Spring 1995

Demonstration of a Method for the Development of a Team Classification System

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A Dissertation submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirement for the Degree of

DOCTOR OF PHILOSOPHY

INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY

OLD DOMINION UNIVERSITY
March, 1995

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ABSTRACT

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DEVELOPMENT OF A TEAM CLASSIFICATION SYSTEM

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The purpose of this research was to demonstrate an approach to developing a system for classifying teams. A classification system is important for formulating theories, generating hypotheses, and especially as an aid in generalizing results from one setting to another. Although a number of classifications can be found in the team literature, each was developed in a rational rather than an empirical manner. As an alternative, an empirically derived classification system based on objective, empirical data was considered an improvement. The development of this type of system was the objective of the present study.

The Sundstrom and Altman (1989) classification system formed the basis for the team classification system in the present study. The Sundstrom and Altman system is based on a theoretical framework, includes a distinct set of variables drawn from its underlying theory, is applicable to a wide variety of teams and work groups, and has relevance for both research and practical purposes. The Sundstrom and Altman taxonomy suggests that there are four classes of work groups, based on the characteristics of integration and differentiation, and that each will display different requirements for environmental support. Hypotheses

pertaining to the expected categories were developed and tested.

Previous team research has identified seven team behavioral attributes that are assumed to underlie team performance in diverse settings. In the present study, information on these attributes was collected from a variety of teams in order to delineate how teams in the Sundstrom and Altman classification system differ with respect to team behavior.

An interview was developed and used to collect information on 91 teams. Cluster analysis procedures, specifically, a method referred to as Ward's minimum variance method, was used to develop the clusters. The study incorporated a modified sequential validation design to evaluate the resulting team classification system.

The results indicated six clusters or "types" of teams that shared many of the characteristics as the four classes identified in the Sundstrom and Altman system. Differences among clusters were identified in two areas of environmental demands, specifically, interaction demands and role differentiation demands. Differences among clusters also were indicated in the behavioral dimension of monitoring.

Practical and theoretical implications of the findings and future research suggestions are discussed.

ACKNOWLEDGEMENTS

Completion of this dissertation would not have been possible without the support of a number of individuals.

First, I would like to thank the members of my committee. Dr. Bob McIntyre, who served as chairperson of the committee, was available with guidance, support, and encouragement whenever they were needed. Dr. Major consistently expressed interest in this project and has provided many valuable suggestions. Dr. Anna Marie Valerio was kind enough to serve on this committee despite her very full schedule. Since I first met Anna Marie during my internship, she has been a wonderful role model and has always been available with support, understanding and encouragement. Finally, I owe a special thanks to Dr. Coates for writing the program I needed for the data analysis. Without his help and occasional prodding I would still be struggling.

A special thanks also goes to Dr. Glickman who interrupted his retirement to look over the interview. His insights and suggestions were invaluable.

I would be remiss if I did not thank my friends and colleagues for their support. In particular, I owe a debt of gratitude to Brian Ruggeberg for his continual help and support throughout not just this project, but our entire graduate education. Lori Bartels was always available with

an encouraging word just when I needed it most. I would not have made it without their friendship.

Throughout my graduate program, my cousins Patricia and Allen Shogren have provided me not just with support and encouragement, but with an escape and a second home whenever it was needed. I can never thank them enough.

Finally, and most importantly, I need to thank my mother. She has provided more support, encouragement, and love than I probably deserve. I will never be able to repay her for all that she has given me. I truly thank God that I was fortunate enough to have her in my life.

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CHAPTER ONE

INTRODUCTION

The purpose of this research was to demonstrate an approach to developing a system for classifying teams. A classification system is important for formulating theories, generating hypotheses, and especially as an aid in generalizing results from one setting to another. In the course of this research, empirical data were collected on a number of variables relating to teams and work groups in a variety of organizations and used to develop and validate a team taxonomy.

Existing Team Research

Work groups and teams have become a critical component of many organizations. While teams have always been a part of the military, more recently they have emerged in settings as diverse as medical, educational, business, and industrial organizations. Fueled by technological advancements, global competition, and world events, teams are seen as the best, if not only, response to problems and tasks too demanding to be tackled by isolated individuals (Modrick, 1986; Salas, Dickinson, Converse, & Tannenbaum, 1992).

One of the major problems cited in the area of team research has been defining "team" (Dyer, 1984). Although Dyer (1984) stated that there is no accepted definition of

team, examination of the proposed definitions indicates that they do not differ considerably from one another.

For example, according to Morgan, Glickman, Woodard, Blaiwes, and Salas (1986), a team is two or more individuals interacting interdependently and adaptively to achieve a specified, shared and valued objective. Ilgen, Major, Hollenbeck, and Sego (1993) used the same basic definition with the exception that the requisite number of members is three rather than two. They excluded dyads from their definition, arguing that such two-person teams differ significantly from larger collectives. Specifically, constructs such as intra-team subgroup relationships, coalition formation, and leader-member relations have no relevance for dyads.

Dyer (1984) defined a team as at least two people working towards a common goal, where each person has been assigned specific roles or functions to perform and where attainment of the goal requires some form of dependency among members. Larson and LaFasto (1989) defined a team as two or more people who must coordinate activity among members in order to achieve a specific performance objective. Whereas Dyer emphasized specificity of roles, Larson and LaFasto emphasized specificity of goals.

In contrast, Klaus and Glaser (1960) and Freeberg and Rock (1987) emphasized a formal or rigid structure as well as specialized member roles or functions. According to Klaus and Glaser, a team has a relatively rigid structure,

designated positions and assignments, and a high degree of specialization and coordination among members. Freeberg and Rock characterize a team as having a goal orientation, a formal structure, interdependence among members, and specialized roles.

An even greater contrast is evident in Sundstrom, De Meuse, and Futrell's (1990) conceptualization of a team, which they define as a small group of interdependent individuals sharing responsibilities for their organization's outcomes. This definition does not specify the number of members comprising a team or the need for role specifications or team structure, thereby minimizing the distinctions between a group and a team.

Because the word team so often is applied indiscriminately, it becomes necessary to specify precisely what the word means. One common way of explaining the definition of team is through the question -- when is a group a team? For the purposes of this research, a team was defined as a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal, objective, or mission, and who each have been assigned specific roles or functions to perform (Salas et al., 1992). This definition was derived through an extensive review of the available literature and represents the key characteristics that have been used to define teams in past research. It recognizes that for a group to qualify as a team, interdependency must exist among

members, coordination must be required to accomplish the team's goals, and some type of structure must be provided through role assignment. Although a distinction can be made between team and group, for the present purposes the terms team and work group will be used to refer to entities possessing the definition's characteristics cited above and, therefore, will be used interchangeably.

Numerous reviews are available covering over 50 years of team research (Denson, 1981; Dyer, 1984; Freeberg & Rock, 1987; Goodman, Ravlin, & Argote, 1986; Hackman & Morris, 1975; Ilgen et al., 1993; Nieva, Fleishman, & Rieck, 1978; Salas et al., 1992) yet all cite the lack of conclusive principles or guidelines for designing, training, evaluating, and managing teams and work groups. One of the major limitations of the existing research is its questionable generalizability (McIntyre & Salas, 1995). Generalizability refers to the applicability of research results obtained with teams in one setting to teams in other contexts. Research results are generalizable to the extent that they have value for explaining or predicting performance outcomes across different settings or within a setting across different forms of activities (Goodman et al., 1986). For example, results indicating that increased performance feedback improves coordination of aircrews is generalizable to basketball teams to the extent that both kinds of teams operate under similar performance conditions.

However, it is not clear whether the conditions under which such teams operate are similar.

The applicability of research findings from one sample of teams to another requires that one consider the comparability of context conditions, task demands and performance requirements across settings. Context conditions refer to characteristics of the organization within which the team operates and may include factors such as the availability of team rewards, organizational resources such as support or materials, or environmental variables such as market growth or competition. For example, Gladstein (1984) studied sales teams in the communications industry and discovered that group effectiveness was influenced by external organizational variables such as market growth. While it is obvious that not all teams will be affected by market growth, it is not clear which other external variables might have an impact on the effectiveness of other forms of teams.

Task demands refer to characteristics of the team's task and may include factors such as ambiguity, the availability of feedback, time constraints, or the use of machinery. For example, in a study which involved mining crews, Goodman (1986) determined that technology variables were important in explaining crew productivity. Problems with certain pieces of equipment, such as a continuous miner, had a significantly greater impact on productivity than problems with other forms of equipment, such as a coal

car. Technology variables obviously vary from one team to another, but it is not known which specific technology variables or which other task demand variables might affect other types of teams.

Finally, performance requirements refer to the actions or behaviors necessary to execute the team's task and may involve elements such as communication or coordination needs. For example, research conducted with military tactical teams has enumerated a number of critical teamwork behaviors that determine team effectiveness (Morgan, et al., 1986; Glickman et al., 1987; McIntyre, Morgan, Salas, & Glickman, 1988). In particular, performance monitoring and back-up behavior have been identified as important elements of teamwork performance in tactical decision-making teams (McIntyre et al., 1988). However, it is unclear whether such behavioral components are important to other kinds of teams such as football teams or task forces.

Although context conditions, task demands, and performance requirements can be expected to vary across teams, the exact nature of this variability is unclear. For example, what particular context factors differ among different types of teams? What impact do differences in these factors have on team performance? At the present time, such questions cannot be answered due to a lack of information pertaining to the context conditions, task characteristics, and performance requirements shared by various forms of teams. This type of information would

provide a basis for comparing teams and would facilitate generalizing results from one setting to another.

Sundstrom et al. (1990) suggest that the recurring difficulty in arriving at generalizations from the available team research stems from the fact that the concept of "team" may represent several different types of social units that share only superficial similarities. For example, although task forces may operate in both government agencies and manufacturing plants, they may actually have very little in common other than the same label -- "task force."

One frequently cited approach for resolving the issue of generalizabilty is the development of a team classification system (Dyer, 1984; McGrath, 1986; McIntyre & Salas, 1995; Modrick, 1986; Nieva et al, 1978). Such a system would classify teams and groups with respect to important features and could be used to clarify how the behavior of various types of groups may differ. In a document entitled "1976 Task Force on Training Technology," the development of a taxonomy of teams based on critical attributes was viewed as a necessary "first step" in a systematic research program (Freeberg & Rock, 1987). The taxonomy would establish a framework for systematic research, aid in the selection of teams for research, and clarify the generalizability of team and small group studies (Knerr, Nadler, & Berger, 1980). More recently, Cannon-Bowers, Oser, and Flanagan (1993) highlighted the need for a classification scheme that would allow researchers and

practitioners to identify commonalities among teams and would delineate the most critical factors in the design and effectiveness of a particular team. In addition, Sundstrom et al. (1990) advocated studying the demographics or differentiating characteristics of work groups to determine the prevalence of various work team applications and features of the contexts in which they occur. This is consistent with Myer, Tsui, and Hinings' (1993) suggested "configurational approach" to the study of work groups. Such an approach recognizes that certain combinations of characteristics, or "demographic composites," may be optimal for one group while other combinations are optimal for another.

Collection of demographic or other types of descriptive data can delineate the similarities and differences among different forms of teams with respect to various characteristics. For example, collection of this type of information may indicate that while all task forces operate under time constraints, the behavioral requirements vary according to particular task requirements. The current study attempted to address this issue by collecting information on teams in a variety of settings. This information identifies various attributes common to teams operating in different environments.

Nature and Purpose of Classification

Although the terms classification and taxonomy are often used interchangeably, distinctions can be made between

the two. Classification involves the ordering or arrangement of objects, entities, or phenomena into groups or sets on the basis of their relationships (Sokol, 1974). These relationships can be based on either inferred or observable properties (Sokol, 1974). A taxonomy, in contrast, represents the "theoretical study of classification including its bases, principles, procedures, and rules," (Sokol, 1974, p. 1116). In other words, taxonomy refers to the formal procedures by which the process of classification is conducted in order to obtain a classification system. However, because formal procedures were used to develop the classifications in the present study, the terms classification, categorization, and taxonomy are considered synonymous throughout this document and are used interchangeably.

Classification is considered an integral aspect of all sciences (McGrath, 1986; Sokol, 1974). It is necessary for the scientific activity of theory development (McKelvey, 1975) and serves as an aid in generalizing previous findings to new settings and applications (Pearlman, 1980).

First, classification assists in theory development by providing a framework around which data can be organized. One of the most basic purposes of classification is to describe the structure and relationship of its constituent objects or phenomena to each other and to similar objects or phenomena (Sokol, 1974). The identification of uniformities among phenomena or objects leads to the development of

theories to account for the observed relationships. The attributes on which the objects or phenomena are classified represent the conditions under which hypotheses might be expected to be valid (McKelvey, 1975; Pearlman, 1980). With respect to a team classification system, teams or work groups would be classified in such a way that members of a particular category would share common characteristics. The members of a given category would differ in important ways from members of other categories. This could lead to the generation of theories encompassing all members of a given category of teams.

For example, suppose basketball teams and military tactical teams were to fall within the same class based on similarities in task characteristics. Research pertaining to effective task performance of military tactical teams would be expected to apply to basketball teams as well. Hypotheses to this effect could be generated and tested. If confirmed, a theory of task performance effectiveness could be developed to account for both types of teams. Hypotheses also could be generated as to how the effectiveness of other categories of teams may vary under similar conditions. Subsequent research may indicate that an alternative theory of effectiveness is required to account for another class of teams having different task performance requirements.

Classification also serves as an aid in generalizing previous findings to new settings and applications. Objects or cases are assigned to a common category on the basis of

shared characteristics and therefore can be treated as functionally equivalent entities (Fleishman & Mumford, 1991). Because of such shared characteristics, research conducted with one entity of a category could be expected to apply to other entities of the same category. With respect to a team classification system, all teams or groups within a particular category would possess similar characteristics. Research results that apply to one case within that category could be expected to generalize to other cases within that same class.

For example, suppose military teams and production groups were to fall within the same class on the basis of shared behavioral requirements. Research aimed at training teamwork behaviors in military teams would be expected to have some application to production groups as well.

Summary. Team research has evolved to a point where a better understanding of how observations of one "type" of team can be applied to others is essential for further progress (McIntyre & Salas, 1995). The development of a classification system in which teams and work groups are categorized on the basis of shared characteristics would be a useful contribution to the area of team research. Such a system would assist in theory development and would serve as an aid in generalizing previous findings to new settings and applications. Therefore, a major purpose of the present study was to demonstrate an approach to developing a team taxonomy.

Team Attributes and Team Classifications

In any classification effort, certain basic issues arise involving the determination of the objectives, content, and method of classification. These basic issues represent the "why, what, and how of classification" (Pearlman, 1980). Within the classification system, objects or entities are sorted into categories representing different "classes" or "types." Members of a particular class share common attributes with each other, but differ in important ways from members of other classes. The objects are classified on the basis of the attributes they possess. Therefore, in order for a classification system to be useful, the attributes on which objects are classified must be appropriate to the system's intended purpose.

In a team classification system, teams and work groups would be classified into various types. One of the first questions that must be addressed in developing a team classification system is -- on what attributes should teams be classified? One way of approaching this issue is to consider classes of attributes that can be used to describe all teams. This set of attributes will provide a common basis for comparing one team with another. The attribute classes consist of specific variables along which teams differ. This variability is important since without it there is no need for a classification system. For example, because all teams are composed of individual members, a class of attributes pertaining to member composition can be

used to describe all teams. This class of attributes would be composed of specific variables such as "skill variety" and "skill interchangeability" on which specific teams can be expected to differ. Based on this class of attributes, teams would be classified according to their degree of skill variety and skill interchangeability.

A second consideration in the selection of team attributes pertains to the purpose of the classification system. Different sets of attributes will be needed for different purposes. For example, a system that was intended for identifying training requirements across teams would be based on different attributes than one that was developed for identifying appropriate organizational interventions to improve team performance. A system for identifying training requirements across teams might consist of a set of attributes pertaining to team performance requirements or task characteristics. In contrast, a classification system for identifying organizational interventions to improve team performance would need to include attributes pertaining to the organizational contexts in which teams operate.

Examination of the literature indicates a number of attribute domains that have been used to describe teams and work groups. These include attributes pertaining to composition, context, authority structure, level of autonomy, timetable or temporal factors, task characteristics, and process requirements. Table 1 contains a list of the most commonly cited variables pertaining to

these attribute sets, a brief description of each variable, and a list of references referring to each variable. The list is not intended to be exhaustive, but rather is meant to illustrate the range of attributes along which teams might be classified.

