a
	Experience	n/a	n/a
Generalized Work Activities	Level	.86	.95
	Importance	.84	.94
	Frequency	.78	.92
Work Context		n/a	n/a
Organizational Context	Across Occupations	.60	.82
	Across Organizations	.41	.77
Abilities	Level	.86	.95
	Importance	.82	.93
Occupational Values		.57	.81
Work Styles	Level	.76	.91
	Importance	.73	.89

Note: r_k is the observed interrater agreement coefficient; r_{30} is the estimated interrater agreement coefficient for 30 raters.

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Figure 17-3
Mean Correlations Between Scales Across Occupations and Descriptors

Questionnaire	Scales	Across Occupations	Across Descriptors
Skills	Level/Importance	.96	.95
	Level/Job Entry Requirement	-.71	-.66
	Importance/Job Entry Requirement	-.74	-.69
Knowledges	Level/Importance	.90	.95
Training, Education, Licensure, & Experience		n/a	n/a
Generalized Work Activities	Level/Importance	.93	.92
	Level/Frequency	.88	.82
	Importance/Frequency	.91	.89
Work Context		n/a	n/a
Organizational Context		n/a	n/a
Abilities	Level/Importance	.82	.92
Occupational Values		n/a	n/a
Work Styles	Level/Importance	.93	.90

Note: Across occupations correlations are the mean ratings on a given occupation for all descriptors for one scale correlated with the mean ratings on the same occupations for all descriptors on the other scale, averaged across occupations. Across descriptors correlations are the mean ratings for a given descriptor for all occupations for one scale correlated with the mean ratings for that descriptor for all occupations for the other scale, averaged across descriptors.

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Figure 17-4
Mean Correlations and Squared Differences Between Incumbents' and Analysts' Ratings

Questionnaire	Scale	r_{ia}	d^2
Skills	Level	.74	1.51
	Importance	.67	.72
Knowledges	Level	.65	.86
	Importance	.65	.47
Training, Education, Licensure, & Experience		n/a	n/a
Generalized Work Activities	Level	.71	1.09
	Importance	.61	.82
	Frequency	.53	n/a
Work Context		.64	n/a
Organizational Context		n/a	n/a
Abilities	Level	.70	.99
	Importance	.65	.39
Occupational Values		n/a	n/a
Work Styles		n/a	n/a

Note: r_{ia} is the mean correlation between incumbent and analyst mean occupation ratings. d^2 is the mean squared difference between incumbent and analyst mean occupations ratings.

Appendix A

Organizational Context:

Computer Assisted Telephone Interview Protocol for Organizational Representatives

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ORGANIZATIONAL INFORMATION

ORGANIZATION ID: ________________

ADDRESS: ________________

CONTACT: ________________

TITLE: ________________

ORGANIZATION NAME: ________________

TELEPHONE #: ________________

SECONDARY NAME: ________________

CONTACT PHONE: ________________

SIC: ________________

OAFC SCREENER INFORMATION

NEGOTIATOR: ________________

OAFC SCREENER DATE: ________________

[ASK TO SPEAK WITH CONTACT ABOVE.]

START. We would like to start by asking you to provide some organizational information. Then, we can discuss how you will help us collect data from your employees.

To begin, we would like to know a little about you.

S1. **How many years have you worked for this organization? ___________ years (IF LESS THAN 1, ENTER 0)**

S2. **How many years have you held your current position? ____________ years (IF LESS THAN 1, ENTER 0)**

S3. **What is your current job title? ______________________________**

Next, I will be asking some questions about your organization. Most of the questions will be about your organization at the following location: [STREET NAME]. However, some questions will refer to your entire organization.

1. **Were you in existence before 1990?**

   1. Yes
   2. No

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS NO TO Q1., DO NOT ASK Q13, Q19, Q24-Q27.

2. **Is your organization part of the ...**

   1. Government; or (SKIP TO Q4.)
   2. Private sector?

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3. **Is [STREET NAME] part of a profit or non-profit organization?**

   1. Profit
   2. Non-profit

4. **Do you have trade unions at this location?**

   1. Yes
   2. No (SKIP TO Q6)

5. **What percentage of the non-management employees at your location at [STREET NAME] belong to trade unions? ___________%**

6. **How many different locations exist within your *entire organization* both nationally and internationally?**

   ____

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:	
6b. Would you say:	
1. Only one	5. 51-100
2. 2-10	6. 101-200
3. 11-25	7. 201-300
4. 26-50	8. More than 300

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7. **In how many countries, other than the US, does your *entire organization* do business? That is, sell products or services to foreign businesses or governments or participate in projects with foreign businesses or governments? ____________**

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:	
7b. Would you say:	
1. None	5. 51-100
2. 1-10	6. 101-200
3. 11-25	7. 201-300
4. 26-50	8. More than 300

8. **How many full-time employees work for your *entire organization* at all locations? ____________**

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:	
8b. Would you say:	
1. 1-25	6. 501-1000
2. 26-50	7. 1001-5000
3. 51-70	8. 5001-10,000
4. 71-100	9. 10,001-20,000
5. 101-500	10. More than 20,000

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9. **How many full-time employees work at [STREET NAME]?** ____________

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:	
9b. Would you say:	
1. 1-25	6. 501-1000
2. 26-50	7. 1001-5000
3. 51-70	8. 5001-10,000
4. 71-100	9. 10,001-20,000
5. 101-500	10. More than 20,000

10. **How many part-time employees work at [STREET NAME]?** ____________

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:	
10b. Would you say:	
1. 1-25	6. 501-1000
2. 26-50	7. 1001-5000
3. 51-70	8. 5001-10,000
4. 71-100	9. 10,001-20,000
5. 101-500	10. More than 20,000

11. How many *new* employees joined your location in the last 12 months? Please include full-time and part-time. ____________

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:	
11b. **Would you say:**	
1. 1-25	6. 501-1000
2. 26-50	7. 1001-5000
3. 51-70	8. 5001-10,000
4. 71-100	9. 10,001-20,000
5. 101-500	10. More than 20,000

12. How many full-time and part-time employees worked at [STREET NAME] *one year ago*? ____________

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:	
12b. **Would you say:**	
1. 1-25	6. 501-1000
2. 26-50	7. 1001-5000
3. 51-70	8. 5001-10,000
4. 71-100	9. 10,001-20,000
5. 101-500	10. More than 20,000

13.Have you downsized or right-sized your workforce in the last five years?

1. Yes, a great deal
2. Yes, somewhat
3. No

14.To what extent does [STREET NAME] use independent contractors? Would you say...

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

15.How often does [STREET NAME] use independent contractors...

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

16.What was the annual revenue at [STREET NAME] last year? ____________

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:

16b. Would you say:

1. Less than $10,000
2. $10,000-$100,000
3. $100,000-$1 million
4. $1 million-$10 million
5. $10 million-$25 million
6. $25 million-$100 million
7. $100 million -$500 million
8. $500 million - $ 1 billion
9. More than $1 billion

17. What was the annual revenue for your *entire organization* last year? ____________

NOTE TO CATI PROGRAMMER: IF RESPONDENT CAN'T ANSWER THEN OVERLAY:

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17b. Would you say:

1. Less than $10,000
2. $10,000-$100,000
3. $100,000-$1 million
4. $1 million-$10 million
5. $10 million-$100 million
6. $100 million -$1 billion
7. More than $1 billion

18. How many levels of formal *management* positions, including your chief administrator, are in your entire organization? If you have an organizational chart, please use it to answer this question.

__________ NUMBER OF LEVELS (SKIP TO Q19)

(IF DON'T KNOW GO TO 18a).