Various combinations of the attributes discussed above have been used in previous attempts at classifying teams and work groups. These attempts include systems developed by Hackman (1990), Larson and LaFasto (1989), McGrath (1984), and Sundstrom and Altman (1989). The systems differ with respect to the purpose for which the system was developed, the attributes included, the number of categories, and finally, the teams comprising the categories themselves (see Table 2).

As Table 2 illustrates, a particular team might fall within a different category depending on the attributes considered. For example, air or cockpit crews are a type of production team in both the Hackman and Sundstrom and Altman systems but are considered a type of creative team under the Larson and LaFasto system. Within each system, however, teams within a given category can be considered comparable to each other. Consequently, within the Sundstrom and Altman system, cockpit crews, sports teams, entertainment groups, expeditions, and military teams are comparable

Table 1

Attributes Used to Describe Teams

Attribute Domains	Variables	Description
Composition	Skill variety	Degree to which members possess the same set of skills (i.e., whether skills are homogeneous/heterogenous within the team) (Hackman, 1990; Tannenbaum, Beard, & Salas, 1992)
	Skill uniqueness	Degree to which skills of team members are common within the organization and easily replaced (Hackman, 1990)
	Role exchangeability	Degree to which members may exchange roles as necessary (i.e., whether roles are fixed/exchangeable) (Tannenbaum et al., 1992)
Team Context	Boundary differentiation	Degree to which team boundaries are easily defined making it easy to distinguish between members and nonmembers (Ancona, 1987; Hackman, 1990; Sundstrom & Altman, 1989)
	Lateral dependency	Degree to which team must work with other groups to accomplish team task (Brett & Rognes, 1986)
Authority Structure	Dispersion of responsibility	Degree to which leadership responsibility is dispersed throughout the group rather than residing with single individual (Hackman, 1990)
	Leadership determination	Degree to which team members have a say in who holds the leadership position (Hackman, 1990)
Level of Autonomy	Decision-making opportunity	Degree to which team can make decisions affecting team or accomplishment of team task (Hackman, 1990)
Timetable	Temporal scope	Life span of team (i.e., ongoing/disbands after single activity cycle) (Hackman, 1990; McGrath, 1984; Sundstrom & Altman, 1989)
	Activity cycle	Whether team engages in sequential cycle where tasks are performed one at a time in given order/simultaneous cycle where a number of tasks occur at same time (Hackman, 1990)

Table 1, continued

	Time allocation	Proportion of members' time allocated to working on team task (Hackman, 1990; McGrath, 1984; Sundstrom & Altman, 1989)
Team Task	Communication structure	Pattern of communication required among team members to complete team task (Naylor & Dickinson, 1969; Nieva et al., 1979)
	Complexity	Information-processing and/or memory storage requirements of team task (Freeberg & Rock, 1987; Herold, 1978; Naylor & Dickinson, 1969)
	Task type	What the team actually does (i.e., generating plans or ideas, solving problems, making decisions, negotiating, resolving conflicts, executing planned actions or performances) (Hackman, 1990; McGrath, 1984)
	Standardization/ predictability	Degree to which all task conditions are identifiable, outcomes are predictable and solutions are available (Boguslaw & Porter, 1962; Herold, 1978)
	Technical demands	Availability or programmability of materials, solutions, or data needed to accomplish task (Herold, 1978)
	Social demands	Degree to which group's product is shaped and determined by the nature of the interaction process (Herold, 1978)
Process Requirements	Team orientation	Processes by which information needed to accomplish team's task are generated and distributed to members (Nieva et al., 1978); nature of the attitudes team members have toward one another, team task, and leadership (Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986)
	Resource distribution	Processes by which decisions are made regarding assignment of members to their particular responsibilities (Cooper et al., 1984; Nieva et al., 1978; Shiflett et al., 1982)
	Timing/activity pacing	Processes by which team activities and resources are organized to ensure task completed in allocated time (Cooper et al., 1984; Nieva et al., 1978; Shiflett et al., 1982)

Table 1, continued

Response coordination	Execution of team activities such that members respond as a function of the behavior of others (Cooper et al., 1984; Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986; Nieva et al., 1978; Shiflett et al., 1982)
Team motivation	Process through which team task objectives are defined and group is energized to achieve objectives (Nieva et al., 1978)
Systems monitoring	Detection of errors in nature and timing of ongoing activities (Cooper et al., 1984; Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986; Nieva et al., 1978; Shiflett et al., 1982)
Procedure monitoring	Monitoring behavior to ensure compliance with established performance standards (Cooper et al., 1984; Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986; Nieva et al., 1978; Shiflett et al., 1982)
Communication	Active exchange of information among two or more team members (Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986)
Team Leadership	Direction and structure provided by formal leaders as well as by other members (Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986)
Feedback	Giving, seeking, and receiving of performance information among team members (Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986)
Backup behavior	Assisting other members to perform their tasks (Dickinson et al., 1992; McIntyre et al., 1989; Morgan et al., 1986)

whereas in the Larson and LaFasto system, aircrews, R&D teams, project teams, and theater and performance groups are similar. None of the classifications are inherently right or wrong. In fact, each system is likely to possess utility for its stated purpose. However, each system also has certain limitations. This is best illustrated through an examination of the strengths and weaknesses of each of the classification systems identified in Table 2.

Hackman's (1990) categorization of teams is based on numerous case studies conducted with a variety of teams and work groups. The team attributes included in the data collection efforts were drawn from earlier work in job design and team effectiveness (Hackman, 1986; Hackman & Oldham, 1980). Although information pertaining to numerous attribute domains was collected, it was not used to compare teams systematically. Instead, the categories were developed on a rational basis for the purpose of organizing and presenting a large amount of information. Consequently, it is not clear what the teams within a given category have in common nor how they differ from teams in other categories. In other words, it is not apparent on what attributes the categories are based. This makes it difficult to incorporate new teams into the specified types. For example, under what category would one place surgical teams or nuclear submarine crews?

Table 2

Existing Team Classifications

Author	Purpose	Attributes	Categories	Examples
Hackman, 1990	Ease of presentation	Skill variety Skill uniqueness Level of autonomy Boundary differentiation Lateral dependency Technical demands Social demands Activity cycle Temporal scope Time allocation Dispersion of responsibility Leadership determination Task type	1.Top-management teams/ decision-making teams 2.Task forces/ problem solving teams 3.Professional support teams 4.Performance teams 5.Human service teams 6.Customer service teams 7.Production teams	Top-management teams Task forces System support groups Airline maintenance crews String quartets Theater companies Basketball teams Prison rehabilitation teams Mental health treatment teams Sales delivery teams Flight attendant teams Cockpit crews Manufacturing/assembly teams
Larson & LaFasto, 1989	To determine how team should be structured with respect to leadership and communication	Task objective	1.Problem resolution teams 2.Creative teams 3.Tactical teams	Community action teams Investigative teams Executive management teams Government teams R&D teams Project teams Air crews Theater/performance groups Military teams Surgical teams Sports teams Expedition teams

Table 2, continued

McGrath, 1984	To organize existing small group literature	Task type (i.e. degree of artificiality) Temporal scope Activity scope	Natural groups 1.Total embedding systems 2.Expeditions 3.Standing crews 4.Task forces Concocted groups 1.Groups engaged in practice games & training problems 2.Crew tests 3.System tests 4.Mock studies 5.Ad hoc laboratory groups with artificial tasks Quasi-groups 1.Restricted communication process studies 2.Structured communication channels studies 3.Highly stylized constrained task & communication studies 4.Structured task & restricted communication studies 5.Structured task studies	Families Space ship crews Exploratory expeditions Nuclear submarine crews Athletic teams Work crews Standing committees Government commissions Industrial/military task forces Academic ad hoc committees

Table 2, continued

Sundstrom & Altman, 1989	To identify physical facilities that could be used to facilitate team's task accomplishment	Specialization Activity scope Temporal scope Frequency of external interactions Standardization External pacing Coordination demands with outside groups Work cycles	1.Advice/involvement groups	Committees Quality circles Employee involvement groups Task forces Focus groups Review panels/boards Advisory councils
			2.Production/service groups	Assembly teams Mining teams Flight attendant crews Data processing groups Production teams Maintenance crews
			3.Research, design & planning groups	Research teams Architect teams Engineering project teams Product development teams Planning commissions
			4.Action/negotiation groups	Sports teams Entertainment groups Expeditions Negotiating teams Cockpit crews Surgical teams

The Larson and LaFasto (1989) system was developed as a result of working with teams to improve their communication and feedback processes. Although data were collected systematically, the categories were developed on a rational basis. A single attribute, specifically, the team's objective at the broadest level, serves as the basis for defining the three types of teams. In other words, what is the expected result of the team's collective effort? According to Larson and LaFasto, the team's objective drives the process that should be emphasized and the personal qualities that members should possess. For example, teams having the objective of resolving problems should focus on issues (process emphasis) and should select members who are intelligent, people sensitive, and have high integrity (Larson & LaFasto, 1989).

Because McGrath (1984) developed his classification system to organize the existing small group literature, he emphasizes attributes relevant to research purposes. Specifically, he considers aspects of the group's longevity and the nature of the group's task (i.e., degree of artificiality). Examination of Table 2 indicates that only one type of group, natural groups, pertains to real teams, and of this type, only three of the four subtypes is relevant to actual teams (i.e., expeditions, standing crews, task forces).

Although it would be relatively easy to categorize new teams with the Larson and LaFasto and McGrath systems, they

overlook other team attributes that could delineate important distinctions between teams. As an example, air crews and project teams fall within the same category in the Larson and LaFasto system, yet there are obvious differences between them with respect to timetable, context, and composition attributes. Such distinctions may have important implications for team design, management, and training purposes.

The Sundstrom and Altman classification differs from the other three systems in that it is built around an elaborated theoretical foundation. Teams and work groups are classified according to their standing on a distinct set of variables drawn from the system's underlying theory. The resulting categories have implications for the environmental requirements needed to support the different types of teams. Because this system is more elaborate than the others, a more detailed explanation will be necessary.

The Sundstrom and Altman (1989) classification scheme. Taking an ecological perspective, Sundstrom and Altman (1989) developed a framework for analyzing environmental factors that influence work group performance. Their approach draws from sociotechnical and open systems theories (Katz & Kahn, 1978), with an emphasis on environmental and temporal factors contributing to team effectiveness. The purpose of the classification system is to describe the characteristics of group-organization boundaries in order to identify features of a team's physical environment that

could be used to support the team's task (Sundstrom & Altman, 1989). Therefore, the attributes included in their system have relevance for defining a group's boundary.

According to Sundstrom and Altman (1989), a work group is "embedded in a larger system, with which its operation and effectiveness are closely tied and interdependent" (p. 176). The relationship between a work group and its organizational context is described in terms of the "group-organization boundary." The term boundary refers to those attributes that: (1) distinguish one work group from another, (2) present real or symbolic barriers between groups, or (3) serve as sites for the external exchange of resources with other entities (Ancona, 1987; Friedlander, 1987; Sundstrom et al., 1990). In other words, the boundary delineates various social units and is the site of transactions between one unit and another. Because all groups are dependent on their environment for resources, transactions across boundaries must be managed effectively (Ancona, 1987; Sundstrom & Altman, 1989).

The concepts of differentiation and integration are central in describing a work group's boundaries, and form the basis of Sundstrom and Altman's classification system. Differentiation refers to the degree of specialization and independence or autonomy of a work team in relation to other units. Differentiation can occur as a result of the special expertise or facilities needed to complete a team's mission or from the need to isolate a team from interference

(Sundstrom et al., 1990). Integration, in contrast, refers to the team's need for communication and coordination with the larger organizational system. It becomes necessary because a team must not only perform its task, but must also satisfy requirements specified by the larger social system (Sundstrom et al., 1990). Sundstrom and Altman's scheme also emphasizes temporal patterns, such as work cycle, that determine the degree of integration and differentiation required.

Differentiation is a higher order attribute that can be seen as a function of several elements. The first is specialization or the group's unique activities or requirements for special expertise. Its operational definition encompasses two components: (1) the presence of other organizational work units having an equivalent purpose and (2) the availability of personnel possessing the unique knowledge, skills, and abilities necessary to achieve the group's goals. The second element is the group's scope of activity which refers to the number of different activities performed by the group and is determined in part by the length of the work cycle. For example, a short work cycle may involve frequent repetition of a limited set of activities. The third element, temporal scope, is defined as the time span available for interaction among group members. This is operationally defined in terms of two characteristics: (1) the group's formal life span and (2)

the proportion of members' work schedules allocated to the group's work (Sundstrom & Altman, 1989).

A second higher order attribute, integration, is also seen as a function of several elements. The first, frequency of required external interactions, refers to the number of work units within the organization or people outside the organization with which the work group must deal. The second element, standardization of procedures and products, refers to the availability of established methods or defined procedures that specify in detail how a task is to be performed or accomplished. External pacing of work, the third element, refers to the constraints on the starting and ending times of the work cycle and is operationally defined as the proportion of a team's activities scheduled or timed according to a nonmember or another work unit's activities. A work group or team whose activities are externally paced must coordinate its activities with the activities of other groups. This coordination requires continuous monitoring of other work units in order to adjust the team's activities in response to those of other groups.

Within the Sundstrom and Altman classification system, groups can be distinguished by their characteristic level of integration (high or low) and differentiation (high or low). Sundstrom and Altman posit that there are four distinct types of groups resulting from the classification scheme. Table 3 identifies the four types of teams, examples of

each, their characteristics in terms of differentiation and integration, and examples of the team outputs.

The different types of teams place different demands on their environments. Specifically, Sundstrom and Altman (1989) suggest that teams function most effectively when their environmental support matches the demands imposed by their level of integration and differentiation. Environmental support refers to the degree to which the physical facilities available to a team or work group facilitate the accomplishment of the team's activities. The demands imposed by a team's level of differentiation and integration can assume four forms: (1) interface demands that involve the accommodation of transactions between the group and nonmembers; (2) barrier demands that involve restrictions in the inflow or outflow of people, goods, or information; (3) interaction demands that involve the accommodation of exchanges among team members; and (4) differentiation demands that involve the accommodation of role differences among team members. Table 4 identifies the four forms of environmental demands and some possible environmental supports.

According to Sundstrom and Altman (1989) the specific environmental demands of a given team will depend upon its characteristics of integration and differentiation. For example, because advice and involvement teams tend to be temporary in nature and have minimal interactions with

Table 3

Sundstrom and Altman (1989) Team Classification System

Team Type	Work-Team Differentiation	External Integration	Typical Outputs
Advice/ Involvement	**Low** differentiation Limited specialization; heterogeneous/representative membership; narrow scope of activity; short group life span/limited working time	**Low** integration Few external interactions or demands for synchronization with other work-units; little standardization; internal pacing; work-cycle may not be repeated	Decisions Selections Suggestions Proposals Recommendations
Production/ Service	**Low** differentiation Limited specialization; variable membership requirements; sometimes high turnover; variable temporal scope or team life span, depending on nature of task and organization; narrow scope of activity	**High** integration Frequent external interactions; externally paced work usually synchronized with suppliers and customers inside and outside the organization; high level of standardization	Food, chemicals Components Assemblies Retail sails Customer service
Project/ Development	**High** differentiation Members usually expert specialists; task may require specialized facilities; wide scope of activity; sometimes extended team life; large proportion of members' work time; intensive interaction among members	**Low** integration Often internally paced project with deadline; little synchronization required; number of external transactions may require much external communication; low standardization	Plans, designs Investigations Prototypes Reports, findings Presentations
Action/ Negotiation	**High** differentiation Exclusive membership of expert specialists; specialized training and performance facilities; broad scope of activity; sometimes extended team life span; proportion of members' time devoted to group activity may vary; intensive internal interaction among members	**High** integration Task performance closely synchronized with other units inside organization; high degree of external pacing; high level of standardization	Combat missions Expeditions Contracts, lawsuits Surgical operations Concerts

NOTE. Table 3 represents a modification of a table that appears in Sundstrom, De Meuse, and Futrell (1990).

individuals or units outside the team, their environmental requirements tend to be low. All that may be necessary is a room where they can meet undisturbed. Therefore, for this type of team barrier demands are most important.

In contrast, production and service groups must interact with individuals and units outside the team in order to accomplish their tasks. External work flow, in the form of taking in resources or putting out a product, is central to the group's existence. Therefore, teams of this type face strong interface demands.