18a. **Can you estimate the range of management levels across different departments, divisions, or other units in your organization?**

__________ RANGE OF LEVELS

19. Has [STREET NAME] removed layers of management across several *different* departments or functions during the last five years?

1. Yes
2. No

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20. **Which of the following written documents exist at [STREET NAME]?**

(ENTER 1 FOR YES, AND 2 FOR NO)

Contracts of employment	( )
An organizational chart	( )
Job descriptions	( )
Manuals of procedures and regulations	( )
Policy manuals	( )
Records of employees' performance	( )
Records of employees' time or hours worked	( )

NOTE TO CATI PROGRAMMER: ONLY ASK Q21 FOR THE ITEMS RESPONDENT ANSWERED YES TO IN Q20

DO NOT ASK Q21 FOR THE LAST 2 ITEMS IN Q20 NO MATTER HOW THEY ANSWER

21. **To what extent do/does (DOCUMENT) dictate how work is performed at [STREET NAME]? Would you say...**

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

Contracts of employment	( )
An organizational chart	( )
Job descriptions	( )
Manuals of procedures and regulations	( )
Policy manuals	( )

22.How many **different job titles, with different functions, exist at [STREET NAME]?**

__________ NUMBER OF TITLES (SKIP TO Q23)
(IF DON'T KNOW GO TO 22a.)

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22a. **How many different job titles, with different functions, exist in your *entire organization*?**

__________ NUMBER OF TITLES

23. **How frequently do employees at [STREET NAME] experience *substantial* changes in their job duties?**

1. Never
2. Rarely
3. Sometimes
4. Often
5. Very often
6. All the time

24. **During the past five years, approximately how many *distinct new types of jobs* have been created at [STREET NAME].** ____________

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN OVERLAY:
24b. Would you say: 1. None 2. 1-5 3. 6-20 4. 21-50 5. 51-100 6. More than 100

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25.During the past five years, how many times has your location gone through a major *reorganization*?

1. Never (SKIP TO Q28)
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6 or more

26. How long has it been since your location's most recent reorganization? Would you say...

1. Less than 6 months
2. Between 6 months and 1 year
3. Between 1 and 2 years
4. Between 2 and 5 years

27.During the past five years, how many times has your location's organizational chart been revised? Was it...

1. Never
2. 1
3. 2
4. 3
5. 4
6. 5 or more

28. Is/Are (ACTIVITY) performed by your employees at [STREET NAME]?

(ENTER 1 FOR YES, 2 FOR NO)

Public relations and advertising	( )
Sales	( )
Customer service	( )
Transporting or carrying outputs and resources from place to place	( )
Employment or human resources activities	( )
Training and developing human resources	( )
Purchasing	( )
Controlling inventory	( )
Maintenance or construction	( )
Accounting	( )
Production control	( )
Inspection or quality control	( )
Design and development of products and processes	( )
Administration	( )
Market research	( )

29. On a 1 to 5 scale, where 1 is not at all standardized and 5 is completely standardized, rate the extent to which the following activities are carried out according to specified procedures? On the 1 to 5 scale, how standardized is/are...

(CODE 1 THROUGH 5 - CODE 6 FOR NA)

Quality control inspections	( )
Financial control or budgets	( )
Operational control	( )
Purchasing	( )
Planning	( )
Sharing information with employees or managers	( )
Recruiting new employees	( )
Selecting new employees	( )
Job evaluation	( )
Performance appraisal	( )
Salary review	( )
Promoting employees	( )
Training	( )
Research and development	( )

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30. To what extent do *nonsupervisory* employees at [STREET NAME] have the authority to...

A. Monitor data on quality, costs, waste, and productivity? Would you say...

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

B. Determine work flow? Would you say...

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

C. **Invest in new equipment and technology? Would you say...**

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

D. Develop new products, services, and procedures? Would you say...

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

E. **Select new work group members? Would you say...**

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

31. **What percentage of employees at [STREET NAME] are routinely provided with the following types of information?**

A. **Information about your overall financial results. __________%**

B. **Information about their unit's financial results. ___________%**

C. **Advance information about new technologies that may affect them. ___________%**

D. **Information on your business plans and goals. _____________%**

E. **Information on competitors' performance. ________________%**

NOTE TO CATI PROGRAMMER: Q31 A-E. IF RESPONDENT ANSWERS DK THEN AN OVERLAY COMES UP READING:	
31b.	**Would you say:** **1. 0%** **2. 1-20%** **3. 21-40%** **4. 41-60%** **5. 61-80%** **6. 81-99%** **7. 100%**

32. **To what extent does [STREET NAME] use formal teams to accomplish its goals? Would you say...**

1. Not at all (WE DON'T HAVE TEAMS) (SKIP TO Q35E.)
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

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33.To what extent are employees in your location accountable for the performance of their team? Would you say...

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

34.Approximately what percentage of your employees at [STREET NAME] work in *intact teams*? By the term *intact teams*, we mean groups of 3 or more employees who are jointly responsible for whole work processes and work toward shared goals. ________ %

35. At your location, do you have the following types of work teams? Are there...

A. **Functional teams that are intact and members have similar skills and expertise?**
   1. Yes (OVERLAY)
   2. No

B. **Cross-functional teams that are intact and members have different skills and expertise?**
   1. Yes (OVERLAY)
   2. No

C. **Management teams, with three or more senior managers who make policies and operational decisions for all parts of your location or the entire organization?**
   1. Yes (OVERLAY)
   2. No

D. **Project or development teams that are temporary and are brought together to conduct research and development, and to develop new products or services?**
   1. Yes (OVERLAY)
   2. No

E. **Quality or improvement teams that are temporary and recommend ways to improve work procedures or solve specific problems?**
   1. Yes (OVERLAY)
   2. No

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS YES TO Q35 A-E., THEN OVERLAY WITH Q35b.
35b. What percentage of employees work in (TEAM)? __________%

IF RESPONDENT ANSWERS DK THEN OVERLAY WITH:
35b. Would you say: 1. 0% 2. 1-20% 3. 21-40% 4. 41-60% 5. 61-80% 6. 81-99% 7. 100%

36.Do you have a formal mission statement?

1. Yes
2. No

37.How many department or division heads at [STREET NAME] are required to set quantitative annual goals?

1. None
2. Few
3. Some
4. Most
5. All

38.Last year, did your management set and publicize to all employees at least one quantitative performance goal?

1. Yes
2. No

39.What percentage of the *managers* at [STREET NAME] are either expected to set or given performance goals for their unit or area of responsibility each year? __________% (IF NONE SKIP TO Q41)

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN AN OVERLAY COMES UP READING:
39b. Would you say: 1. 0% (SKIP TO Q41) 2. 1-20%

3. 21-40% 4. 41-60% 5. 61-80% 6. 81-99% 7. 100%

40. What percentage of the *managers* at your location are allowed to negotiate their own goals with their supervisors? ____________%

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN AN OVERLAY COMES UP READING:	
40b.	Would you say: 1. 0% 2. 1-20% 3. 21-40% 4. 41-60% 5. 61-80% 6. 81-99% 7. 100%

41. What percentage of *non-management employees* at this location are either expected to set for themselves or given one or more individual performance goals each year? ____________%

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NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN AN OVERLAY COMES UP READING:
41b. Would you say: 1. 0% (SKIP TO Q43) 2. 1-20% 3. 21-40% 4. 41-60% 5. 61-80% 6. 81-99% 7. 100%

42. What percentage of *non-management employees* at your location are allowed to negotiate their own goals with their supervisors? ____________%

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN AN OVERLAY COMES UP READING:
42b. Would you say: 1. 0% 2. 1-20% 3. 21-40% 4. 41-60% 5. 61-80% 6. 81-99% 7. 100%

43. How many formal performance reviews are managers required to give each employee *in a two year period*? Only count standard reviews, not probationary or initial reviews for new employees

____

ERIC

44.Does [STREET NAME] or your entire organization offer formal training programs to employees?

1. Yes
2. No (SKIP TO Q53.)

45. Which of the following training methods are used in-house at [STREET NAME]? Do you use...

(ENTER 1 FOR YES, 2 FOR NO)

Case study exercises	( )
Conference method, or group discussions	( )
Lectures with questions	( )
Business games	( )
Machine simulators, like flight simulators	( )
Films or videos	( )
Interactive videos	( )
Workbooks	( )
Role plays	( )
Computer-assisted instruction	( )
Audiocassettes	( )

46.How many of the training programs used at [STREET NAME] incorporate a careful, systematic training needs analysis? Would you say...

1. None
2. Few
3. Some
4. Most
5. All

47. **How often are the training programs used at [STREET NAME] systematically evaluated to determine whether or not they are effective? Would you say...**

1. Never
2. Rarely
3. Sometimes
4. Often
5. Very often

48. **In which of the following content areas does your location provide formal training? Do not include on-the-job or mentoring activities.**

(ENTER 1 FOR YES, 2 FOR NO)

Diversity	( )
Team Skills	( )
Quality Control Skills	( )
Basic Business and Economics	( )
Problem Solving Skills	( )
Leadership Skills	( )
Customer Service	( )

49a. **Approximately what percentage of employees at this location attend no company sponsored training courses each year?** ________%

49b. **One company sponsored training course each year?** ________%

49c. **Two or more company sponsored training courses each year?** ________%

Q49a,b,c. NOTE TO CATI PROGRAMMER: RESPONSES MUST SUM TO 100% BEFORE INTERVIEWER CAN LEAVE THE QUESTION.

50. **Does [STREET NAME] have a formal program for improving product or service quality, such as, TQM or similar programs?**

1. Yes
2. No (SKIP TO Q51)

50a. **What percentage of employees have received training in quality control or quality improvement methods?** _____ %

51. **Approximately what is your location's annual training budget?**

_________________ hundred

_________________ thousand

_________________ million

52. **Approximately what percentage of your employee payroll is spent on training and development? _____ %**

53. **Does [STREET NAME] have programs designed to support continuous learning on the part of employees, like, cross-training or job rotation?**

    1. Yes
    2. No

54. **Does [STREET NAME] provide financial assistance to individuals who wish to pursue job-relevant training outside the organization at a local college, university, or vocational-technical school?**

    1. Yes
    2. No

55. **Which of the following statements *best describes* the job rotation policies for employees at your location? Would you say...**

    1. There is no job rotation
    2. Rotation within work groups
    3. Rotation within and across work groups in the same department
    4. Rotation across work groups and departments

56. **Does your location have a formal recruitment or staffing plan in place?**

    1. Yes
    2. No (SKIP TO Q59)

57. **Which of the following types of data do you routinely collect to aid in evaluating and improving your recruitment process? Do you collect data on...**

	(ENTER 1 FOR YES, 2 FOR NO)
Total budget for recruiting operations	( )
Total recruiting budget per individual hired	( )
Number of recruiting leads generated by each recruiting source used	( )
Number of prospects hired for each recruiting source used	( )

Success after hire of individuals identified through various recruiting sources ( )

Average amount of time that elapses between stages in the recruitment process. ( )

58. At [STREET NAME], are recruiters trained or instructed to provide realistic information to job candidates concerning available jobs?

1. Yes
2. No

59. Does [STREET NAME] have one or more formal orientation programs for *groups* of new employees?

1. Yes
2. No

60. Does [STREET NAME] have a formal mentoring program?

1. Yes
2. No

61. Does [STREET NAME] have any formal selection systems, such as, tests or interviews?

1. Yes
2. No (SKIP TO Q66)

62. How many of the selection systems now in place at your location are based on formal job analyses? Would you say...

1. None
2. Few
3. Some
4. Most
5. All

63. How many of the selection systems used in your location are made up of procedures that have been carefully researched and shown to be related to job success? Would you say...

1. None
2. Few
3. Some
4. Most
5. All

64. To what extent does [STREET NAME] spend money on research designed to produce data to help you make business decisions? Would you say...

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

65. To what extent does [STREET NAME] use research and data to make organizational decisions? Would you say...

1. Not at all
2. To a limited extent
3. To some extent
4. To a moderate extent
5. To a great extent

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66. What percentage of the jobs at [STREET NAME] have their pay rates determined or adjusted based on formal job evaluation studies? ____________%

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN AN OVERLAY COMES UP READING:	
66b.	Would you say: 1. 0% 2. 1-20% 3. 21-40% 4. 41-60% 5. 61-80% 6. 81-99% 7. 100%

67. What percentage of the jobs at [STREET NAME] have their pay rates determined or adjusted based on comparisons with similar jobs in other organizations? __________%

NOTE TO CATI PROGRAMMER: IF RESPONDENT ANSWERS DK THEN AN OVERLAY COMES UP READING:	
67b.	Would you say: 1. 0% 2. 1-20% 3. 21-40% 4. 41-60% 5. 61-80% 6. 81-99% 7. 100%

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68.Approximately what percentage of the employees at [STREET NAME] have a compensation package that includes the following elements?

Salaried pay	___%
Profit or Gain Sharing	___%
Knowledge or skill-based pay	___%
Pay based on individual performance	___%
Pay based on team performance	___%
Pay based on customer satisfaction	___%
Pay based on job tenure/seniority	___%
Pay based on job attributes such as, hazards involved or Hay points assigned	___%

69. **Approximately what percentage of the employees at [STREET NAME] have a compensation package that includes the following benefits?**

Stock ownership in the organization	___%
Retirement plan, such as, 401(k), or a pension plan	___%
Major medical insurance	___%
Life insurance	___%
Disability insurance	___%
Flexible working hours	___%
Daycare	___%
Paid leave, including, holidays, vacation time, and maternity leave	___%

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NO RANDOM START

70. **Next, I am going to read a list of organizational values. These values are expressed in terms of how organizational employees should behave or what attitudes are appropriate for employees to hold. For each of these values, please evaluate the extent to which the value is characteristic of your location. Use a 1 to 7 point scale, where 1 least characterizes your location and 7 is characterizes your location.**

Security of employment	_______	Tolerance	_______
Risk-taking	_______	Taking advantage of opportunities	_______
Flexibility	_______	Customer service orientation	_______
Analytical orientation	_______	Action orientation	_______
People orientation	_______	Stability	_______
Fairness	_______	Autonomy	_______
Competitiveness	_______	Attention to detail	_______
Collaboration	_______	Team orientation	_______
Adaptability	_______	Sharing information freely	_______
Predictability	_______	Willingness to experiment	_______
Innovation	_______	Aggressiveness	_______
Social responsibility	_______	Precision	_______
Quality	_______	Achievement orientation	_______
Results orientation	_______	Supportiveness	_______

Thank you for answering the organizational questions.

ERIC

C1. As [NEGOTIATOR] discussed with you, we would like you to help us gather information about your employees' job responsibilities. To do this, we need you to serve as a liaison or Point of Contact between us and your organization's employees. I would now like to give you the list of occupations that we want to study and the number of employees that we need for each occupation. First, I'd like to verify that you have at least:

CATI PROGRAMMER: REPEAT THE FOLLOWING FOR AS MANY OCCUPATIONS THAT ARE NEEDED

C1A. (NUMBER1) (OCCUPATION1) at [STREET NAME]. Is that correct?