Because the activities of project and development teams involve relatively few external interactions, they face few organizational demands for integration with other work units. Instead, barrier demands tend to be more of a concern. Such groups may be especially sensitive to external accessibility, as for example, product development groups whose activities need to be confidential. In addition, groups of this type are characterized by intensive interactions among members, therefore, interaction demands are likely to be high. However, because project/development teams are composed of highly specialized experts, they also face differentiation demands in the form of role differences. The most effective environment for this type of group may be one that facilitates interactions among members, while at the same time, provides individual work spaces.

Table 4

Environmental Demands and Environmental Support

Form of Environmental Demand	Specific Environmental Demands	Environmental Support
Interface demands	Communication of group duties, rank and identity to counterparts	Functional displays; status demarcation, identity displays
	Reception of incoming materials and delivery of finished output	Reception/delivery area(s) adjacent to working area
	Face-to-face interaction with nonmembers; service-delivery, exhibition, information exchange, coordination, etc.	Peripheral reception/meeting area equipped for visitors; staging/ performance area, audience zone & preparation-training-practice area
	Remote communication with nonmembers for coordination, synchronization, direction, feedback	Electronic communications equipment in group working areas (e.g., telephone, radio, terminal)
Barrier demands	Insulation from noise, visual distraction, and other possibly disruptive inputs	Physical distance of group territories from potential sources of disruption
	Restricted visibility, audibility for protection of group interactions from observation, audiences	Enclosure of part of group working area by walls, partitions, windows, visual or acoustical barriers
	Restriction of personal access to group territories by nonmembers to limit disturbance or interference by incompatible activities	Delineated territorial perimeter with actual or symbolic barriers to travel (e.g., counters, signs)
Interaction demands	Group meetings, conferences involving task-related, face-to-face discussions	Conference area with seating, work-surface and audio-visual support for group mission and members, enclosed for privacy
	Coordinated work-sessions involving cooperation	Clustered work-stations in close proximity and accessible for

Table 4, continued

		efficient exchange
	Work-flow: exchange of tools, materials, unfinished and finished products	Work-stations with open lines of sight, face-to-face orientation comfortable conversation distance
	Informal, face-to-face, intermember interaction	Gathering places near work-stations or work-related facilities (e.g., mailboxes, copier, vending machine; seating for visitors in work-spaces assigned to individual)
	Inter-member remote communication	Electronic communication links among work-stations: telephone, computer, etc.
Differentiation demands	Separate individual roles, identities within the group	Functionally distinct, delineated work-stations
	Individual ability to restrict accessibility to other members	Enclosed or delineated individual work-spaces

NOTE. Table 4 represents a modification of a table appearing in Sundstrom and Altman (1989).

Finally, action and negotiation teams consist of highly specialized members who must interact and coordinate their activities with other groups or units. Both interface and barrier demands tend to be high. Consequently, this type of team requires an environment that supports specialized equipment and provides enough flexibility that the group can be isolated from sources of disruption during certain stages of their work, yet open to external interactions during others. For example, a football team requires extensive external interaction with an opposing team during a game, but needs isolation from outside interference when practicing a new play. The fact that such teams are composed of expert specialists suggests that they face differentiation demands as well.

The Sundstrom and Altman taxonomy suggests that the four classes of work groups with their different characteristics of integration and differentiation will display different requirements for environmental support. However, this proposition, as well as the taxonomic system, remain untested (Sundstrom & Altman, 1989) and therefore served as the basis for several of this study's hypotheses. First, the major objective of the present study was to demonstrate the development of a team classification system based on the Sundstrom and Altman (1989) framework. Second, in order to validate the classification system, hypotheses pertaining to the assumption stated above were developed and tested.

Summary. Teams and work groups can be categorized according to various attributes. The attributes included in a given system depend on the classification's intended purpose. A number of classifications can be found in the team literature, each serving a different purpose and, therefore, describing different types of teams. One commonality among the classification systems discussed above is that each was developed in a rational rather than an empirical manner. As an alternative, an empirically derived classification system based on objective, empirical data may represent an improvement. The development of this type of system was the objective of the present study.

Of the four systems discussed above, the Sundstrom and Altman (1989) classification appeared to have the most potential value and therefore formed the basis for the team classification system in the present study. The Sundstrom and Altman system is based on a theoretical framework, includes a distinct set of variables drawn from its underlying theory, is applicable to a wide variety of teams and work groups, and has relevance for both research and practical purposes. Therefore, the Sundstrom and Altman (1989) scheme served as a hypothesized or target system. This classification system represented a model that could be tested statistically. Hypotheses pertaining to the expected categories were developed and tested.

The information included in the Sundstrom and Altman framework also provided a way of validating the proposed

classification system. The validation of a classification system is important in proving the meaningfulness of the resulting categories or types. The Sundstrom and Altman taxonomy suggests that the four classes of work groups, with their different characteristics of integration and differentiation, will also display different requirements for environmental support. The present study examined this hypothesis by comparing the obtained clusters on the environmental demands variables through means of a MANOVA.

It is important to realize that the development of a single, absolute classification scheme that encompasses all conceivable purposes is impossible (Fleishman & Mumford, 1991; Pearlman, 1980). Different systems may be necessary to serve different purposes. For example, the Sundstrom and Altman (1989) classification system provides a way of classifying teams according to the attributes of differentiation and integration. These attributes encompass aspects of a team's functional activity (i.e., specialization, activity scope, standardization) and timetable (i.e., temporal scope, external pacing). However, the system does not include information that would be useful for training or evaluation purposes (Cannon-Bowers et al., 1992). Specifically, it is not known how performance requirements might vary among the different types of teams proposed by Sundstrom and Altman (1989). To accommodate training or evaluation purposes, it was necessary to obtain

additional information about the behavioral or performance attributes of the different types of teams.

Team Performance Requirements

Research examining the behavioral attributes of teams has been conducted by researchers at Old Dominion University (Dickinson et al., 1992; Glickman et al., 1987; McIntyre, Morgan, Salas, & Glickman, 1988; McIntyre, Salas, Morgan, & Glickman, 1989; Morgan et al., 1986) and elsewhere (Cooper, Shiflett, Korotkin, & Fleishman, 1984; Nieva, Fleishman, & Rieck, 1978; Shiflett, Eisner, Price, & Schemmer, 1982). The emphasis of this work is on the activities of the team as an entity rather than the actions or behaviors of particular individuals. Consideration is given to both the interconnectedness among team members and task accomplishment.

The work conducted at Old Dominion University has identified seven core components of teamwork: (1) communication, (2) team orientation, (3) team leadership, (4) monitoring, (5) feedback, (6) backup behavior, and (7) coordination (Dickinson et al., 1992; McIntyre et al., 1988). The seven components and their definitions are provided in Table 5.

A similar set of attributes has been identified by Nieva et al. (1978), Shiflett et al. (1982), and Cooper et al. (1984). Specifically, they have identified seven team functions: (1) orientation functions, (2) resource

Table 5

Core Teamwork Components

Communication	Active exchange of information between two or more team members. It is viewed as the mechanism that links the other teamwork processes.
Team orientation	Nature of the attitudes that team members have toward one another, the team task, and their leadership; includes self-awareness as a team member and group cohesiveness.
Team leadership	Direction and structure provided by formal leaders as well as by other members; incorporates planning and organizing activities that enable members to respond as a function of the behavior of others.
Monitoring	Observation and awareness of the activities and performance of other team members. Team members must be competent in their individual tasks and have a substantive understanding of the tasks of other members.
Feedback	Includes the giving, seeking, and receiving of performance information among team members; enables teams to adapt and learn from their performance.
Backup behavior	Assisting other members to perform their tasks; includes the observation and awareness of the performance of other team members and requires a degree of task interchangeability among members and a willingness to provide assistance.
Coordination	Execution of team activities such that members respond as a function of the behavior of others; implies the successful operation of other teamwork components (e.g., communication, monitoring, and backup behavior) in such a way that the actions of individual members are merged to produce synchronized team performance.

NOTE. Based on Dickinson et al. (1992); Glickman et al. (1987); McIntyre, Morgan, Salas, & Glickman (1988); McIntyre, Salas, Morgan, & Glickman, (1989); and Morgan et al. (1986).

distribution functions, (3) timing functions, (4) response coordination functions, (5) motivational functions, (6) systems monitoring functions, and (7) procedure maintenance functions. The team functions and a description of each are provided in Table 6.

Although the work of both groups of researchers has been conducted with military teams, it is based on the assumption that certain common dimensions underlie team performance in diverse settings. The levels of performance may vary, however, depending on the specific task requirements. For example, backup behavior may be more critical in the performance of military tactical teams than it is in the performance of committees or task forces.

Examination of the two sets of team behavioral attributes indicates that there are more similarities than differences between the two. For example, elements of coordination and performance monitoring are evident in both systems but are described by different terms and at different levels of detail. What Morgan et al. (1986) refer to as coordination, Nieva et al. (1978) incorporate under timing functions and response coordination. In a similar manner, what is referred to as monitoring in one system (McIntyre et al., 1988; Morgan et al., 1986) is referred to as systems monitoring and behavior maintenance functions in

Table 6

Team Performance Functions

Team orientation	Processes by which information needed to accomplish task is generated and distributed to relevant team members. Information may be internal to the team such as information about member resources, task requirements, and team goals or mission, or external, referring to environmental resources and constraints.
Resource distribution	Involves decisions regarding assignment of members to their particular responsibilities; includes load balancing, where team resources are shifted as required by changing situational demands.
Timing/activity pacing	Involves organizing team resources and activities to ensure tasks are completed in the allocated time; involves general activity pacing of entire group as well as pacing of individual activity.
Response coordination	Coordination and integration of independent and synchronized member activities; involves response sequencing where responses are ordered to meet task requirements while avoiding conflict and interferences.
Team motivation	Processes through which team task objectives are defined and group is energized to achieve those objectives; involves development and acceptance of team performance norms, establishment of performance-reward linkages for team as a unit, and resolution of informational, procedural, and interpersonal conflicts.
Systems monitoring	Detection of errors in nature and timing of ongoing activities; includes monitoring of both team and individual member responses and subsequent adjustment of activities in response to errors and omissions.*
Procedure maintenance	Monitoring behavior to ensure compliance with established performance standards; involves monitoring both team and individual activities and making adjustments as required. Differs from systems monitoring in that emphasis is on conformity to specified procedures rather than error detection.*

* There are two other critical components of these functions. One is referred to as "mutual compensatory performance," which occurs when members perform tasks that have not been specifically assigned as part of their individual responsibilities. The other aspect of these functions involves mutual compensatory timing whereby team members informally adjust the time involved in completing specific subtasks in order to accomplish effectively the overall task.

NOTE. Based on Cooper et al. (1984); Fleishman and Zaccaro (1992); Nieva et al. (1978); and Shiflett et al. (1982).

the other (Nieva et al., 1978). The core component, team orientation (McIntyre et al., 1988), is similar to the motivation function suggested by Nieva et al. (1978). Finally, Nieva et al.'s (1978) team orientation function incorporates the elements of communication and team leadership identified in the Morgan et al. (1986) system.

Both sets of team behavioral attributes described above can be used to obtain information about the behavioral requirements of different types of teams. Because they contain essentially the same elements described at different levels of detail, it seemed reasonable to use these attributes in the development of a team classification system.

Summary. A number of team behavioral attributes have been identified and are assumed to underlie team performance in diverse settings. The development of the systems described above has been based on research with military teams. Two questions arise: (1) Can these systems serve as the basis of a team classification system? (2) Do these systems' behavioral attributes have relevance for other types of teams? Therefore, the present study addressed these issues by collecting information on these attributes for a variety of teams. This research provides the basis of an examination of how the different types of teams delineated in the Sundstrom and Altman classification system differ with respect to the team behavioral attributes.

Development of a Classification System Through Cluster Analysis Procedures

The available team classification systems have been developed through purely rational methods. The teams and work groups have been sorted into categories or types in a way that "seems to make sense." As an alternative, a more objective, quantitative approach may represent an improvement. This involves the use of cluster analysis procedures to generate an empirically-based classification system.

Cluster analysis refers to a family of multivariate statistical procedures used to create classifications by empirically forming relatively homogeneous groups or "clusters" of highly similar entities (Aldenderfer & Blashfield, 1984). In recent years, cluster analysis has had a number of applications within the social sciences including efforts to classify people (Owens & Schoenfeldt, 1979), alcoholic patients (Finney & Moos, 1979; Morey, Blashfield, & Skinner, 1983), managerial jobs (Tornow & Pinto, 1976) and organizations (Pinto & Pinder, 1972).

Despite their widespread use, there are several problems associated with the use of cluster analysis procedures. First, there is no universal agreement on what constitutes a cluster (Everitt, 1974). Although the different cluster analysis methods are intended to identify the actual structure present in a data set, in operation, the methods have a tendency to impose structure with

different techniques finding clusters that have a characteristic shape (Aldenderfer & Blashfield, 1984; Everitt, 1974).

A second problem associated with the use of cluster analysis is that, although most cluster analysis methods represent plausible algorithms for forming classes or types, they are not supported by an extensive body of statistical reasoning (Aldenderfer & Blashfield, 1984). Each method attempts to find the "optimal" clustering that best represents the underlying structure of a given data set (Milligan & Cooper, 1987). However, unlike classical statistical procedures, there are no simple means of objectively evaluating the significance of a given cluster solution (McIntyre, 1978).

A third problem associated with cluster analysis is that among the literally hundreds of clustering algorithms in existence, there is no single method that has been found to work best in every situation (Everitt, 1979; Milligan & Cooper, 1987). In fact, the application of different methods to the same data set will generate different solutions (Aldenderfer & Blashfield, 1984; Everitt, 1974). An associated problem is that essentially all clustering algorithms yield clusters regardless of the presence or absence of structure in the data (Milligan & Cooper, 1987). Consequently, it is imperative that the validity of any classification generated by cluster analysis procedures be evaluated (Aldenderfer & Blashfield, 1984; Everitt, 1974;

Milligan & Cooper, 1987; Morey et al., 1983; Skinner & Blashfield, 1982).

Despite the problems associated with cluster analysis, the techniques have value for developing classification systems. When sufficient caution is exercised in applying the procedures, cluster analysis can be used to generate objective and unbiased classifications (Blashfield & Morey, 1980).

Four major steps are required in the use of cluster analysis to generate a classification system: (1) Specification of the domain of objects to be classified. (2) Definition of the essential properties or attributes of the units in the domain. (3) Use of cluster analysis methods to create groups of similar objects or entities. (4) Evaluation or validation of the resulting classification system (Aldenderfer & Blashfield, 1984; Fleishman & Mumford, 1991).

Issues pertaining to Steps 1 and 2 have been addressed in earlier sections. Specifically, a definition of team was provided, the defining characteristics of teams and work groups were enumerated, and the attributes on which teams can be classified were discussed. Further elaboration of Steps 1 and 2, with respect to the specifics of the present study, are presented in the Methods section. The following sections refer to issues pertaining to the remaining two steps.

The third step in the development of a classification system involves using a cluster analysis procedure to create groups of similar objects. In applying cluster analysis procedures, several issues must be addressed. These include selecting a cluster analysis method and determining the number of clusters.

Selection of Cluster Analysis Method

A number of cluster analysis methods are available, each having certain advantages and disadvantages. The different approaches follow different procedures for clustering the objects of concern and essentially reflect a particular definition of class or type. A broad class of procedures referred to as hierarchical agglomerative methods have been widely used in the social sciences (Aldenderfer & Blashfield, 1984). These procedures begin the clustering process by forming a similarity matrix representing pairwise comparisons of all the entities in a given data set. Initially, each entity is considered a separate cluster. At each successive level of clustering, two of these clusters are merged by putting together the most similar elements (Milligan & Cooper, 1987). The clustering process continues until only one cluster, namely the entire data set, remains. Once two elements become members of the same cluster, they remain together and will not be separated for the remainder of the process (Milligan & Cooper, 1987). The partitions that are formed from the data set represent nonoverlapping clusters. They are depicted in the form of a tree diagram

or dendrogram, a multi-level structure showing the fusions at various levels (Lorr, 1983).

A number of hierarchical techniques have been developed that differ from each other in the way in which they define similarity (Everitt, 1974). One technique found to produce uniformly good results is the "minimum variance method," also referred to as Ward's (1963) method. Ward's method defines a cluster or type as a group of entities in which the "error sum of squares" among members is minimal (Blashfield, 1976). The error sum of squares, or within-cluster variance, represents an index of information loss. Ward's method is designed to minimize the within-cluster variance while maximizing the between cluster variance (Aldenderfer & Blashfield, 1984). Euclidean distance is used in the minimum variance method in determining the similarity of one object with another. The union of every possible pair of clusters is considered at each step in the analysis and the two clusters whose fusion results in a minimum increase in the error sum of squares -- that is, in the minimal loss of information on each entity -- are combined (Aldenderfer & Blashfield, 1984).