1. Yes (SKIP TO C1B.)
2. No

C1Aa. How many (OCCUPATION1) do you have? _______

C1B. We will send you (NUMBER SAMPLED OR MAX NUMBER OF EMPLOYEES) questionnaires *{disks}* for (OCCUPATION1).

In a couple of days we will Fed-ex you a package. This package will contain:

- A copy of the occupation list we just reviewed so you know which occupations we are studying.
- An information sheet about how to select participants and coordinate the data collection.
- A management information sheet and copies of the fact sheet that you can distribute to management or the employees' supervisors at your discretion. The letter introduces the study and explains the importance of employee participation.
- You will also get (TOTAL NUMBER OF EMPLOYEES ABOVE) envelopes containing study introductions and job questionnaires *{floppy disks with job questions}*, one for each employee we listed.
- Finally, you will get a postage paid envelope addressed to Westat, so that you can return questionnaires when employees have finished.

ERIC

For each occupation, we would like you to select the individuals who will participate. Then we would like you to pass out the questionnaires {*disks*}, collect them from employees as they finish completing them, and mail them back to Westat in the postage paid envelope that we are sending.

A project representative from Westat will call you in about a week to see how everything is going and to answer and any questions that you might have.

In the meantime, if you have any questions, please contact the Westat Project Coordinator, Katy Erickson at 1-800-937-8281 x4454. Alternatively, if you have access to electronic mail through the Internet, you may contact Ms. Erickson at ONET@Westat.com. Thanks again for participating in this important study.

Appendix B

Data Collection Materials

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Exhibit 1. Screening interview

ORGANIZATION ID # ____________________

DOT
SCREENER FOR BASELINE STUDY

Hello, my name is________________, and I'm calling on behalf of the U.S. Department of Labor and the Utah Department of Employment Security from Westat, Inc. We are a research firm in Rockville, MD and we are preparing an important nationwide study to revise the Dictionary of Occupational Titles.

1. **Have I reached (NAME OF BUSINESS ON RIS)?**

   YES (PRIMARY NAME MATCH)........................1 (Q4)
   YES (SECONDARY NAME MATCH)........................2 (Q4)
   BUSINESS CHANGED NAME........................3
   NO, ANOTHER BUSINESS........................4
   RESIDENCE ONLY (NOT A BUSINESS)........................5 (Q9)

2. **What is the name of your business?**

   ____

   RESIDENCE ONLY (NOT A BUSINESS)........................(Q9)

3. **Is this business the same as (NAME OF BUSINESS ON RIS)? [PROBE: Do you consider it the same business?]**

   YES........................1
   NO........................2 (Q5)

4. **Are you located at (ADDRESS ON RIS)? [IF P.O. BOX, OBTAIN ADDRESS AND NOTE ON RIS.]**

   YES........................1 (Q15)
   NO........................2 (Q13)

5. **Are you located at (ADDRESS ON RIS)? [IF P.O. BOX, OBTAIN ADDRESS AND NOTE ON RIS.]**

   YES........................1
   NO........................2 (Q7)

6. **Do you know what happened to (NAME OF BUSINESS ON RIS)?**

   CLOSED/OUT OF BUSINESS........................1 (CODE S1)
   MOVED........................2 (Q8)
   DON'T KNOW........................3 (CODE NL)

7. **Do you know anything about (NAME OF BUSINESS ON RIS) at (ADDRESS ON RIS)?**

   CLOSED/OUT OF BUSINESS........................1 (CODE S1)
   DON'T KNOW........................2 (CODE NL)

Exhibit 1. Screening interview (continued)

8. **Do you know the current address and phone number for (NAME OF BUSINESS ON RIS)?**

   YES..1 (Q12)
   NO..2 (CODE NL)

9. **Are you located at (ADDRESS ON RIS)?**

   YES..1
   NO..2 (CODE NL)

10. **Do you know what happened to (NAME OF BUSINESS ON RIS)?**

    CLOSED/OUT OF BUSINESS..1 (CODE S1)
    MOVED..2
    DON'T KNOW..3 (CODE NL)

11. **Do you know the phone number or address of (NAME OF BUSINESS ON RIS)?**

    YES..1
    NO..2 (CODE NL)

12. **What is the phone number or address of (NAME OF BUSINESS ON RIS)?**

    PHONE NUMBER: (________)________________________

    ADDRESS:____________________________________

    ____

13. **Does (NAME OF BUSINESS ON RIS) have an office at (ADDRESS OF BUSINESS ON RIS)?**

    YES..1
    NO, MOVED FROM (ADDRESS ON RIS)..2 (Q15)
    NO..3 (CODE NL)

14. **Can you give me the telephone number for that location?**

    YES..1

    (________)____________________________

    NO..2 (CODE NL)

    ADDRESS:__________________________________

    ____

15. **Are there 5 or more people employed at [ADDRESS ON RIS]?**

    YES..1
    NO..2 (CODE I)

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Exhibit 1. Screening interview (continued)

16. We would like to send some information regarding this study to your human resources director or the person who is most knowledgeable about organizational and job information at (LOCATION ON RIS).

    What is that person's ...

name?:	______________________ Mr., Ms., Dr.
title?:	______________________
address?:	______________________
	______________________
	______________________
direct phone number?:	(________)______________
fax number?:	(________)______________

Different location.

CLOSING: To verify that I have spoken to someone at this business, could I please have your name?

____

Thank you for your assistance.

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Exhibit 2. Negotiation Script

[ASK TO SPEAK WITH NAME ON RIS. IF PERSON NO LONGER THERE ASK FOR PERSON IN CHARGE OF HIS/HER JOB]

Hello, my name is________________ and I am calling on behalf of the U.S. Department of Labor {WESTAT STAFF: from Westat, an independent research firm, located in Rockville, MD} regarding a study to revise and computerize the Dictionary of Occupational Titles. The completed version will be called O*NET. The O*NET project team sent you a letter about this important study about a week ago.

Q1. Did you get that letter?

YES ....1(SKIP TO Q2_INT)
NO..2

Q1a. I would be happy to fax you a copy of the letter after our conversation. What is your fax number?

(______)________________________________ (SKIP TO Q2_INT)
NO FAX...(NF)

Q1b. I can send it. What is your address?

ADDRESS:____
____
____

By computerizing and expanding the DOT we hope to make it more useful to employers like yourself. We will add more detailed information about potential employees.

ERIC

Exhibit 2. Negotiation Script (continued)

In order to do this, we need to collect information from you about your organization. We would like to have a representative from Westat call you back in a couple of weeks. {OAFC STAFF: Westat is a private research firm in Rockville, MD who will be helping us to collect information.} The representative will interview you for about 45 minutes on information about your organization. Most of the topics are listed in the letter from the O*NET project team. The Westat representative is a trained professional interviewer. Any information that you provide the interviewer will remain completely confidential and neither you nor your company will be individually identified in any way.

After this 45 minute interview with you, we will need to collect information from up to 30 of your employees about their jobs. Westat will send paper and pencil questionnaires {on computer disk} that employees can fill out at their convenience. These questionnaires will take about an hour of their time. It would be helpful if you would allow time in their workday to complete the surveys. Again the information they provide is completely confidential, we don't even need to know their names.

We would like you to act as a Point of Contact to organize this effort. We need you to pass out questionnaires to selected employees, collect them, and send them back to Westat in a postage paid envelope. Depending on the number of employees needed, you may also be asked to randomly select participants.