Ward's method has been shown to be superior to other hierarchical methods in several investigations (Blashfield, 1976; Edelbrock, 1979; Everitt, 1979; Milligan & Cooper, 1987; Morey et al., 1983). Blashfield (1976) compared the accuracy of four hierarchical methods in analyses of computer-generated data based on a "mixture model." This

model assumes that any given data set to be cluster analyzed comprises subsets of data from a number of populations, where the exact number of populations and their distributional parameters are unknown. In Blashfield's study, populations with known distributional parameters were created, the populations were sampled, and the samples were mixed together to determine which of the four clustering procedures most accurately reconstructed the underlying populations. Results indicated that Ward's method obtained the highest accuracy values, outperforming three other common methods: single linkage, complete linkage, and average linkage methods.

Edelbrock (1979) compared five hierarchical clustering algorithms on their ability to resolve ten multivariate normal mixtures. The mixtures were selected to represent a range of parameters as well as to offer a range of difficulty in solution. The results indicated that Ward's method was one of a subset of algorithms that obtained accurate solutions.

Morey et al. (1983) compared 23 different methods of cluster analysis, including different combinations of parameters with various clustering methods. Results demonstrated that the solution given by Ward's method was particularly powerful in comparison to solutions yielded by other techniques.

In reviewing a number of cluster analysis studies, Everitt (1979) found that Ward's method did well overall.

Milligan and Cooper (1987) also reviewed clustering methodologies and concluded that Ward's method performed well in the majority of cases where it was tested, often providing the best recovery. In addition, unlike other procedures, Ward's method is unaffected by overlap between clusters (Milligan & Cooper, 1987).

Ward's minimum variance method, however, does have some limitations. It tends to find clusters of relatively equal size and shape (Aldenderfer & Blashfield, 1984) and is sensitive to profile elevation (Blashfield & Morey, 1980) particularly as profile scatter increases (Morey et al., 1983). Within this context, profile refers to a vector of measurements on the attributes on which objects are being classified. The accuracy of Ward's method was found to deteriorate when clusters of unequal size were present (Milligan & Cooper, 1987) and it also was found to be strongly affected by the presence of outliers (Milligan, 1980). In addition, a problem common to hierarchical techniques in general is that they contain no provision for the reallocation of entities that may have been poorly classified at earlier stages of the analysis (Aldenderfer & Blashfield, 1984; Everitt, 1974).

Despite these limitations, Ward's method is the preferred procedure of all hierarchical clustering techniques available, particularly in the social sciences. The present study applied Ward's method in the development of a team classification system.

Determining the Number of Clusters

A second issue that must be addressed in using cluster analysis involves determining the number of clusters present in the data set. Hierarchical methods, such as the minimum variance method, produce a series of solutions ranging from n clusters to a solution subsuming the entire data set (Milligan & Cooper, 1985). From this series of partitions, one must determine the level that best reproduces the structure present in the data set. In other words, a stopping rule is required to select the optimum number of clusters (Lorr, 1983). One formal, albeit heuristic, approach is to graph the fusion or amalgamation coefficient (Aldenderfer & Blashfield, 1984). This is the "criterion" value at which cases merge to form a cluster. This stopping rule is analogous to the "scree test" in factor analysis (Aldenderfer & Blashfield, 1984). Monte Carlo studies have found the use of the scree test for this purpose to be relatively accurate (Blashfield & Morey, 1979).

Another commonly used rule is Mojena's Stopping Rule One (Mojena, 1977). Mojena's rule uses the distribution of the clustering criterion, specifically, the within-group sum of squares in the minimum variance procedure, to determine when a partition should occur (Lorr, 1983). It parallels a one-tail confidence interval based on the fusion values at each level in the hierarchy (Milligan & Cooper, 1985). The first instance where the fusion value exceeds this

confidence limit indicates that the previous hierarchy level was optimal.

A number of other alternatives are available. One alternative is the "cubic clustering criterion" that is used as one of the test statistics in the SAS programming package (Ray, 1982; Sarle, 1983). The cubic clustering criterion is based on the assumption that the data have been sampled from a uniform distribution based on a hyperbox (i.e., groupings of entities that have been characterized by multiple dimensions) and that clusters are shaped roughly like hypercubes (Sarle, 1983). The criterion is obtained by comparing the observed $\underline{R}^2$ to the approximate expected $\underline{R}^2$. Positive values of the cubic clustering criterion mean that the obtained $\underline{R}^2$ is greater than would be expected if the sample was drawn from a uniform distribution, and therefore, indicates the possible presence of clusters (Sarle, 1983). The maximum value of the criterion across hierarchy levels is used to indicate the optimal number of clusters in the data (Milligan & Cooper, 1985).

Another alternative criterion is the Calinski and Harabasz (1974) index, or the pseudo $\underline{F}$ statistic. This criterion is analogous to the $\underline{F}$ statistic in univariate analysis (Calinski & Harabasz, 1974). At each cluster stage the "best sum of squares split" is used to calculate the minimum pooled within-cluster sum of squares and the maximum between-clusters sum of squares. As with the cubic clustering criterion, the maximum value across hierarchy

levels is typically used to indicate the correct number of partitions in the data (Milligan & Cooper, 1985).

In a study that compared procedures for determining the number of clusters, both the pseudo F and the cubic clustering criterion performed well. The Calinski and Harabasz index was the best stopping rule examined in the study and was found to perform consistently across varying numbers of clusters (Milligan & Cooper, 1985). The cubic clustering criterion ranked sixth out of the 30 procedures examined (Milligan & Cooper, 1985). The criterion displayed a tendency to produce solutions with more clusters than were actually present in the data. However, it produced a relatively low number of solutions with too few clusters. Identifying too few clusters is often considered a more serious error than too many because the identification of too few clusters results in a greater loss of information (Milligan & Cooper, 1985). In contrast, Mojena's rule ranked ninth out of the 30 procedures examined. Milligan and Cooper discovered that the method exhibits some insensitivity to the critical value. Specifically, they found that the critical value required for optimal recovery at two clusters differed from the value needed when four or five clusters were present. This could present a problem in applied settings where one would not know the actual number of clusters present in the data and, therefore, could not make adjustments to the critical value (Milligan & Cooper, 1985).

A final but practical consideration in the selection of a clustering criterion concerns availability. Although five other procedures were ranked higher than the cubic clustering criterion in the Milligan and Cooper (1985) study, a number of those procedures were developed by various researchers and are not present in the available statistical packages such as SAS or SPSSX. The cubic clustering criterion and the pseudo F statistic are generated by the cluster procedure in SAS and therefore were used to determine the number of clusters existing in the data in the present study.

Validation of the Classification System

The final and one of the most critical steps in the development of a classification system involves evaluating or validating the end result. A number of testing procedures have been developed to determine whether significant cluster structure exists in the partitions obtained by a clustering technique (Milligan & Cooper, 1987). These procedures test the null hypothesis that the data consist of a random distribution of points with no distinct clustering present. Two general approaches can be distinguished depending on whether an internal or external criterion is used.

One approach, which uses an internal criterion, involves a comparison of partitionings from different clustering methods (Milligan & Cooper, 1987). If the cluster structure remains fairly constant across different

methods, it is plausible to conclude that the structure is stable and is not an artifact of a particular procedure. However, a failure to replicate the cluster structure introduces a level of confounding. It would be impossible to determine whether the lack of replicability was due to a lack of structure in the data or to differences in the types of structures imposed by the different clustering procedures (Milligan & Cooper, 1987). Thus, the use of a single sample impairs the ability to generalize the results to other data sets.

An alternative approach involves estimating the degree of replicability of a cluster solution across a series of data sets (Aldenderfer & Blashfield, 1984). A cluster solution that is discovered repeatedly across different samples drawn from the same general population displays stability, making it reasonable to conclude that it has generalizability as well. Examination of a solution's stability, based on the logic of cross validation as used in regression analysis, was proposed by McIntyre and Blashfield (1980). They used a technique referred to as the "nearest centroid assignment" to assign elements of a second sample to one of the centroid vectors obtained from a cluster analysis of the original or derivation sample. In this approach, two samples are obtained for clustering purposes (Sample 1 and Sample 2). The first sample is cluster-analyzed and the centroids for the clusters are calculated. Next, the distance between each element in Sample 2 and each

of the centroids determined from Sample 1 is computed. The next step involves clustering the second sample based on the characteristics of the first sample by assigning each element in Sample 2 to the nearest cluster centroid from Sample 1. This is followed by a cluster analysis of the second sample using its own data. A measure of agreement between the two partitions of Sample 2 is computed to obtain an indication of the consistency or stability between the original cluster solution and the cross-validated cluster assignments.

McIntyre and Blashfield (1980) demonstrated the usefulness of the nearest-centroid procedure for evaluating cluster analysis solutions. They also demonstrated that the cross validation design is a viable approach to assess a solution's stability. However, Aldenderfer and Blashfield (1984) emphasize that replication is essentially an indication of the internal consistency of a cluster solution and does not provide strong evidence for the validity of a solution. In other words, replication is a necessary but not sufficient condition for demonstrating a solution's validity.

In an attempt to overcome this limitation, Morey, Blashfield, and Skinner (1983) extended this strategy in a design that circumvents many of the methodological problems common to cluster analysis. Their approach, which uses an external criterion, involves a sequential validation framework consisting of four phases: (1) a derivation

phase, (2) a replication phase, (3) an external validation phase, and (4) a cross validation phase.

In the derivation phase, a sample is randomly divided into two groups (Sample X and Sample Y) and a cluster analysis is performed on both groups. The second phase, replication, involves using the nearest centroid assignment technique to assign the elements in Sample X to the clusters obtained from Sample Y. Then a comparison is made of this assignment to the original clustering of Sample X.

The goal of the third phase, external validation, is to assess the generalizability of the replicated classifications across external domains and variables as well as an external sample (Sample Z). After application of the nearest centroid assignment technique, the elements in Sample Z are assigned to the cluster solution derived from Sample X. Once cluster membership is determined, it is possible to use multivariate statistics, such as MANOVA, to test for significant differences between the various groups.

The final phase, cross validation, examines the discriminating power of those typologies that were significant with respect to external validity (Morey et al., 1983). This involves four steps. First, discriminant functions for the external validation domains are obtained using the elements in Sample Z. Second, the discriminant functions are used to assign the elements of a new sample (Sample Q) to the various groups or types. Third, elements in Sample Q are assigned to the clusters obtained from

Sample X by means of the nearest centroid assignment technique and the original set of variables (i.e., those used to derive the clusters). Finally, the assignments of the elements of Sample Q, made in steps 2 and 3, are compared.

The sequential validation design provides an indication of both the internal and external validity of a cluster solution (Morey et al., 1983). The power of the external validation aspect is that it provides a direct test of the generality of a cluster solution against relevant criteria (Aldenderfer & Blashfield, 1983). Consequently, clusters obtained with this design can be considered to be stable as well as generalizable. The present study used a variant of the sequential validation design to develop a team classification system.

Measurement of Classification Agreement

The use of a replication to examine a cluster solution's stability involves consideration of one final issue, namely, the choice of agreement statistic. A measure is needed to compare the degree of correspondence between a solution and its replication. One commonly used measure is the kappa statistic or "agreement kappa" used by McIntyre and Blashfield (1980) as a measure of consistency. The measure, which is considered an index of the goodness of the cluster solution, can range from 0.0 (no agreement) to 1.0 (perfect agreement). Using Monte Carlo generated data, McIntyre and Blashfield (1980) found that when the solutions

were characterized by relatively little overlap (i.e., a high degree of multivariate separation among populations), agreement kappa was high, suggesting a stable solution. However, when there was a relatively large amount of overlap, the statistic generally was low. The study also found that agreement kappa was moderately to highly correlated with accuracy kappa (i.e., the kappa statistic). This suggests that the agreement kappa, which is a direct estimate of stability, also provides an indirect estimate of how well the minimum variance cluster solutions match the actual cluster structure of the data (McIntyre & Blashfield, 1980).

The value of the kappa statistic in replication designs is that it corrects for chance agreement (Morey & Agresti, 1984). However, use of the statistic is limited to cases where there is an identical number of clusters in the two solutions being compared (Morey & Agresti, 1984). A suggested alternative is the Hubert and Arabie (1985) adjusted Rand index. The Rand statistic defines two instances of classification agreement: (1) when two solutions agree that two elements are to be assigned to the same cluster; and (2) when two solutions agree that two elements are to be assigned to different clusters (Morey & Agresti, 1984). Although the Rand statistic, as originally derived, made no correction for chance agreement, Morey and Agresti (1984) developed an adjusted Rand that overcame this limitation by adjusting for the marginal probabilities of

assignment to any one cluster (Morey, Blashfield, & Skinner, 1983). However, subsequent studies have shown that the adjustment process used by Morey and Agresti (1984) leaves the index with a slight positive bias (Hubert & Arabie, 1985). Hubert and Arabie (1985) proposed their own adjusted Rand that corrects for both chance agreement and this slight positive bias. In a study that compared five measures for evaluating the extent of recovery of the true cluster structure, the Hubert and Arabie (1985) adjusted Rand was found to be particularly effective (Milligan & Cooper, 1986). It was suggested that this statistic is the index of choice for clustering validation research. Consequently, the Hubert and Arabie (1985) adjusted Rand statistic was used in the present study. A statistical definition of the adjusted Rand statistic is presented in the Results section.

Summary

Cluster analysis procedures provide a method for empirically deriving a classification system. A number of specific procedures are available, each possessing specific strengths and weaknesses. One general class of techniques commonly applied in the social sciences is comprised of hierarchical clustering methods. Within this general class, one specific procedure has been found to produce favorable results. Specifically, a method referred to as the minimum variance method or Ward's method is recommended. It is this procedure that was applied in the present study. Application of this technique requires a method for

determining the number of partitions available in the data. The cubic clustering criterion and the pseudo F statistic used in the SAS programming package have been found to compare favorably with other available methods and were used in the present study. Finally, validation of the resulting cluster solutions is critical in the use of cluster analysis procedures. This study incorporated a modification of the sequential validation design proposed by Morey et al. (1983) to evaluate the resulting team classification system. The Hubert and Arabie (1985) adjusted Rand statistic was used to compare the degree of classification agreement.

Research Objectives

The objective of the present research was to develop an empirically based team classification system. The Sundstrom and Altman (1989) classification served as a hypothesized or target system. Information pertaining to the attributes delineated by Sundstrom and Altman (1989) were obtained systematically from actual teams and work groups and were analyzed using cluster analysis procedures to determine the most appropriate groupings. The following hypotheses pertaining to the expected categories were tested.

Hypotheses

It was hypothesized that the application of cluster analysis procedures to the obtained data set would identify four clusters. The following hypotheses pertain to the expected composition of the clusters.

Hypothesis 1: One cluster would comprise teams and work groups that are low on the attribute sets pertaining to integration and differentiation. Sundstrom and Altman refer to this group as advice/involvement groups.

Hypothesis 2: A second cluster would comprise teams and groups high on the attribute set pertaining to integration but low on the attribute set relating to differentiation. Sundstrom and Altman refer to this group as production/service groups.

Hypothesis 3: A third cluster would comprise teams and groups low on the attribute set pertaining to integration but high on the attribute set pertaining to differentiation. Sundstrom and Altman refer to this group as project/development groups.

Hypothesis 4: A fourth cluster would comprise teams and groups high on the attribute sets pertaining to integration and differentiation. Sundstrom and Altman refer to this group as action/negotiation groups.

By design, cluster analysis identifies groups or clusters within a data set in such a way that objects within the same cluster are more similar to each other than they are to objects in other clusters. However, within the Sundstrom and Altman's framework, some overlap between clusters on the clustering variables can be expected. The specific nature of the overlapping characteristics is expressed in the following hypotheses:

Hypothesis 5: Teams and work groups within the team types referred to as advice/involvement groups and project/development groups would be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to integration.

Hypothesis 6: Teams and work groups within the team types referred to as production/service groups and action/negotiation groups would be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to integration.

Hypothesis 7: Teams and work groups within the team types referred to as advice and involvement groups and production/service groups would be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to differentiation.