Finally, we will send you a few brief organizational values surveys to pass out to and collect from mid- to upper-management in your organization. These surveys only take about 5 minutes to complete.

Q2. Would you be willing to participate in this study?

YES 1
NO ....2(SKIP TO CLOSE2)

Q2a. Would you be willing to coordinate the distribution and collection of job questionnaires to your employees?

YES 1
NO ....2(SKIP TO CLOSE2)

Q2b. Would you be willing to allow employees time in their workday to participate in this study?

YES 1
NO 2

ERIC Full Text Provided by ERIC

Exhibit 2. Negotiation Script(continued)

Q3_INT. Great! Thank you very much. I just need to verify that you employ people in several occupations. I am going to read you a short list of occupations. Please tell me whether or not you have full-time people currently working in these occupations at your location. As I read the list, please answer yes if you do and no if you don't. Then, I will ask you how many people are currently employed, full-time in each occupation, at your location.

OCCUPATION AUTOMATICALLY PRINTED FROM DATABASE	Q3. Do you employ... YES	NO	Q4. How many (OCCUPATION) do you employ full time at this location? # EMPLOYED
(OCCUPATION 1)?	1	2 (b)	________
(OCCUPATION 2)?	1	2 (c)	________
(OCCUPATION 3)?	1	2 (d)	________
(OCCUPATION 4)?	1	2 (e)	________
(OCCUPATION 5)?	1	2 (f)	________
(OCCUPATION 6)?	1	2 (g)	________
(OCCUPATION 7)?	1	2 (h)	________
(OCCUPATION 8)?	1	2 (i)	________
(OCCUPATION 9)?	1	2 (j)	________
(OCCUPATION 10)?	1	2 (k)	________
(OCCUPATION 11)?	1	2 (l)	________
(OCCUPATION 12)?	1	2 (m)	________
(OCCUPATION 13)?	1	2 (n)	________
(OCCUPATION 14)?	1	2 (o)	________
(OCCUPATION 15)?	1	2 (Q5_INT.)	________

ERIC

Exhibit 2. Negotiation Script (continued)

Q5_INT. Thank you for verifying the occupations. We will enter this information into a database and use it to select which occupations we want information on. A Westat interviewer will call you in a couple of weeks. The interviewer will do the 45 minute organizational interview with you over the phone. He or she will also give you the list of occupations we want ask your employees about. This list will tell you how many employees in each occupation we want to collect information on. Depending on the number we need, you may be asked to pick only a few of the employees in a particular occupation or all of them.

Q5. Is there a particular day of the week or time that is best for Westat to call you back for the organizational interview?

ANY DAY/TIME..1 (SKIP TO CLOSE)
PARTICULAR DAY/TIME 2

Q5a. BEST DAYS AND TIMES (COMPLETE ALL THAT APPLY)

CIRCLE DAY		CIRCLE AM OR PM
MONDAY	AT:____________________	AM / PM
TUESDAY	AT:____________________	AM / PM
WEDNESDAY	AT:____________________	AM / PM
THURSDAY	AT:____________________	AM / PM
FRIDAY	AT:____________________	AM / PM
SATURDAY	AT:____________________	AM / PM
SUNDAY	AT:____________________	AM / PM

CLOSE1: Thank you in advance for your help when the Westat interviewer calls and again for the help you have already given the U.S. Department of Labor. The interviewer will be talking with you soon.

CLOSE2: (USE FOR REFUSAL AT ANY TIME) Thank you for your time.

ERIC

YOUR INTERVIEW IS SCHEDULED FOR:

Day:		Date:		Time:	

Thanks for your help!

ITEMS INCLUDED IN THE INTERVIEW

The purpose of this study is to obtain comprehensive and up-to-date information about organizations and occupations. To gather accurate information, a Westat interviewer will be asking some questions about your ***entire organization*** and other questions about ***the location below***.

Address:

Some of the questions you will be asked will be very specific in nature. Below, is a list of questions that you may need to consult your records (payroll, etc.) to answer. If you have not had time to do this when called for an interview, the interviewer will be glad to call you back at a later time. If you have any questions about the study or the information we are requesting, please call Katy Erickson at Westat, 1-800-937-8281 ext. 4454.

Information Needed	At Location Above	In Entire Organization
Percentage of non-management employees belonging to trade unions.	X	
Number of establishments.		X
Number of countries you do business with outside of the US .		X
Number of full-time employees.	X	X
Number of part-time employees.	X	
Number of full- and part-time employees one year ago.	X	
Number of new full- and part-time employees in the last 12 months.	X	
Annual revenue last year.	X	X
Number of different job titles.	X	X
Number of new job titles created in the last five years.	X	
Amount of annual training budget.	X	
Percentage of payroll spent on employee training and development.	X	

Exhibit 3. CATI Assignment of Occupations

C1. As we discussed in the beginning of the interview, we would like you to help us gather information about your employees' job responsibilities. To do this we would like you to serve as a liaison between us and your employees. As (NEGOTIATOR'S NAME) discussed with you, I would now like to give you the list of occupations that we would like to study and the number of employees that we need for each occupation. First, I'd like to verify that you have at least:

CATI PROGRAMMER: REPEAT THE FOLLOWING FOR AS MANY OCCUPATIONS THAT ARE NEEDED

C1A. (NUMBER1) (OCCUPATION1) at [STREET NAME]. Is that correct?

1. Yes (SKIP TO C1B.)
2. No

C1Aa. How many (OCCUPATION1) do you have? _______

C1B. We will send you (NUMBER SAMPLED OR MAX NUMBER OF EMPLOYEES) questionnaires *{disks}* for (OCCUPATION1).

In a couple of days we will Fed-ex you a package. This package will contain:

- Copies of a short organizational value surveys to pass out to mid- to upper-management at [STREET NAME].
- A copy of the occupation list we just reviewed so you know which occupations we are studying.
- You will also get (TOTAL NUMBER OF EMPLOYEES ABOVE) envelopes containing job questionnaires {*floppy disks with job questions*}, one for each employee we listed.
- You will get an information sheet that explains about selecting participants and coordinating the data collection.
- Finally, you will get a postage paid envelope addressed to Westat, so that you can return questionnaires when employees have finished.
-

For each occupation, we would like you to select the individuals who will participate. Then we would like you to pass out the questionnaires {*disks*}, collect them from employees as they finish completing them, and mail them back to Westat in the postage paid envelope that we are sending.

Someone from Westat will call you in about a week to see how everything is going and to answer and any questions that you might have.

In the meantime, if you have any questions, please call Katy Erickson at 1-800-WESTAT1. This is a toll-free call. Thanks again for participating in this important study.

ERIC

Exhibit 4. POC packet

October, 1995

[ORG ID]

Dear [POC NAME]:

On behalf of the O*NET Project Team, I would like to thank you for agreeing to participate in this important nationwide project to gather data about occupations. The information that you and other employers provide will form the foundation of O*NET, the Occupational Information Network.

O*NET will be the nation's primary source of occupational information. It will be a comprehensive database that provides information about occupations, worker skills, and training requirements. O*NET will be a useful tool for employers looking for qualified people, people looking for jobs, and educators preparing people for the job market.

Your role is critical to the success of this project. We are asking you to distribute to and collect the enclosed questionnaires from selected employees. We would like you to return them to Westat, the company gathering the occupational data for this project, within two weeks of receiving this package.

All information that we receive from your organization is confidential. No individual or company will be identified in any statistical summary that is released or published.

This package includes everything needed to carry out your role, including:

- Instructions for Implementing this Project - The following pages lead you, step by step, through your role in the data collection effort.

- Employee Selection Table - This table presents a list of occupations to be studied and the number of employees needed in each occupation.

- Employee "Job Analysis Questionnaires" - Enclosed you will find questionnaires for each selected employee. Again, we ask you to distribute these questionnaires as soon as possible and collect and return them to Westat within two weeks of receiving this package. It should take each participant approximately 60 to 90 minutes to complete his or her questionnaires.

- Sample Management Information Sheet - You may find it helpful to spread the word among department managers and employees about this project. The enclosed Management Information Sheet provides a sample way to do so.

- Sample cover memo to send to employees participating in the project - You may choose to use this sample cover memo to send to employees with their questionnaires. The memo serves to introduce the project to them, identify you as the "Point of Contact" for [COMPANY NAME], and highlight key points about the project and the employee's participation.

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Exhibit 4. POC packet (continued)

- O*NET Fact Sheet - This fact sheet describes the O*NET project. Please feel free to copy and distribute it, or call us to request additional copies.

- Large postage paid return envelopes - Please use these envelopes to mail completed employee questionnaires back to Westat.

A Westat representative will be calling in about a week to see how things are going. If you or your employees have any questions in the meantime, please call the Westat Project Coordinator, Katy Erickson, at 1-800-937-8281, x4454. Alternately, if you have access to electronic mail through the Internet, you may contact Ms. Erickson at ONET@Westat.com.

Thank you again for your participation in this important project. Employers and employees across the United States will benefit as a result of your support.

Sincerely,

Norman D. Peterson

Norman Peterson
Project Director, O*NET Project Team
American Institutes for Research

Enclosures

ERIC

Exhibit 4. POC packet (continued)

Instructions for Implementing this Project

YEE SELECTION TABLE:

: Employee Selection Table contains a list of occupational titles and unique identification numbers. It also contains a column titled "Random Start." This will help with the selection process discussed below. The table is intended to help you keep track of whom you selected to participate, when you distributed questionnaires and when each employee returned them. This table is for your use only and should not be sent back to Westat. If your table lists an occupation more than once, please select as many employees in that occupation as listed. As you select employees for participation, please write his or her name in the space adjacent to his or her occupation.

'ING EMPLOYEES:

ase refer to the list of occupations in the Employee Selection Table to be studied and the number of employees in each occupation. For some occupations, the number of employees needed may be less than the total number of full-time employees currently working in that occupation at your location. If this is the case, a ***sample*** of employees in those occupations must be drawn to ensure a complete range of responses. Please use the procedure outlined below to sample employees.

Sampling -

1. Generate and number an alphabetical list of all employees who work in the first occupation listed on the Employee Selection Table at your location.
2. Divide the total number of employees in that occupation by the number of times that occupation appears on the table. Round the result **down** to the nearest whole number. This will be your *"sampling interval"*. If the sampling interval is equal to 1, please distribute one packet to each of the employees in that occupation and skip to step 5. If not, go to step 3.
3. The first employee you select should be the first person whose *last name* starts with the letter that appears under the column **Random Start**. If no employee's last name starts with that letter, begin with the employee whose last name starts with the next closest letter.
4. Count down the list the number indicated by your sampling interval to select the next employee. Continue selecting employees down the list, returning to the top if necessary, until you have the needed number in that occupation.
5. Write each selected employee's name under the column **Employee Name** next to their occupation on the Employee Selection Table.
6. Repeat steps 1 - 5 for each occupation on the list.

An example of how this technique works appears on the following page.

Example for: Marine World, Inc.

Employee Selection Table

Occupation	Random Start	ID Number	Employee Name	Date Distributed	Date Returned
#1 Marine Biologist	J	0999111			
#2 Marine Biologist	J	0999112			
#3 Marine Biologist	J	0999113			

- The POC generated and numbered an alphabetical list of full-time Marine Biologists at her location. The POC has 17 Marine Biologists at her location.

Marine Biologists at Marine World, Inc.

1. Mary Arnold
2. Jim Brown
3. Philip Cohen[3]
4. Nancy Delgato
5. Lisa Eaton
6. Paul Fisher
7. Sarah Graham
8. Dwayne Howerton
9. Jack Innes
10. Greg Long[1]
11. Anita Myer
12. Paula Norville
13. Wilma Persley
14. Michael Reeder
15. Rhonda Spear[2]
16. Mark Trent
17. John Van Mead

- She divided her 17 Marine Biologists by 3 (the number of times the occupation was listed on the Employee Selection Table) and got 5.6. She rounded down to 5 (the lower whole number). This was her "sampling interval".
- "Random Start" told her that she should start selecting employees with the person whose last name began with "J". Since there were no "J's" on the list and Greg Long was the next name, she started numbering with him.
- She went down the list, marking every 5th employee until she had 3 employees numbered.
- She wrote in selected employees' names next to the ID Number on the table.
  1) She wrote Greg Long's name next to ID Number 0999111.
  2) She wrote Rhonda Spear's name next to ID Number 0999112.
  3) She wrote Philip Cohen's name next to ID Number 0999113.
- She checked to see if there was another occupation listed for which she needed to select employees. In this case there wasn't one.

Selecting Replacements -

If one of the employees you select:
- has been in his or her job for **less than six months**; or
- is not currently working at your location because of vacation, leave, etc.; or
- can not participate for some other reason, please select a replacement.

Then:

Select the person whose name appears on the list immediately following the person who can not participate. In the previous example, Nancy Delgato would fill in for Philip Cohen if he could not participate.

JRAGING PARTICIPATION:

We realize that supervisors and other management personnel within your organization may need to know why their employees are participating in this study. For this reason we have enclosed the Management Information Sheet that describes your organization's involvement with this project and an O*NET Fact Sheet that gives a complete overview of the O*NET project. Also, we have included a sample Cover Memo to Employees that you can send to employees with their questionnaire packets to encourage their participation.

DISTRIBUTING QUESTIONNAIRE PACKETS:

Each questionnaire packet is different and is intended to be tailored to individual occupations. ID Numbers from the Employee Selection Table should correspond to the ID Number printed on the label of each envelope. This number will help you keep track of each packet as employees return them.

- Please match the ID Number on the Employee Selection Table to the ID Number printed on the label on each questionnaire packet.
- Distribute the packet with the corresponding ID Number to each participating employee within one week.
- Instruct all participants to complete their questionnaire packets and return them to <u>you</u> within two weeks.
- Record the date you distributed each packet on the Employee Selection Table.

ERIC

Exhibit 4. POC packet (continued)

RETURNING COMPLETED PACKETS TO WESTAT:

- Employees should return packets to you in sealed envelopes. They should not send their own questionnaires in to Westat.
- Make sure each employee signed your company name across the seal of the envelope to ensure confidentiality of their answers.
- Record the date each packet was returned on the Employee Selection Table.
- Compile returned packets for one week and use one of the business reply envelopes addressed to Westat to mail these to Westat.
- At the end of the second week, use another business reply envelope addressed to Westat to mail the packets that have been returned to you during the second week.
- If you still have outstanding packets after two weeks, please remind the employees to complete the packets within a week.
- At the end of the third week, use a final business reply envelope to return the last of the employee packets to Westat.
- **Keep the Employee Selection Table for your records. Please do not send this back to Westat.**

A Westat representative will call you in about a week to see if you need any help with data collection. If you have any questions before then, please call the Westat Project Coordinator, Katy Erickson, at 1-800-937-8281 ext. 4454. Alternatively, if you have access to electronic mail through the Internet, you may contact Ms. Erickson at ONET@Westat.com. Thanks again for your assistance with our data collection efforts. Many people across the U.S. will benefit from the development of this new Occupational Information Network.