Hypothesis 8: Teams and work groups within the team types referred to as project/development groups and action/negotiation groups would be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to differentiation.

The Sundstrom and Altman taxonomy suggests that four classes of work groups, with their different characteristics of integration and differentiation, will also display

different requirements for environmental support. Therefore, information pertaining to team and work group requirements for environmental support were also obtained and used to validate the classification system. This led to the following hypothesis:

Hypothesis 9: Teams that are categorized on the basis of their characteristics of differentiation and integration, should display different requirements for environmental support.

Hypothesis 9a: Advice/involvement teams will demonstrate strong barrier demands.

Hypothesis 9b: Production/service teams will demonstrate strong interface demands.

Hypothesis 9c: Project/development teams will demonstrate strong barrier demands, internal interaction demands, and role differentiation demands.

Hypothesis 9d: Action/negotiation teams will demonstrate strong barrier demands, interface demands, and role differentiation demands.

Information about the behavioral or performance attributes of the different teams also was collected. Because all previous work in this area was conducted with military teams, it is not known how performance requirements might vary among other types of teams. However, based on the characteristics of the hypothesized types of groups,

several tentative hypotheses concerning behavioral requirements were generated.

First, the team types referred to as action/negotiation groups and product/service groups must synchronize their work with other units. Consequently, schedules and timelines are likely to be important issues to the teams. In order to meet such timelines, these teams must perform as a synchronized unit. This led to the following hypothesis:

> **Hypothesis 10:** Action/negotiation groups and product/service groups would display a higher incidence of the behavior attributes pertaining to backup behavior and/or the systems monitoring function than will the other two types of groups.

Second, action/negotiation groups generally are composed of expert specialists who not only must synchronize their work with other units, but often must coordinate the independent activities of the team members. This led to the following hypothesis:

> **Hypothesis 11:** Action/negotiation groups would display a higher incidence of the team behavior attributes pertaining to the response coordination function than that displayed by the other three types of groups.

Third, the team type referred to as advice/involvement groups consists of groups with a limited time span and a limited cycle of activity. Generally such groups are formed to respond to specific problems and once the problem is resolved, the group disbands. In order to accomplish their

task of resolving a given problem, it is important that such teams have a good understanding of what needs to be accomplished and what resources are available. This led to the following hypothesis:

Hypothesis 12: Advice/involvement groups would display a higher incidence of the team behavior attributes pertaining to the team orientation function than that displayed by the other three groups.

Fourth, advice/involvement groups and project/development groups tend to deal with tasks that are not well-defined. Therefore, it is important that direction and structure be provided by formal leaders. This led to the following hypothesis:

Hypothesis 13: Advice/involvement groups and product/development groups would display a higher incidence of the team behavior attributes pertaining to team leadership than that displayed by the other two groups.

CHAPTER TWO

METHOD

The development of a classification system involves four major steps: (1) Specification of the domain of objects to be classified. (2) Definition of the essential properties or attributes of the units in the domain. (3) Creation of groups of similar objects or entities. (4) Validation of the resulting classification system (Aldenderfer & Blashfield, 1984; Fleishman & Mumford, 1991). Steps 1 and 2 refer to the selection of the sample and the development of a measurement instrument and are explained in the sections below. Steps 3 and 4 involving the application of cluster analysis and other statistical procedures are explained in the Results Section.

Identification of Domain

Identification of the domain or universe of objects to be classified involves specifying the objects or entities to be categorized. With respect to the team classification system developed in the present study, the universe of objects classified consisted of teams and work groups. A team or work group was defined as a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, and who each have been assigned specific roles or functions to perform (Salas et al., 1992).

In order to fall within the specified domain, a team or group had to display the following characteristics: (1) interdependency must exist among members, (2) coordination must be required to accomplish the team's goals, and (3) some type of structure must be provided through role assignment. However, it should be noted that Sundstrom and Altman's proposed classification scheme includes loosely structured groups such as committees and advisory councils. Their conception of a team emphasizes shared responsibility for its organization's outcomes, rather than the need for role specifications or team structure. Because the classification scheme was to be based on Sundstrom and Altman's theory, some latitude was necessary in obtaining teams or groups for the sample. Therefore, as long as a team could be characterized as having a minimal level of interdependency, coordination, and structure, they were included in the sample. The level of these characteristics was assessed by a screening instrument which will be described below.

Sample

In selecting the sample for this study, an attempt was made to represent the wide variety of teams and work groups identified in the literature. The final sample consisted of 91 teams drawn from 23 organizations throughout the Hampton Roads area. The number of team members on each team varied,

Table 7

List of Teams Included in Sample

	N
Advanced Life-Saving Team	1
Advisory Council	1
Assembly Group/ Manufacturing Group	5
Basic Life-Saving Team	2
Basketball Team	1
Child Study Team	6
Combat Fire Team	1
Committee	3
Customer Response Team	2
Dive Team	2
Energy Efficiency Team	1
Field Hockey	1
Fire Fighting Team	5
Flight Crew	2
Gas Construction Crew	6
Hazardous Materials Team	3
Hostage Negotiation Team	1
LaCrosse Team	1
Management Team/ Executive Committee	3
Mosquito Control Crew	1
Musical Group	3
Quality Improvement Team	11
Research Team	3
Sanitation Crew	1
Shipping Team	1
Squad Truck Team	3
Staff Development Team	2
Surf Rescue Team	2
SWAT Team	1
Task Team/Project Team	13
Technical Rescue Team	3
	91

ranging from 2 to 28 (M = 8.80; SD = 5.60). The actual composition of the sample is illustrated in Table 7. In addition, to ensure adequate coverage of a wide range of team types, an attempt was made to ensure that the sample was composed of teams and work groups from diverse organizational settings throughout the Hampton Roads area. Table 8 represents a list of the variety of organizations from which the teams were drawn.

Table 8

List of Organizations

	Number of Teams
City governments	15
Colleges & universities, schools	14
Community agencies	1
Entertainment groups	3
Hospitals	4
Local government agencies	11
Manufacturing firms	15
Military agencies	1
Police, fire departments	13
Transportation companies	2
Utilities	12
	91

Participants

The participants for this study consisted of 91 individuals, one representing each team or work group in the sample. Thirty-three were actual team members, 34 were team leaders, 9 were facilitators or coordinators, and 15 were supervisors or coaches. Length of time associated with the

teams ranged from one month to more than 10 years (M = 46.38 months; SD = 33.92).

Recruitment of Participants

The sample was obtained through personal contacts in various organizations. An initial phone call was made to request help in obtaining participants and to provide a brief description of the study. This was followed with a letter explaining the study's purpose, the data collection procedures, the time required, and the researcher's background and qualifications. An offer to supply a summary of the study's results was also made. Once an agreement to participate was obtained, arrangements were made for an interview time and location that was convenient for the participant involved.

Prior to contacting participants, a description of the study and a copy of the proposed measurement instrument were submitted for review by the Human Subjects Committee of the Psychology Department at Old Dominion University. Participants were not contacted until approval by the Committee had been obtained.

Definition of Attributes

The second step in the development of a classification system is to define the attributes on which the objects will be compared and classified. For the purposes of the present study, teams were classified on the attributes of integration and differentiation delineated by Sundstrom and Altman (1989). Based on the resulting classifications,

differences between the teams on environmental demands and behavioral requirements also were examined. The behavioral requirements section included the team components initially identified by Morgan et al. (1986) and later modified by others, and the team performance functions initially identified by Nieva et al. (1978) and modified by others.

Materials

Pilot study. An instrument was developed to assess the variables associated with integration, differentiation, environmental demands, and behavioral requirements. The instrument consisted of 15 items assessing integration, 20 items assessing differentiation, 35 items assessing environmental demands, and 74 items assessing behavioral requirements. The integration and differentiation items were rated on a 5-point scale, ranging from 1 (low) to 5 (high). The environmental demands and behavioral requirements were also rated on a 5-point scale, ranging from 0 (not at all important) to 4 (critically important).

A pilot study was conducted to determine the applicability of each item to various teams. Eighteen individuals representing a range of different teams completed the instrument. The items were read to the participant by the researcher so that any questions pertaining to the meaning of the items could be answered. In addition, the participants were asked to indicate which items needed clarification or rewording to better apply to their particular type of team.

As a result of the pilot study it was found that not all items on the integration and differentiation scales applied to all teams. The evidence collected indicated that questions in an open-ended format would apply to a broader range of teams and would provide more extensive information. Therefore, items in this section were rewritten. The only changes made to the sections representing environmental demands and behavioral requirements involved eliminating redundant items.

Revised instrument. The revised instrument consisted of an interview composed of four sections (see Appendix A). The first covered basic demographic data and consisted of information pertaining to the type of organization in which the team works, the number of members on the team, the kind of team (e.g., task force, basketball team, maintenance crew, etc.), and the basic nature of the team's work (e.g., production, service, decision-making, problem-solving, performance, or a combination). It also included a screening questionnaire that consisted of three items assessing the team's level of interdependency, coordination, and structure. Each item contained three response options. The response options described a minimum level (i.e., a score of 1), a moderate level (i.e., a score of 2), and a high level (i.e., a score of 3) of the construct being assessed. Teams were excluded from the sample if the respondent gave the team a score of 1 on two or more of the

three screening items. Based on this screening questionnaire, 5 teams were dropped from the analysis.

The second section covered items specific to the dimensions of integration and differentiation proposed by Sundstrom and Altman (1989). It consisted of 30 questions pertaining to the teams' specialization, activity scope, temporal scope, frequency of external interactions, standardization, external pacing, and coordination demands with outside groups. The questions involved a combination of open-ended and forced-choice items. To ensure that items included in the interview were pertinent to a wide variety of team and work group types, the questions were worded so that they were general enough to apply to nearly all teams, yet not so specific as to be unique to only a few. In addition, the items were worded so that they applied to the team or work group as an entity rather than to individual members.

The third section consisted of information about the teams' environmental demands (see Table 4). The primary source of this information was Sundstrom and Altman (1989) and Sundstrom, De Meuse, and Futrell (1990). This section consisted of 32 items referring to conditions that might be necessary for successful achievement of the teams' task objectives. Items represented four areas: (1) interface demands, or the need to accommodate transactions between the group and nonmembers; (2) barrier demands, or the need to restrict the inflow or outflow of people, goods, or

information; (3) interaction demands, or the need to accommodate exchanges among team members; and (4) differentiation demands, or the need to accommodate role differences among team members. The items were printed on 3 by 5 inch index cards. The participants were asked to rate the items' importance by sorting the cards according to a 5-point scale that ranged from 0 (Not At All Important) to 4 (Critically Important).

The fourth section encompassed dimensions pertaining to the teamwork components or behavioral requirements. The primary source of this information was drawn from the work of Nieva et al. (1978) and Dickinson et al. (1992) (see Tables 5 and 6). This section consisted of 60 items referring to behaviors necessary for successful achievement of the teams' task objectives. Items represented 7 dimensions: (1) communication, (2) team orientation, (3) monitoring, (4) feedback, (5) backup behavior, (6) coordination, and (7) team leadership. The items were printed on 3 by 5 inch index cards. The participants were asked to rate the items' importance by sorting the cards according to a 5-point scale that ranged from 0 (Not At All Important) to 4 (Critically Important).

Cronbach Alpha scores were computed for the items representing the environmental demands and behavioral requirements dimensions. After a preliminary analysis, items with low inter-item correlations were eliminated from further analysis. A total of 8 items were eliminated (see

Appendix B). The resulting Cronbach Alpha scores are presented in Table 9.

Data Collection

The interviews were conducted with an individual who was thoroughly familiar with the team's task requirements and its environmental setting. All interviews took approximately 1 hour to complete.

Interview Coding

A coding scheme for the open-ended questions pertaining to the integration and differentiation attributes was developed based on Sundstrom and Altman's theory. A separate rating scale was developed for each item, whereby a high rating generally indicated a high score on that particular dimension. Coding for each variable will be described below. Appendix C contains the interview scoring criteria.

Specialization refers to a group's unique activities or requirements for special expertise. It was operationally defined as the presence of other organizational work units having an equivalent purpose (i.e., question 2) as well as the need for unique knowledge, skills, and abilities to achieve a group's goals (i.e., questions 4, 5, and 7).

Question 2 assessed the number of other groups having the same responsibilities as the group and was scored according to a 3-point scale. A high rating on this item represented a high degree of specialization; in other words, few other groups had the same responsibility.

Table 9

Cronbach Alpha Test for Internal Consistency of Environmental Demands and Behavioral Requirements

Dimension	Number of Items	Alpha =
Environmental Demands		
Interface Demands	8	.7388
Barrier Demands	9	.7600
Interaction Demands	7	.6634
Role Differentiation Demands	4	.6203
Behavioral Requirements		
Communication	8	.8206
Team Orientation	9	.7871
Monitoring	4	.6869
Feedback	7	.8585
Backup Behavior	10	.8104
Coordination	11	.8468
Team Leadership	7	.8518

Question 4 assessed the similarity of skills among members and was also scored according to a 3-point scale where a high rating indicated that all members had essentially the same skills. The rationale for the scoring was based on the notion that if all members of a team needed unique skills, those skills would set them apart from the rest of the organization.

Question 5 assessed the level of training required by team members. It was scored according to a 7-point scale whereby a higher rating indicated a need for a higher level of training. Question 6 asked whether all members of a team needed the same type of training. However, the information provided was judged to be redundant with Question 4 which asked about the similarity of team members' skills; therefore, Question 6 was omitted from analysis.

Question 7 assessed the amount of training as a team that was needed by a group. It was scored according to a 5-point scale whereby a higher rating indicated a need for more team training. A need for frequent training as a team was seen as an indication of a group's specialization in that it set it apart from the rest of the organization.

Question 8 attempted to assess the availability of personnel possessing the unique knowledge, skills, and abilities necessary to achieve the group's goals by asking about the difficulty in replacing team members. The rationale for the question was that the more specialized the skills needed for a team's task, the more difficult it would

be to find a replacement for a team member. However, responses obtained for this item indicated that the participants were taking hiring constraints into account. For example, although a team might prefer to hire from outside the organization someone possessing the special skills needed to replace a team member, they were forbidden to do so because of hiring constraints. Therefore, they would have to rearrange work assignments rather than find a replacement member. Consequently, the item was dropped from analysis.

Scope of activity refers to the number of different activities performed by a group. It was assessed by Question 1 and Question 9. Question 1 was rated on a 3-point scale whereby a higher rating indicated a broader range of activities. The information also was coded for the nature of the group's primary activity and the nature of the group's decision-making responsibilities. With respect to the nature of the group's activities, a group may meet to perform a physical activity, to discuss information, or to coordinate activities. The nature of the group's decision-making responsibilities attempted to assess the level of decision-making in which the group could engage. This was rated on a 4-point scale ranging from limited to broad decision-making responsibilities. Question 12 also was intended to assess the amount of decision-making authority available to a group. However, because a number of

participants expressed an uncertainty about their responses to this item, the question was omitted from analysis.

Question 9 assessed the amount of repetition involved in a group's activities. It was rated on a 4-point scale where the higher the rating the less repetition was involved. Questions 10 and 11 also referred to the amount of repetition involved in a group's activities. However, the responses were not scored directly, but rather were used as supplementary information for questions pertaining to temporal scope.

Temporal scope refers to the time span available for interaction among group members. This was operationally defined in terms of a group's formal life span (i.e., Question 13) and the proportion of members' work schedules allocated to the group's work (i.e., Questions 14 and 15).

Question 13 assessed the length of time a team was expected to be together or the team's life span. It was rated on a 4-point scale where the higher the rating, the longer the group was expected to be together.

Question 14 assessed the amount of time a group worked together per week and was rated on a 9-point scale. The higher the rating, the greater the amount of time a team spent working together.

Question 15 referred to the amount of time team members spent working on activities that did not involve the rest of the group. It was rated on a 3-point scale whereby the higher the rating, the less time spent on other activities.

Frequency of required external interactions refers to the number of work units within the organization or people outside the organization with which a work group must deal. Questions 16 and 17 assessed this dimension. Question 16 simply asked if a group needed to interact with other groups. If the answer was no, Questions 17 through 19 were omitted and received a score of 0. If the answer was yes, the next three questions were asked. Question 17 asked about the particular groups with which a team interacted. For this particular item, it was necessary to identify a way in which to capture the range of other groups with which the teams in the sample needed to interact that would make comparisons possible. Examination of the interviews suggested that eight broad categories could account for the majority of external interactions (see Appendix C). One point was scored for each category of group with which a team interacted and the points were summed to arrive at a total score, ranging from 0 to 8.