ERIC

Exhibit 4. POC packet (continued)

TABLE 1

OCCUPATIONS SELECTED AND NUMBER OF EMPLOYEES NEEDED

Occupation	Random Start	Packet ID#	Employee Name	Date Distributed	Date Returned
#1					
#2					
#3					
#4					
#5					
#6					
#7					
#8					
#9					
#10					
#11					
#12					
#13					
#14					
#15					
#16					
#17					
#18					
#19					
#20					

Potential Communication Tools for the Project's Point of Contact

To help make your role as Point of Contact easier, we have developed some tools that you can use for communicating to your organization about the O*NET project.

Management Information Sheet. You may find it helpful to spread the word among department managers and employees about this project. The attached sample Management Information Sheet, entitled "Important Information about a Nationwide Department of Labor Project" is one way to do so. Here are some possible ways to use it:

- Simply fill in your name and extension in the blanks on the bottom of the page. Copy it onto your organization's letterhead.

  (If you prefer, retype this Management Information Sheet, substituting your organization's name wherever the words "our organization" appears. Copy it onto your organization's letterhead.)

- Post the Management Information Sheet on bulletin boards throughout your facility.

- Post it or have copies available in employee kitchens, the cafeteria, or the mailroom. Consider inserting it into employees' mailboxes.

- Consider reformatting it and turning it into a memo to department heads. Have it come from yourself, as the project's Point of Contact, or perhaps another executive in your organization.

- If a newsletter publication date is approaching soon, consider submitting it for inclusion in your organization's newsletter.

Cover Memo to Employees. We also have another tool you can use if interested: a sample cover memo to send to employees with their questionnaires. This memo serves to introduce the project to them, identify you as the Point of Contact for your organization, and highlight key points about the project and the employee's participation. Attached please find a sample memo you might like to use for this purpose.

Simply fill in information such as your name and date in all the blanks provided, and then copy and distribute the memo. If you prefer, retype it, substituting your organization's name wherever the words "our organization" appears.

O*NET Fact Sheet. This fact sheet describes the O*NET project. Please feel free to copy and distribute it, or call us to request additional copies.

If you have questions about any of these materials or their suggested uses, please call the Westat Project Coordinator, Katy Erickson, at 1-800-937-8281, x4454.

<u>Important Information about a Nationwide Department of Labor Project</u>

Our organization has been selected to participate in a nationwide project, sponsored by the U.S. Department of Labor and supported by several companies from private industry and state government organizations, to develop an easy-to-use occupational database called O*NET, the Occupational Information Network.

O*NET will become the nation's primary source of occupational information. It will be a comprehensive database that provides important information about occupations, worker skills, and training requirements.

O*NET will help employers like us find the right people for jobs within our organization, and it will help our employees meet their career development needs.

The O*NET project team is gathering occupational data that will provide the foundation of O*NET. They have asked us to participate in this project, and we have agreed to do so. We are providing information about some of the occupations within our organization.

It is necessary for some of our employees to complete questionnaires about their jobs. These employees have been randomly selected to participate, so no one person or group will be singled out. If someone in your workgroup has been chosen to participate, please allow time in his or her workday to complete their questionnaires.

Here are some important facts about our involvement in this project:

- Employees' responses are completely **confidential**. The data collected will be used for research purposes only. No information about any individual or organization will be released to anyone outside the O*NET project team.
- The questionnaires do <u>not</u> ask employees for any information about their supervisors or other individuals in our organization.
- No sensitive or confidential information is asked.
- The questionnaires take from 60 to 90 minutes to complete.
- A report containing summary information about this project will be published early next year.

If you would like to learn more about this project or our organization's participation in it, please call ______________________________ at ______________________.

Thank you for your support on this important project!

ERIC

MEMORANDUM

TO: Project Participant

FROM: ____________________

DATE: ____________________

SUBJECT: Participation in U.S. Department of Labor Occupational Research Project

---

Our organization has been selected to participate in a nationwide project, sponsored by the U.S. Department of Labor and supported by several companies from private industry and state government organizations, to develop an easy-to-use occupational database called O*NET, the Occupational Information Network.

O*NET will become the nation's primary source of occupational information. It will be a comprehensive database that provides important information about occupations, worker skills, and training requirements. O*NET will help employers like us find the right people for jobs within our organization, and it will help our employees like yourself meet their career development needs.

The O*NET project team is gathering occupational data that will provide the foundation of O*NET. They have asked us to participate in this project, and we have agreed to do so. We are providing information about some of the occupations within our organization.

A scientific, random sample of employees in organizations across the country has been selected to participate in this project. You have been selected to be one of the participants. Your role is to provide key information about the kind of work you do by completing the attached questionnaires.

I am the designated "Point of Contact" for our organization for this project. My role is to distribute to and collect questionnaires from our employees who are participating in the project.

Attached please find your questionnaires. It describes the O*NET project and includes a set of Job Analysis Questionnaires for you to complete and return to me. The questionnaires ask you to provide information about your occupation. The questionnaires should take about 60 to 90 minutes to complete. Please look the questionnaires over right away and at earliest opportunity complete them and return them to me by ________________.

Finally, I want to stress that all the information you provide will be **confidential**. It won't be viewed by your supervisor, company management, or any other employee for any purpose. The information you provide is for research purposes only.

If you would like to learn more about this project or have questions about your participation, please call me at ________________________.

Thank you for your support on this important project!

Exhibit 4. POC packet (continued)

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Exhibit 5. Incumbent packet

October, 1995

Dear Project Participant:

You are being asked to participate in a very important nationwide project. A team of public and private sector organizations, sponsored by the U.S. Department of Labor, is developing an easy-to-use occupational database called O*NET, the Occupational Information Network. The database will help *millions* of employees like yourself, employers, educators, and students make informed decisions about careers, training, education, and work.

O*NET will assist individuals in identifying the right skills and training needed to achieve their career goals. O*NET will also assist employers in selecting, training, and placing qualified people in jobs. O*NET will equip you with the knowledge and informational tools necessary to compete and succeed in today's competitive economy.

We are contacting organizations nationwide and asking employees like yourself to provide key information about the type of work they do. The data you are being asked to provide will become the foundation of O*NET. Although your participation is completely voluntary, we are counting on your support. Ultimately the successful development of O*NET depends upon your responses to the questions being asked regarding jobs and the skill and training requirements necessary to perform those jobs.

Your responses will remain completely **confidential**. The information you provide will be used for research purposes only. Data will be used to describe occupations, not specific jobs or the people performing them. Your answers will <u>not</u> be seen by anyone in your organization and will <u>not</u> affect your employment within your organization in any way. No individual or company will be identified in any statistical summary that is released or published.

Thank you for your support. Without your help, the development of O*NET would not be possible!

Sincerely,

Norman D. Peterson

Norman Peterson
Project Director, O*NET Project Team
American Institutes for Research

P.S. Attached is an information sheet which lists the contents of this package and explains how easy it is to participate in this important nationwide project.

Enclosures

Exhibit 5. Incumbent packet

IMPORTANT INFORMATION FOR PROJECT PARTICIPANTS

This Package Contains the Following Materials:

- Letter from the O*NET project team - This letter was sent to the person in your organization who is serving as the "Point of Contact" between the O*NET team and employees like yourself. This person has already agreed to support your participation in this project.

- O*NET Fact Sheet - This fact sheet describes O*NET, the Occupational Information Network, and the project in which you are being asked to participate.

- Job Analysis Questionnaires - These questionnaires ask you to provide background information and to answer questions about various aspects of your occupation.