A team may differ not only in the types of other groups with which it must interact, but also in the frequency of those interactions. Therefore, Question 18 assessed the frequency or extent of a team's interactions with other groups. For this item, each of the 8 categories in Question 17 was rated according to a 4-point scale whereby the higher the rating, the more frequent the interaction. The ratings were then summed across the 8 categories to arrive at a final score.

Although a team may interact regularly with another group, the interaction may be of only minor importance to the team's actual group. Therefore, Question 19 assessed the importance of a team's interactions with other groups. Each of the 8 categories in Question 17 was rated according to a 4-point scale whereby the higher the rating, the more important the interaction to the team's task. The ratings were then summed across the 8 categories to arrive at a final score.

Standardization of procedures and products refers to the availability of established methods or defined procedures that specify in detail how a task is to be performed or accomplished. It was assessed by Questions 21 and 22. Both items were rated on a 4-point scale where the higher the rating, the higher the degree of standardization.

Question 24 asked about the way in which a team's work was evaluated. It was intended as an additional measure of standardization in that the more standardized a team's work, the easier it should be to evaluate. However, the responses to this item indicated that, for most of the teams in the sample, an evaluation of the team's work did not occur. Only the performance of individual team members was evaluated. Consequently, the item was dropped from analysis.

External pacing of work refers to constraints on the starting and ending times of a group's work cycle. A work group or team whose activities are externally paced must

coordinate its activities with the activities of other groups. It was assessed by Questions 20, 25, 26, and 28.

Question 20 assessed the degree to which a team provided input to the work of another group. It was rated on a 3-point scale whereby the higher the rating, the more essential the input.

Question 25 assessed the degree to which a team's work was controlled by deadlines or time constraints that were established outside the group. It was rated on a 4-point scale whereby the higher the rating, the greater the external control.

Question 26 assessed the degree to which the timing or pace of a team's work was externally controlled, while Question 28 assessed the degree to which a team's work schedule was externally controlled. Both items were rated on a 3-point scale whereby the higher the rating, the greater the external control.

Question 27 asked whether or not a team needed to adjust its activities in response to the activities of another group. However, because all teams responded yes to this question, it did not discriminate between different types of teams and therefore was dropped from analysis.

Questions 20, 29 and 30 provided information about the nature or purposes of a team's interactions with other groups. Examination of the responses of the teams in the sample indicated 15 different purposes or reasons why a team needed to interact with other groups. Each of the 15

purposes was coded for whether of not it applied to a particular team. The information was used for supplemental purposes only and was not used in the cluster analysis.

Scoring reliability. Ten percent of the interviews were scored by a second rater. Interrater agreement, measured by the percentage of agreement between the two raters, ranged between .85 and .95 with a mean of .90.

Principal Components Analysis

Prior to the application of clustering procedures, a principal components analysis was conducted as a means of data reduction. Principal components analysis is a statistical technique whereby an original set of variables is linearly transformed into a smaller set of uncorrelated variables that represents most of the information contained in the original set (Dunteman, 1989). Although similar to factor analysis, principal components analysis differs in that it does not necessarily rely on an underlying model of latent "constructs" and it focuses on explaining the total variation, rather than the common variation, in the observed variables. Because the principal components are uncorrelated, each one makes an independent contribution to accounting for the variance of the original variables (Dunteman, 1989).

The "FACTOR" procedure in the SAS programming package (Release 6.07) was used to carry out the "component" extraction for the integration and differentiation variables. The principal components analysis method and

varimax rotation were used. This method uses three criteria, which can be specified by the user, in determining the number of factors that are extracted. These criteria are (1) the maximum number of factors to be extracted, (2) the proportion of common variance to be accounted for by the retained factors, and (3) the smallest eigenvalue for which a factor is to be retained. The number of factors retained is the minimum number that satisfies any of these criteria. In the present study, the default value for each of these criteria was used. Specifically, the default value for the number of factors to be extracted was set at the number of variables, in this case, 17. The default value for the proportion of common variance to be accounted for was set at 1.0 or 100%. The default value of for the smallest eigenvalue for which a factor was retained was set at zero.

Five components were extracted for the integration and differentiation variables, explaining 77% of the total variance. The components are described in Table 10.

Sundstrom and Altman (1989) proposed two distinct sets of attributes, one comprising variables that pertain to integration (i.e., the group's need to interact with the larger system), and the other comprising variables pertaining to differentiation (i.e., the group's need to perform autonomously of the larger system). However, the results of the principal components analysis suggest that

Table 10

5 Principal Components Solution for Integration and Differentiation Variables

Component	Factor Loading	Variable
1	.8837	Time spent in individual activities
	.8548	Time members spend together
	.8178	Must follow established procedures
	.7719	External determination of schedule
	.6087	External pacing
	.5953	Externally imposed deadlines
	.5510	Provides input to others
	.4941	Similarity of skills
2	.7841	Need for team training
	.7362	Repetition of activities
	-.7911	Frequency of unexpected situations
3	.8856	Importance of external interactions
	.8721	Frequency of external interactions
	.5688	Education requirements
4	.7871	Presence of similar groups
	.7180	Number of responsibilities
5	.9446	Team life-span

integration and differentiation may not represent two distinct constructs, at least as measured in the present study. The "overlap" is evident in components one and three which consist of elements of both integration and differentiation.

Although the purpose of the principal components analysis was intended primarily as a means of data reduction, some interpretation of the components is possible. Future research might use this interpretation for measurement refinement. The first component, which accounts for 25.58% of the total variance, appears to represent the amount of time a group needs to spend together in order to meet external demands. The second component accounts for 17.39% of the total variance and appears to represent the need for team training in order to handle unusual situations. The third component, accounting for 16.68% of the total variance, appears to represent the degree of external interactions, while the fourth component, accounting for 10.86% of the total variance, seems to represent the degree of broad and unique activities. The final component represents the team's life span and accounts for 6.52% of the total variance.

Component scores for the integration and differentiation variables for each team were calculated and used in the subsequent cluster analyses. The component scores have a mean of zero and variance of one.

Design and Procedures

A modification of the sequential validation design proposed by Morey et al. (1983) was used. This involved four phases: (1) the derivation phase; (2) the replication phase; (3) the external validation phase; and (4) the cross validation phase. The procedures and analyses are discussed separately for each phase in the Results section.

CHAPTER THREE

RESULTS

Creation of Groups

The third step in the development of a team classification system involves the creation of groups of similar objects or entities. In the current study, teams and work groups were sorted into groups by the application of cluster analysis procedures. Appendix D contains a summary of the steps followed and the variables used in the present study.

Derivation Phase

The actual grouping of teams and work groups into categories or classes occurred in the derivation phase. The results of the cluster analysis performed in the derivation phase were used in examining Hypotheses 1 through 8. Specifically, these hypotheses are as follows:

> **Hypothesis 1:** One cluster will comprise teams and work groups that are low on the attribute sets pertaining to integration and differentiation. Sundstrom and Altman refer to this group as advice/involvement groups.
>
> **Hypothesis 2:** A second cluster will comprise teams and groups high on the attribute set pertaining to integration but low on the attribute set relating to differentiation. Sundstrom and Altman refer to this group as production/service groups.
>
> **Hypothesis 3:** A third cluster will comprise teams and groups low on the attribute set pertaining to integration but high on the attribute set pertaining to differentiation. Sundstrom and Altman refer to this group as project/development groups.

Hypothesis 4: A fourth cluster will comprise teams and groups high on the attribute sets pertaining to integration and differentiation. Sundstrom and Altman refer to this group as action/negotiation groups.

Hypothesis 5: Teams and work groups within the team types referred to as advice/involvement groups and project/development groups will be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to integration.

Hypothesis 6: Teams and work groups within the team types referred to as production/service groups and action/negotiation groups will be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to integration.

Hypothesis 7: Teams and work groups within the team types referred to as advice and involvement groups and production/service groups will be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to differentiation.

Hypothesis 8: Teams and work groups within the team types referred to as project/development groups and action/negotiation groups will be similar to each other but significantly different from the other two types of groups on the attribute set pertaining to differentiation.

The original sample of 91 teams was randomly divided into two groups, one containing 45 teams (Sample A) and the other containing 46 teams (Sample B). In this phase, Samples A and B were cluster analyzed independently on the basis of the five component scores obtained from the principal components analysis of the integration and differentiation variables.

First, the minimum variance method with Euclidian distance as a measure of dissimilarity, found in the "CLUSTER" procedure of SAS (Release 6.07), was used to determine the initial clusters (Ward, 1963; Ward & Hook,

1963). This method is designed to minimize the within-cluster variance while maximizing the between cluster variance (Aldenderfer & Blashfield, 1984). At each step of the analysis, the union of every possible pair of clusters, where a cluster can consist of one or more entities, is considered and the two "clusters" whose fusion results in a minimum increase in the error sum of squares are combined (Aldenderfer & Blashfield, 1984). The formula for the error sum of squares is

$$ESS = \sum_{s=1}^{p} \sum_{g=1}^{k-1} \sum_{r=1}^{n_g} [(y_{rsg})^2] - \sum_{s=1}^{p} \sum_{g=1}^{k-1} [1/n_g (\sum_{r=1}^{n_g} y_{rsg})^2]$$

where:

r = object [r=1, . . ., n_g]

g = group [g=1, . . ., k-1]

s = characteristic [s=1, . . ., p]

y_{rsg} = observation of the sth attribute for the rth entity in the gth group (Aldenderfer & Blashfield, 1984). The matrix of squared Euclidian distances among the objects to be clustered served as input data for the minimum variance clustering procedure.

In effect, hierarchical methods, such as the minimum variance method, produce a series of "partitions" ranging from n clusters to a solution subsuming the entire data set (Milligan & Cooper, 1985). From this series of partitions, one must determine the one level that best reproduces the

structure present in the data set (Milligan & Cooper, 1985). In the present study, the "cubic clustering criterion" and the pseudo F statistic were used. The cubic clustering criterion is the product of two terms: (1) the natural logarithm of

$$(1 - E(R^2)) / (1 - R^2)$$

where R^2 is the proportion of variance in the attributes used in the cluster analysis that is accounted for by the clusters; and (2)

$$((np/2)^{.5})/((.001 + E(R^2))^{1.2})$$

where p is an estimate of the dimensionality of the between cluster variation (Milligan & Cooper, 1985; Sarle, 1983). The pseudo F is computed as

$$[traceB/(k-1)]/[traceW/(n-k)]$$

where n is the total number of items, k is the total number of clusters in the solution, and B and W are the between and pooled within-cluster sum of squares and cross-products matrices (Calinski & Harabasz, 1974; Milligan & Cooper, 1985).

Tables 11 and 12 contain the results of the cluster analysis conducted on Sample A and Sample B independently.

The tables include the values obtained for the cubic clustering criterion (CCC) and the pseudo F statistic (PSF). Interpretation of these criteria were aided by following several general guidelines. First, positive values of the cubic clustering criterion mean that the obtained R^2 is greater than would be expected if the sample was drawn from a uniform distribution, and therefore, indicates the possible presence of clusters (Sarle, 1983). Second, to identify the optimal number of clusters in the data, one typically uses the highest obtained value of the cubic clustering criterion or the pseudo F statistic (Milligan & Cooper, 1985). However, in some cases both criteria tend to increase as the number of clusters increases. In this situation, it is more appropriate to look for large jumps in these statistics than to consider the highest value overall in determining the number of clusters (Ray, 1982). Finally, a cubic clustering criterion exceeding 2 or 3 is considered strong evidence of clusters (Sarle, 1983).

As indicated in Tables 11 and 12, the cubic clustering criterion is positive for both Samples A and B indicating the presence of clusters. Because the cubic clustering criterion and the pseudo F statistic increase with the number of clusters, large jumps in these criteria were examined to determine the most likely number of clusters. For Sample A, the largest increases in the values of the cubic clustering criterion and the pseudo F statistic occur at the level of 6 clusters. For Sample B, the largest

Table 11

Results of Ward's Minimum Variance Cluster Analysis for Sample A

Number of Clusters	R^2	Expected R^2	CCC	PSF
9	.866	.725	11.20	29.2
8	.840	.696	10.50	27.7
7	.792	.661	8.46	24.1
6	.743	.620	7.35	22.6
5	.641	.563	3.68	17.8
4	.525	.485	1.56	15.1
3	.378	.376	0.09	12.8
2	.195	.220	-0.94	10.4
1	.000	.000	0.00	.

Table 12

Results of Ward's Minimum Variance Cluster Analysis for Sample B

Number of Clusters	R^2	Expected R^2	CCC	PSF
9	.849	.725	9.47	26.1
8	.820	.696	8.65	24.7
7	.773	.662	7.05	22.2
6	.718	.621	5.61	20.4
5	.651	.567	4.08	19.1
4	.536	.491	1.83	16.2
3	.380	.386	-0.18	13.2
2	.202	.225	-0.82	11.1
1	.000	.000	0.00	.

increase in the value of the cubic clustering criterion occurs at five clusters, whereas the pseudo F statistic suggests the presence of either four or five clusters. Because of this discrepancy between the criteria and the values of the pseudo F, the cluster compositions were examined to determine which solution was more interpretable. Examination of the cluster compositions for Sample B suggests that the five-cluster solution makes finer discriminations and, therefore, more interpretable distinctions between the groups (see Tables 14 and 15). For example, Cluster 1 in the four-cluster solution is very large and consists of teams that make up clusters one, two and three in the five-cluster solution. Examination of the specific teams within Cluster 1 of the four-cluster solution indicates that child study teams, customer response teams, task project teams, quality improvement teams, and entertainment groups are included with rescue teams and sports teams. In contrast, the five-cluster solution of Sample B, allocates the child study teams, customer response teams, task project teams, quality improvement teams, and entertainment groups to another cluster. This separation would appear to make more sense intuitively as rescue teams and sports teams are more action-oriented whereas child study teams, customer response teams, task project teams, and quality improvement teams are more service-oriented. Consequently, the five-cluster solution of Sample B is seen as more appropriate. Finally, for both samples the cubic

clustering criterion exceeded 2 providing further evidence of clusters.

A later phase of the analysis involves a direct comparison of the cluster solution for Sample A with the cluster solution of Sample B. Therefore, to facilitate this comparison, the six-cluster solution for Sample B was also examined. Although it was not directly indicated by the pseudo F statistic or the cubic clustering criterion, the six-cluster solution of Sample B would allow a more direct comparison with the six clusters identified in Sample A. Comparison of the six-cluster solution of Sample B with the five-cluster solution indicates that cluster membership is nearly identical with the exception of five teams. These five teams appear in Cluster 2 in the five-cluster solution and Cluster 5 in the six-cluster solution. Therefore, the six-cluster solution of Sample B was determined to represent a reasonable clustering worthy of further examination. A list of teams making up each cluster for Samples A and B is found in Tables 13-16.

Hypotheses 1 through 4. Sundstrom and Altman (1989) proposed a classification system of four distinct types of teams. The results of the present study indicate six types of teams. However, comparison of the characteristics of the obtained clusters with those proposed by Sundstrom and Altman (1989) indicate strong similarities. Table 17 contains a summary of these comparisons. The

Table 13

List of Teams by Cluster for Sample A With Ward's Method

Type of Team	Frequency
Cluster 1	
Fire Fighting Team	3
Hazardous Materials Team	2
Technical Rescue Team	1
Lacrosse Team	1
Basketball Team	1
Task Project Team	1
Musical Group	1
Surf Rescue Team	1
Dive Team	1
SWAT Team	1
Combat Team	1
Cluster 2	
Child Study Team	4
Customer Response Team	1
Cluster 3	
Gas Construction Crew	2
Advanced Life Saving Team	1
Squad Truck Team	1
Mosquito Control Team	1
Flight Crew	1
Cluster 4	
Quality Improvement Team	8
Task Project Team	1
Committee	1
Cluster 5	
Assembly Group	3
Sanitation Crew	1
Cluster 6	
Task Project Team	1
Management Team	1
Staff Development Team	1
Research Team	2

Table 14

List of Teams by Cluster for Sample B With Ward's Method -- 4-Cluster Solution

Type of Team	Frequency
Cluster 1	
Fire Fighting Team	2
Hazardous Materials Team	1
Technical Rescue Team	2
Field Hockey Team	1
Surf Rescue Team	1
Hostage Negotiation Team	1
Child Study Team	2
Task Project Team	7
Musical Group	2
Dive Team	1
Customer Response Team	1
Quality Improvement Team	2
Cluster 2	
Gas Construction Crew	4
Assembly Group	2
Shipping Team	1
Flight Crew	1
Quality Improvement Team	1
Cluster 3	
Basic Life Saving Team	2
Squad Truck Team	2
Cluster 4	
Task Project Team	2
Management Team	2
Staff Development Team	1
Research Team	1
Energy Efficiency Team	1
Committee	2
Advisory Council	1

Table 15

List of Teams by Cluster for Sample B With Ward's Method -- 5-Cluster Solution

Type of Team	Frequency
Cluster 1	
Fire Fighting Team	2
Hazardous Materials Team	1
Technical Rescue Team	2
Field Hockey Team	1
Surf Rescue Team	1
Hostage Negotiation Team	1
Cluster 2	
Child Study Team	2
Customer Response Team	1
Task Project Team	7
Quality Improvement Team	2
Musical Group	2
Dive Team	1
Cluster 3	
Gas Construction Crew	4
Assembly Group	2
Shipping Team	1
Flight Crew	1
Cluster 4	
Basic Life Saving Team	2
Squad Truck Team	2
Cluster 5	
Task Project Team	2
Management Team	2
Staff Development Team	1
Research Team	1
Energy Efficiency Team	1
Committee	2
Advisory Council	1

Table 16

List of Teams by Cluster for Sample B With Ward's Method -- 6-Cluster Solution

Type of Team	Frequency
Cluster 1	
Fire Fighting Team	2
Hazardous Materials Team	1
Technical Rescue Team	2
Field Hockey Team	1
Surf Rescue Team	1
Hostage Negotiation Team	1
Cluster 2	
Child Study Team	2
Customer Response Team	1
Task Project Team	4
Musical Group	2
Dive Team	1
Cluster 3	
Gas Construction Crew	4
Assembly Group	2
Shipping Team	1
Flight Crew	1
Quality Improvement Team	1
Cluster 4	
Basic Life Saving Team	2
Squad Truck Team	2
Cluster 5	
Task Project Team	3
Quality Improvement Team	2

Table 16, continued

List of Teams by Cluster for Sample B With Ward's Method -- 6-Cluster Solution

Cluster 6	
Management Team	2
Staff Development Team	1
Research Team	1
Energy Efficiency Team	1
Committee	2
Advisory Council	1
Task Project Team	2

Table 17

Comparison of Obtained Clusters with Team Types Hypothesized by Sundstrom and Altman

Sundstrom and Altman's Hypothesized Team Types	Team Types Obtained in Present Study
Action/Negotiation	Cluster 1
Project/Development	Cluster 2
Production/Service	Cluster 3 (emphasis on service)
Advice/Involvement	Cluster 4
Production/Service	Cluster 5 (emphasis on production)
Project/Development Action/Negotiation	Cluster 6

characteristics of the obtained clusters, with respect to the integration and differentiation variables, as well as a comparison with the groups proposed by Sundstrom and Altman are discussed more fully in the Discussion section below.

Hypotheses 5 through 8. Within the Sundstrom and Altman framework, some overlap between clusters was expected. The nature of the overlapping characteristics was expressed in the hypotheses 5 through 8. Specifically, advice/involvement groups and project/development groups would be similar to each other on the attribute set pertaining to integration. Production/service groups and action/negotiation groups would be similar to each on the

attribute set pertaining to differentiation. Advice/ involvement groups and production/service groups would be similar to each other on the attribute set pertaining to integration. Project/development groups and action/ negotiation groups would be similar to each other on the attribute set pertaining to differentiation. Because the results of the present study indicate six types of teams rather than the four types proposed by Sundstrom and Altman, comparison between types is difficult. However, an indication of the overlap between the obtained clusters was provided through a MANOVA performed with the five component scores. The interest was in the post hoc analyses rather than the overall MANOVA itself. According to the post hoc analyses, Clusters 2, 4, and 6 were similar to each other but significantly different from the other clusters on Component 1. These clusters are comparable to what were termed advice/involvement and project/development teams which provides support for Hypothesis 5. In addition, Clusters 1, 3, 5, and 6 were similar to each other but significantly different from the other clusters on Component 2. These clusters are comparable to production/service and action/negotiation teams, thus providing support for Hypothesis 6. Hypotheses 7 and 8 were not confirmed.

Environmental demands and behavioral requirements variables. In addition to the integration and differentiation variables suggested by Sundstrom and Altman (1989), two other sets of variables were considered to have

relevance for a team classification system. The first set, referred to as environmental demands, pertain to requirements that teams have with respect to their environment. Sundstrom and Altman posit that different types of teams place different demands on their environments. Specifically, these environmental demands are represented by four dimensions: (1) interface demands that involve the accommodation of transactions between the group and nonmembers; (2) barrier demands that involve restrictions in the inflow or outflow of people, goods, or information; (3) interaction demands that involve the accommodation of exchanges among team members; and (4) differentiation demands that involve the accommodation of role differences among team members.

The second set of variables examined in the present study represented team behavioral requirements. Behavioral requirements refer to seven components that have been suggested as essential to team performance (Dickinson et al., 1992; Glickman et al., 1987; McIntyre, Morgan, Salas, & Glickman, 1988; McIntyre, Salas, Morgan, & Glickman, 1989; Morgan et al., 1986). These are: (1) communication, (2) team orientation, (3) team leadership, (4) monitoring, (5) feedback, (6) backup behavior, and (7) coordination (Dickinson et al., 1992; McIntyre et al., 1988). The behavioral requirements were derived through research conducted with military teams. They were included in the

present study to examine their relevance for other types of teams.

The environmental demands and behavioral requirements variables were included to determine whether either set of variables could serve as the basis of a team classification system. The procedure for deriving clusters that was described above was followed with the environmental demands variables and the behavioral requirements variables substituted for the integration and differentiation variables. The analyses were conducted separately for the environmental variables and the behavioral variables. Both sets of analyses resulted in a single cluster in Samples A and B. This indicates that neither the environmental variables nor the behavioral variables exhibit sufficient variance among teams to serve as the basis of a classification system.

Summary. In the derivation phase, a sample of 91 teams was randomly split into two subsamples, one containing 45 teams (Sample A) and the other containing 46 teams (Sample B). Sample A and Sample B were cluster analyzed independently by means of Ward's minimum variance method. The cubic clustering criterion and the pseudo F statistic were examined to determine the number of clusters. Both criteria indicated the presence of six clusters in Sample A. For Sample B, the cubic clustering criterion indicated five clusters, whereas the pseudo F statistic suggested four or five clusters. Examination of the four- and five-cluster

solutions of Sample B suggested that the five-cluster solution was more appropriate. In addition, although not directly indicated by the criterion statistics, the six-cluster solution of Sample B was examined and determined to represent a reasonable clustering solution worthy of further examination. Finally, cluster analyses performed on the environmental demands and behavioral requirements variables failed to indicate the presence of multiple clusters.

Validation of Classification System

An important step in the development of a classification system involves evaluating or validating the resulting classifications. Validation entails demonstrating that a classification is stable, internally consistent, generalizable, and meaningful (Morey et al., 1983).

In addition, the classification should have discriminatory power in variable domains other than those used to create the original categories. This provides further evidence of a classification's generalizability and also an indication of its meaningfulness or utility (Morey et al., 1983). This aspect of validity was examined in the external validation phase described below.

Replication Phase

The purpose of the replication phase is to determine if the cluster solution can be replicated in a similar data set. This provides an indication of a classification's stability, internal consistency, and external generalizability. In this phase, cases in Sample B were

assigned to clusters derived from Sample A in the derivation phase, by means of the nearest-centroid assignment procedure (McIntyre & Blashfield, 1980). The integration and differentiation component scores were used in the clustering process. The nearest-centroid assignment procedure is part of the FASTCLUS procedure of SAS (Release 6.07). FASTCLUS uses a k-means procedure whereby objects in a second data set are assigned to one of the centroid vectors from a cluster analysis of the first data set by means of the smallest Euclidian distance.

First, the centroids for the clusters derived from Sample A in the derivation phase were calculated. Next, the distance between each element in Sample B and each of the centroids determined from Sample A was computed. The elements in Sample B were clustered by assigning each element in Sample B to the nearest cluster centroid from Sample A. Table 18 contains a list of teams making up each cluster for Sample B assigned on the basis of the centroids from Sample A.

Comparison of the original six cluster solution of Cluster B with the nearest-centroid solution indicates that, in general, cluster membership was relatively similar. Three teams in Cluster 2 in the original clustering (i.e., two musical groups and a dive team) moved to Cluster 1 in the centroid solution. Cluster 4 in the centroid solution has the same membership as Cluster 5 in the original clustering and membership in Cluster 6 is identical in both

Table 18

List of Teams by Cluster for Sample B Based on Centroids from Sample A

Type of Team	Frequency
Cluster 1	
Fire Fighting Team	2
Hazardous Materials Team	1
Technical Rescue Team	2
Field Hockey Team	1
Surf Rescue Team	1
Hostage Negotiation Team	1
Musical Group	2
Dive Team	1
Cluster 2	
Child Study Team	2
Customer Response Team	1
Task Project Team	4
Cluster 3	
Gas Construction Crew	3
Basic Life Saving Team	2
Squad Truck Team	2
Flight Crew	1
Cluster 4	
Quality Improvement Team	2
Task Project Team	3
Cluster 5	
Gas Construction Crew	1
Quality Improvement Team	1
Shipping Team	1
Assembly Group	2

Table 18, continued

List of Teams by Cluster for Sample B Based on Centroids from Sample A

Cluster 6	
Task Project Team	2
Management Team	2
Staff Development Team	1
Research Team	1
Energy Efficiency Team	1
Committee	2
Advisory Council	1

solutions. Finally, four teams in Clusters 3 and 4 in the original solution exchanged places and appear in Clusters 3 and 5 in the centroid solution.

This assignment of Sample B cases was compared to the original clustering of Sample B that occurred in the derivation phase by means of the Hubert and Arabie (1986) adjusted Rand statistic. The Rand statistic defines two instances of classification agreement: (1) when two solutions agree that two elements are to be assigned to the same cluster, and (2) when two solutions agree that two elements are to be assigned to different clusters (Morey & Agresti, 1984). Given an n object set S, where U and V represent two different partitions of S, then

$$\frac{\sum_{i,j}\binom{n_{i,j}}{2} - \sum_{i}\binom{n_{i.}}{2}\sum_{j}\binom{n_{.j}}{2} \Big/ \binom{n}{2}}{\frac{1}{2}\left[\sum_{i}\binom{n_{i.}}{2} + \sum_{j}\binom{n_{.j}}{2}\right] - \sum_{i}\binom{n_{i.}}{2}\sum_{j}\binom{n_{.j}}{2} \Big/ \binom{n}{2}}$$

where for each distinct pair,

$$\binom{n}{2}$$

n_{ij} = the number of objects that are common to classes u_i and v_j;

$n_{i.}$ = the number of objects in class u_i (row i)

$n_{.j}$ = the number of objects in class v_j (row j)

The equation above corrects for chance agreement. Larger values of this statistic indicate greater consistency among the partitions. The reassignment of Sample B cases with the centroids from Sample A was compared to the four-, five-, and six-cluster solutions of Sample B and an adjusted Rand statistic calculated for each comparison. The results are displayed in Table 19. The program for computing the adjusted Rand statistic is contained in Appendix E.

Table 19

Comparison of 3 Different Cluster Solutions of Sample B with Nearest Centroid Cluster Solution

Cluster Solution	Rand Statistic	Expected Rand	Adjusted Rand
4-Clusters	.80386	.61549	.48991
5-Clusters	.86184	.68902	.55572
6-Clusters	.92174	.72610	.71427

Examination of the adjusted Rand statistic for each of these three cluster solutions indicates that the six-cluster solution is the most similar and internally consistent.

Therefore, the six-cluster solution was selected to be examined in the next phase of the study.

Summary. In the replication phase, the centroids for the clusters derived from Sample A in the derivation phase were calculated. The centroids were used in the nearest-centroid assignment procedure in which the elements in Sample B were clustered by assigning each element in Sample B to the nearest cluster centroid from Sample A. Comparisons of the original four- and five- cluster solutions of Sample B obtained in the derivation phase were made with the nearest-centroid solution of Sample B. A six-cluster solution of Sample B was also examined in order to allow for a more direct comparison with the six-cluster solution of Sample A. The comparisons were made by means of the Hubert and Arabie (1986) adjusted Rand statistic. Examination of the adjusted Rand statistic indicated that the six-cluster solution was the most similar and internally consistent and, therefore, would be examined in the next phase of the study.

External Validation Phase

The purpose of the external validation phase is to examine the classification's discriminatory power in variable domains other than those used to create the original categories (Morey et al., 1983). This provides further evidence of a classification's generalizability and also an indication of its meaningfulness or utility.

The results of this phase of the analysis were used to examine Hypotheses 9 through 13. Specifically, these are as follows:

> **Hypothesis 9:** Teams that are categorized on the basis of their characteristics of differentiation and integration, should display different requirements for environmental support.
>
> **Hypothesis 9a:** Advice/involvement teams will demonstrate strong barrier demands.
>
> **Hypothesis 9b:** Production/service teams will demonstrate strong interface demands.
>
> **Hypothesis 9c:** Project/development teams will demonstrate strong barrier demands, internal interaction demands, and role differentiation demands.
>
> **Hypothesis 9d:** Action/negotiation teams will demonstrate strong barrier demands, interface demands, and role differentiation demands.
>
> **Hypothesis 10:** Action/negotiation groups and product/service groups will display a higher incidence of the behavior attributes pertaining to backup behavior and/or the systems monitoring function than will the other two types of groups.
>
> **Hypothesis 11:** Action/negotiation groups will display a higher incidence of the team behavior attributes pertaining to the response coordination function than that displayed by the other three types of groups.
>
> **Hypothesis 12:** Advice/involvement groups will display a higher incidence of the team behavior attributes pertaining to the team orientation function than that displayed by the other three groups.
>
> **Hypothesis 13:** Advice/involvement groups and product/development groups will display a higher incidence of the team behavior attributes pertaining team leadership than that displayed by the other two groups.

In this phase, the derived clusters or types were examined with respect to their ability to discriminate among

the various kinds of teams on an external set of variables. In other words, do the obtained clusters also differ with respect to variables other than those used in deriving those clusters? For this purpose, the attributes pertaining to environmental demands and team behavioral requirements were used. The environmental demands variables consist of four dimensions: (1) interface demands that involve the accommodation of transactions between the group and nonmembers; (2) barrier demands that involve restrictions in the inflow or outflow of people, goods, or information; (3) interaction demands that involve the accommodation of exchanges among team members; and (4) differentiation demands that involve the accommodation of role differences among team members. The behavioral requirements variables consist of seven dimensions: (1) communication, (2) team orientation, (3) team leadership, (4) monitoring, (5) feedback, (6) backup behavior, and (7) coordination.

It was intended originally to assign cases in a separate sample, Sample C, to the clusters derived from Sample A in the derivation phase, by means of the nearest centroid assignment procedure described above. The resulting groups then would be compared on the variables pertaining to environmental demands and behavioral requirements by means of MANOVAs. However, because an additional sample was not possible, Samples A and B were combined to increase sample size and the resulting sample was examined with respect to the environmental demands and

team behavioral requirements variables. Because this information was not used at any point in the clustering process, its use as a means to validate the clustering results is acceptable (Milligan & Cooper, 1987).

In combining Samples A and B, the teams in Sample A were coded with respect to their assignment in the six-cluster solution obtained in the derivation phase by means of Ward's method. The teams in Sample B were coded with respect to their assignment in the six-clusters obtained in the centroid clustering of Sample B that occurred in the replication phase. The combined sample consisted of 90 teams (i.e., one team was dropped due to missing data) divided into six clusters. The clusters were derived from the Ward's method clustering of Sample A and the centroid clustering of Sample B. This resulted in 25 teams in Cluster 1, 12 teams in Cluster 2, 14 teams in Cluster 3, 16 teams in Cluster 4, 9 teams in Cluster 5, and 14 teams in Cluster 6. Mean scores for the four environmental demands variables and the seven behavioral requirements variables were used as dependent variables in separate MANOVAs.

The results for the MANOVA for the environmental demands variables showed an overall main effect of cluster membership, Wilks' Lambda = .4557, F (5,20) = 3.6047, p < .001. The results for the MANOVA for the behavioral requirements variables also showed an overall main effect of cluster membership, Wilks' Lambda = .3777, F (7,35) = 2.4671, p < .001.