- Envelope with your Point of Contact's name on it - Please use the *same* envelope in which you received your questionnaires to return completed questionnaires to your Point of Contact.

Here's How Simple It Is To Participate in this Worthwhile Project!

The enclosed questionnaires ask you to provide valuable information about your occupation. The entire process should take you about 60 to 90 minutes.

All you need to do is follow these 3 easy steps...

(1) Read the instructions for each questionnaire and answer each question. Complete the questionnaires within 2 weeks.

(2) Place the completed questionnaires in the O*NET envelope and seal it. Sign your company name across the sealed flap of the envelope to ensure that your envelope will remain unopened until it reaches Westat, the research company evaluating the data.

(3) Return the sealed envelope to your Point of Contact.

If you have any questions or are missing any of the package materials, please call the Westat Project Coordinator, Katy Erickson, at 1-800-937-8281, x4454.

Thank You for Your Help!

Exhibit 5. Incumbent packet

September 5, 1996

Dear Employer,

On behalf of the U.S. Department of Labor, we request your assistance in an important nationwide research project to develop a powerful occupational database called O*NET, the Occupational Information Network.

O*NET will become the nation's primary source of occupational information. It will be a comprehensive database that provides important information about occupations, worker skills, and training requirements. Essentially, O*NET will help employers find the right people and people find the right jobs.

O*NET is being developed by the O*NET project team, which consists of the Department of Labor, American Institutes for Research, and several other private and public sector organizations. The enclosed Fact Sheet gives you more specific information about the O*NET project.

Your organization, along with many other small, mid-sized, and large businesses across the United States, has been selected to participate in this important research project by a scientific and random process. In a recent telephone call to your organization, you were identified as the person most knowledgeable about occupational information within your organization.

A member of the O*NET project team will call you within the next two weeks to discuss the details of this research project. Subsequently, an interviewer from Westat Inc., the company responsible for gathering the occupational data for this project, will contact you to ask some questions about your organization. The final phase of the project involves collecting job analysis occupational information from a sample of employees in your organization. All the information that you and your organization's employees provide will be completely confidential and will only be used in composite form with the information obtained from other companies. No individual person or company will be analyzed or reported in any way.

While participation is completely voluntary, we strongly urge your assistance in this important project. Your help provides the building blocks needed to develop the O*NET database, so that people like you can use and benefit from this timely database of occupational information.

If you have any questions about this project, please contact the Westat Project Coordinator, Katy Erickson, at 1-800-937-8281, x4454. Alternately, if you have access to electronic mail through the Internet, you may contact Ms. Erickson at ONET@Westat.com.

Thank you in advance for your help on this important project. Employers and employees across the United States will benefit as a result of your participation.

Sincerely,

Norman D. Peterson

Norman Peterson
Project Director, O*NET Project Team
American Institutes for Research

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Exhibit 6. Follow-up interview (continued)

Q4. Did you distribute the assigned questionnaire packets or {disks} to all of the employees that you selected in each occupation?

YES (All) 1 (Q5)
NO (Not All) 2 (Q4a)

Q4a. Please refer to the list of selected occupations that we sent to you. How many employees out of the requested number in each occupation listed did not receive a questionnaire packet or {disk}? ____________________

[R MAY REFER TO PACKET ID#, IF SO, PLEASE WRITE IT DOWN - TRY TO GET OCCUPATION ALSO]

Exhibit 6. Follow-up interview

[REFER TO OCCUPATION LIST. ASK TO SPEAK WITH POC (FOUND ON RIS). IF POC NO LONGER THERE ASK FOR PERSON IN CHARGE OF HIS/HER JOB]

***NOTE: Interviewers will be provided a list of the occupations and number of employees requested from each organization. This can be used to determine if all survey packets are complete.*

Hello, my name is ____________________, calling from Westat about the employee survey that you are coordinating for the U.S. Department of Labor. I am calling to check on the status of the employee questionnaire packets or {disks} and to see if you have any questions. You may need to refer to you copy of table 1 for this discussion.

(NOTE: IF THERE IS ANY QUESTION THAT YOU CANNOT ANSWER, TELL THE RESPONDENT TO CALL KATY ERICKSON OR ANGIE RASMUSSEN AT 1-800-937-8281. TRY TO GET ANSWERS TO ALL QUESTIONS FIRST)

Q1. Did you receive the package of survey materials from Westat?

YES.. 1 (Q2)
NO .... 2 (P-MAILOUT)

Q2. Were you able to randomly select the requested number of employees in each occupation?

YES 1 (Q3)
NO 2 (Q2a)

Exhibit 6. Follow-up interview (continued)

Q2a. What kinds of problems did you have with random selection? [ALSO READ P-SLCTN AFTER RECORDING RESPONSES TO Q2a]

1. One or more selected employee(s) was unavailable, but I still used random selection (Q3)
2. My organization did not have as many employees in the occupation as was needed, so I selected all employees in that occupation (Q3)
3. Didn't feel like doing random selection (Q2b)
4. Have too many employees to do random selection (Q2b)
5. The process was too confusing (Q2b)
6. Other (Specify): (Q2b)

____

____

____

____

P-SLCTN I may ask one of my supervisors to call you in regard to your difficulties with the selection process so that we might get some information that will help us to improve the process for future data collection. Let's go on.

Q2b. If you were not able to use random selection, did you distribute the survey packets or {disks} to the requested number of employees in each occupation listed anyway?

YES.. 1 (Q3)
NO 2 (Q2c)
I USED RANDOM SELECTION 3 (Q3)

Q2c. Did you select any employees to participate in the study?

YES 1 (Q3)
NO .... 2 (P-NOEES)

Q3. How many employees did you select altogether?

____________________ employees selected total (Q4)

NONE (P-NOEES)

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Exhibit 6. Follow-up interview (continued)

Q4b. Why didn't these employees receive questionnaire packets or {disks}?

OCCUPATION	NUMBER UNDISTRIBUTED	REASON

Exhibit 6. Follow-up interview (continued)

Q5. According to your copy of Table 1, how many employees have returned questionnaire packets or {disks} to you?

_________________ returned packets (Q6)
None .... (CLOSE2)

Q6. How many employees have not returned their packets or {disks} to you?

_________________ outstanding packets (CLOSE2)
None (Have all packets) .... (Q7)

Q7. Have you mailed the packets or {disks} back to Westat?

YES 1 (CLOSE1)
NO 2 (CLOSE1)

P-MAILOUT: I will check with our survey distribution staff to find out why you did not receive a package. You should be receiving a package within the next week. We will call you again in a couple of days to see how things are going. Thanks! (END CALL)

P-NOEES: Have supervisor call them back. (END CALL)

CLOSE1: Great! The U.S. Department of Labor really appreciates your assistance with this important project. I am looking forward to receiving the employee surveys from you in the mail shortly. Thanks again. (Q8)

CLOSE2: As soon as you receive all of the surveys from your employees, please send them to Westat in the business reply envelope that we sent you. I am looking forward to receiving the employee surveys from you in the mail shortly. I want to thank you again on behalf of the U.S. Department of Labor for all of your help with this important project. (Q8)

Exhibit 6. Follow-up interview (continued)

Q8. Do you have any other questions?

YES 1
NO .... 2 (end call)

(RECORD AND CODE QUESTION) [IF CAN'T ANSWER, GO TO SUPVSR]

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____

SUPVSR I do not have the resources to answer your specific question. I will ask someone on the project supervision staff to call you with more information. Or, if you like, you can call Katy Erickson or Angie Rasmussen directly at 1-800-937-8281. (END CALL)

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