To clarify which particular variables differed among clusters, a univariate analysis of variance (ANOVAs) was computed for each of the four environmental demands variables and for each of the seven behavioral requirements variables. The results indicated that the six clusters differed on the interaction and role differentiation dimensions among the environmental demands variables and on the communication, monitoring, backup behavior, and coordination dimensions among the behavioral requirements variables. Summaries of the results are presented in Tables 20 and 21.

Because a number of the ANOVAs were significant, post hoc analyses were conducted to determine among which clusters differences existed. In order to be considered significant, a difference between clusters had to be indicated by the results of Scheffe's Test at the $p < .05$ level. This reliance on a conservative post hoc test served to reduce the number of dimensions considered significant. For purposes of future hypothesis testing, these marginal results are included in Appendix F.

Interaction demands. Responses from teams in Cluster 1 ($M = 3.32$) indicated stronger needs for interaction among group members than that indicated by teams in Clusters 2 ($M = 2.33$), 3 ($M = 2.56$), 4 ($M = 2.44$), and 5 ($M = 2.25$).

Table 20

Summary of Analysis of Variance for Environmental Demands Variables

Source	df	SS	MS	F
Interface Demands				
Cluster	5	3.8305	0.7661	1.50
ERROR	84	42.9396	0.5112	
Corrected Total	89	46.7701		
Barrier Demands				
Cluster	5	3.4354	0.6871	1.22
ERROR	84	47.3542	0.5637	
Corrected Total	89	50.7896		
Interaction Demands				
Cluster	5	14.6967	2.9393	9.46 **
ERROR	84	26.0890	0.3106	
Corrected Total	89	40.7857		
Role Differentiation Demands				
Cluster	5	11.9603	2.3920	4.13 *
ERROR	84	48.6397	057904	
Corrected Total	89	60.6000		

* $p < .01$

** $p < .001$

Table 21

Summary of Analysis of Variance for Behavioral Requirements Variables

Source	df	SS	MS	F
Communications				
Cluster	5	10.3213	2.0642	3.96 *
ERROR	84	43.7926	0.5213	
Corrected Total	89	54.1139		
Team Orientation				
Cluster	5	0.4155	0.0831	0.22
ERROR	84	31.4502	0.3744	
Corrected Total	89	31.8657		
Monitoring				
Cluster	5	19.8695	3.9739	7.41 **
ERROR	84	45.0444	0.5362	
Corrected Total	89	64.9139		
Feedback				
Cluster	5	4.0510	0.8102	1.33
ERROR	84	51.0114	0.6073	
Corrected Total	89	55.0624		

* $p < .01$

** $p < .001$

Table 21, continued

Summary of Analysis of Variance for Behavioral Requirements Variables

Source	df	SS	MS	F
Backup Behavior				
Cluster	5	6.7972	1.3594	4.05 **
ERROR	84	28.2117	0.3358	
Corrected Total	89	35.0089		
Coordination				
Cluster	5	9.1148	1.8229	3.53 *
ERROR	84	43.3884	0.5166	
Corrected Total	89	52.5032		
Leadership				
Cluster	5	3.8305	0.7661	0.95
ERROR	84	67.9871	0.8094	
Corrected Total	89	71.8176		

* $p < .01$

** $p < .001$

Role differentiation demands. Responses from teams in Cluster 1 (M = 1.38) indicated stronger needs for the acknowledgement of role differences among members than that indicated by teams in Cluster 4 (M = 0.31).

Communication. Although a significant difference in communication between clusters was indicated in the ANOVA, the results of the Scheffe did not provide evidence of significant differences between clusters.

Monitoring. Monitoring was rated as more important among teams in Cluster 3 (M = 2.96) than among teams in Cluster 4 (M = 1.84) and Cluster 6 (M = 1.80).

Backup behavior. Although a significant difference in backup behavior between clusters was indicated in the ANOVA, the results of the Scheffe did not provide evidence of significant differences between clusters.

Coordination. Although a significant difference in coordination between clusters was indicated in the ANOVA, the results of the Scheffe did not provide evidence of significant differences between clusters.

Hypotheses 9 through 13. The results of the overall MANOVA indicated that neither barrier nor interface demands were significant, therefore, Hypotheses 9a and 9b were not confirmed. Similarly, among the behavioral requirements variables, neither team orientation nor team leadership were significant. Therefore, Hypotheses 12 and 13 were not confirmed. Although ANOVAs indicated that monitoring, back-up behavior, and coordination were significant, the post hoc

analyses confirmed significant differences between clusters only for monitoring. Consequently, Hypothesis 10 was partially confirmed but hypothesis 11 was not confirmed.

Significant differences among clusters were indicated for interaction demands and role differentiation demands. This provides a partial confirmation of Hypothesis 9c and 9d. However, as previously stated the results of the present study indicate six types of teams rather than the four distinct types proposed by Sundstrom and Altman (1989). While this makes a direct test of the hypotheses difficult, comparisons among the obtained clusters on the significant environmental demands and behavioral requirements variables are discussed in the Discussion section below.

Summary. The clusters derived in the previous two phases were examined with respect to an external (i.e., not used in the original cluster analysis) set of variables by means of MANOVAs. Specifically, these variables consisted of environmental demands and behavior requirements. Significant differences among clusters were indicated on the attributes of interaction demands, role differentiation demands, and monitoring.

Cross Validation Phase

The purpose of the final phase, referred to as cross validation in the sequential validation design (Morey, et al., 1983), was to examine whether the same category assignments could be obtained by another assignment method, discriminant analysis. Specifically, this phase was to

examine the discriminating power of the clusters or types found to be significant with respect to external validity in phase three. The assignments made in this phase would differ with respect to the assignment technique, the variables used, and the sample used. However, as previously stated, it was not possible to obtain a fourth sample, therefore, this phase was not completed. Because the obtained sample and three sets of variables (i.e., integration and differentiation, environmental demands, and behavioral requirements) had been examined by means of multiple procedures (i.e, cluster analyses, MANOVAs), omission of the final phase in the sequential validation framework was not viewed as a significant loss of information.

CHAPTER FOUR

DISCUSSION

The purpose of the present study was to demonstrate an approach to the development of an empirically based team classification system. Currently, the only such classification systems available are those developed purely by rational means. This research makes an important contribution to team research by demonstrating the feasibility of developing and validating a classification system based on empirical data. Sundstrom and Altman's (1989) proposed system, which classifies teams and work groups into four distinct groups on the basis of their degree of integration and differentiation, was used as a target system. Data were collected on a variety of teams and then cluster analyzed by means of Ward's minimum variance method. The resulting clusters were examined with respect to their requisite environmental demands and behavioral requirements.

Examination of Obtained Clusters

The results of the present study indicate six types of teams rather than the four distinct types proposed by Sundstrom and Altman (1989). Although this made a direct test of the hypotheses difficult, the characteristics of each cluster with respect to the integration and differentiation variables and the significant environmental demands and behavioral requirements variables are discussed below. In addition, the obtained clusters are compared to

the four groups proposed by Sundstrom and Altman with respect to their standing on the integration and differentiation variables. Finally, the obtained clusters and the demonstrated approach to the development of a classification system are discussed with respect to their practical and theoretical implications.

Characteristics of Clusters

Sundstrom and Altman (1989) proposed a classification system of four distinct types of teams that vary with respect to two sets of attributes, differentiation and integration. Differentiation refers to the degree of specialization and independence or autonomy of a work team in relation to other units and is seen as a function of several elements: (1) specialization, which refers to the group's unique activities, the skills needed to perform those activities, and the similarity of skills among team members; (2) scope of activity, which refers to the number of different activities performed by the group; and (3) temporal scope, which refers to the time span available for group interaction. Integration pertains to a group's need for communication and coordination with the larger organizational system and is seen as a function of: (1) frequency of external interactions, which refers to the number of outside groups with which a team must deal; (2) standardization, which refers to the availability of established methods or procedures for completing a group's task; and (3) external pacing, which refers to the need to

schedule or time a group's activities in accordance with the activities of an outside group or individual.

The results of the present study indicated the presence of six clusters or types of teams as opposed to the four proposed by Sundstrom and Altman. However, comparison of the characteristics of the obtained clusters with those proposed by Sundstrom and Altman indicate some strong similarities. The characteristics of the obtained clusters, with respect to the integration and differentiation variables, as well as a comparison with the groups proposed by Sundstrom and Altman are discussed below.

Cluster 1. Cluster 1 consists of fire-fighting and rescue teams, sports teams, and performing groups. For teams in Cluster 1, special expertise is required to perform their given tasks, although the nature of the expertise varies. For fire-fighting and rescue teams, this expertise is acquired through a specific course of education leading to some form of certification (e.g., certification in handling hazardous materials). For sports and performing groups, it is generally accumulated through repeated practice. In fact, one of the distinguishing characteristics of teams in this group is the need for frequent team-training or practice. During the playing season, sports teams practice several times a week. The practice sessions of performing groups varies, with the frequency of practice increasing prior to a performance. The fire-fighting and rescue teams spend a portion of nearly

every duty day in some form of practice or training. In addition, they get together with regional teams for special drills on a quarterly basis. With respect to similarity of skills, the members of Cluster 1 teams tend to have skills that are similar to each other yet a given individual may hold a unique position within the team. For example, in the hazardous materials teams, a distinction is made between a technician and a specialist. Both have the same basic skills, but the specialist has more training in a particular area, such as technical decontamination. When the team responds to a hazardous material call, the specialist in technical decontamination would serve as the decontamination officer, while the technician would be assigned another role.

With respect to scope of activity, teams in this cluster tend to have relatively limited areas of specific responsibilities but they may have to adapt to varying circumstances. For example, a sports team's task is generally restricted to playing a particular sport. However, they play against different teams with different strengths and weaknesses and they compete on different playing fields under different weather conditions. Each of these different conditions involves some type of adjustment in the team's strategy. In addition, the scope of activity of fire-fighting teams is restricted to the areas of fire prevention and safety. However, conditions at a fire scene may vary considerably depending on the materials involved,

the amount of property involved, the location of the fire, etc. Each of these different conditions would involve a different strategy. Therefore, although teams in Cluster 1 may not be involved in a variety of activities, they deal with a variety of conditions that, as a result, keeps repetition to a minimum. Although there is some degree of repetition involved, in that certain activities are repeated every time the group meets, various aspects of the task change. For example, in responding to a fire, there are certain procedures that a fire-fighting team must always follow, (e.g., procedures involved in setting up hoses and equipment), but there are other procedures that are implemented only when the situation warrants (e.g., in cases when hazardous materials are present). In other cases, there may be long periods of time between repetitions or the conditions under which the group must perform may differ, sometimes drastically. For example, technical rescue teams are trained to perform high elevation rescues but may not be called to do so very often. Finally, with respect to the type of activity involved in a team's task, the activities of teams in Cluster 1 involve some sort of physical activity, such as engaging in a sporting competition, putting out a fire, or performing a rescue operation.

The life-span of teams in this cluster tend to be relatively long and membership fairly stable. In some cases, the teams are generally together indefinitely, whereas in others, the tenure of certain individuals may

change. For example, members of a sports team may only be eligible to play for a certain number of years. In general, most teams in this cluster spend a large amount of time together, such as fire-fighters who spend a large portion of their 24 hour shift responding to calls or working on team drills. However, certain teams, specifically the SWAT and hostage negotiation teams, actually work together only as necessary, for example, when a hostage situation arises. Most teams in this cluster tend to spend more time on group activities than on individual duties. For other teams, more time may be spent on individual activities than on working with the group. For example, members of a performing group may spend more time learning and practicing their individual parts than they spend practicing with the other members.

External interaction is rather important to teams in Cluster 1, and in general, they must interact with a fairly large number of external groups. Most deal with customers or clients on a regular basis. In fact, this interaction is critical or central to the group's purpose. For example, fire-fighting, hazardous materials, and technical rescue teams' sole purpose is to provide a service to the community. Most occasionally deal with the general public, although the interaction usually occurs in course of the group's work and is basically tangential to it. Many teams in this cluster deal with government or public agencies on a regular basis, usually for the exchange of information. For example, hazardous materials teams must interact with

individuals from the Environmental Protection Agency. Most teams in this cluster also have to deal with other teams of the same type on a regular basis. For instance, sports teams compete against other teams and fire-fighting teams may receive assistance from another fire-fighting team.

With respect to standardization of procedures, most teams follow general operating procedures that allow some room for decision-making or adjustment to a given situation. For example, certain procedures must always be followed at a fire scene, but adjustments may need to be made to accommodate existing conditions. In addition, for most teams in this cluster the potential for the unexpected is high; for some the unexpected often occurs, whereas for others, unexpected events may occur but most situations tend to be fairly stable. Fire-fighting, hazardous materials, and rescue teams operate under dangerous conditions where the potential for the unexpected is always present. In contrast, performing groups may run into an unexpected situation, such as unruly audience members, but usually operate under predictable conditions.

Although the teams in Cluster 1 do not provide input to the work of other groups, their critical activities are externally paced. Meeting deadlines is not a major part of these teams' work, but whatever deadlines exist are imposed externally. The timing or pacing of activities is important and is controlled by conditions outside the group's control

so that they must constantly monitor and adjust their actions to changing conditions. For example, fire-fighting teams monitor conditions at the fire scene and adjust their actions accordingly. In a similar manner, sports teams monitor the actions of the opposing team so that they may respond as appropriate. Finally, the schedules that these teams follow are established outside the group. Sports teams follow a schedule established by the league in which they play, performing groups follow a schedule established by management or administration, while fire-fighting and rescue teams cannot respond until there is a call for their services.

In summary, Cluster 1 teams are characterized by specialized skills, a rather limited scope of responsibility, generally long team life-spans, and a great deal of external interaction. In general, they spend a substantial amount of time together and operate under standard procedures that allow some degree of flexibility. In addition, the pacing of their activities is largely dictated by external conditions. The teams in Cluster 1 exhibit many of the same characteristics as those identified as action/negotiation teams by Sundstrom and Altman (1989).

Cluster 2. Cluster 2 consists of child study teams, customer response teams, and task project teams. The teams are heterogeneous with respect to members' skills and may include members from different occupations and with different education levels. Membership may also represent

individuals from different levels of the organization's hierarchy. For example, a task project team may include members of management as well as production workers. A relatively high level of expertise is required to perform the teams' tasks. For some, this involves some type of special training (e.g., customer response teams) while for others, education beyond a four-year college degree is needed (e.g., child study teams). However, team training generally is not needed or, at least, is not provided.

The scope of activity for teams in this cluster generally involves a single area of responsibility. In contrast to the teams in Cluster 1, the team's task usually involves discussion or coordination rather than physical activity. The teams' decision-making opportunities vary; for some there may be no decision-making involved, whereas others may have broad latitude in making decisions. For example, customer response teams, which are responsible for providing electrical service to new customers, have virtually no need for decision-making. They simply follow procedures. In contrast, child study teams must make recommendations regarding learning and behavioral problems. They must determine what services a child needs as well as what course of action the teacher or parents should follow. A rather high degree of repetition is involved for teams in this cluster. Although they may deal with many different cases or customers, many of the same activities tend to be repeated. For example, a child study team may deal with a

hundred different cases each year, yet it follows a standard protocol with each.

Teams within Cluster 2 are characterized by long team life-spans and stable memberships, with virtually all teams expecting to be together indefinitely. The members generally spend from two to 15 hours per week together, with the most of their time spent on individual activities. For example, members of a child study team spend more time conducting individual assessments than they do meeting with other team members.

Teams within this cluster also have a relatively high degree of external interaction. The majority must deal with customers or clients every time the group is together. In fact, it is this interaction that is crucial to the teams' existence. Without customers, for example, the customer response team would have no need to exist. Some teams deal occasionally with government or public agencies, typically for the purpose of exchanging information. For example, child study teams may need information from social service agencies. Child study teams also must deal with other professionals occasionally, whereas the task project teams may need to deal with contractors. Most also have to deal with other personnel or departments within their organization on a regular basis.

The degree of standardization varies within this cluster, depending on the nature of the team's work. Because child study teams see a variety of problems yet must

meet legal requirements, they follow general guidelines that provide broad limits on how the work is to be done. The task project teams follow general operating procedures that allow some room for decision-making or adjustment to a given situation. For customer response teams, standard operating procedures exist and must be followed. In general, most teams deal with basically stable conditions where the unexpected rarely occurs.

A low degree of external pacing is characteristic of teams in Cluster 2. Their work generally does not serve as input to the work of other individuals or groups. Although child study teams provide recommendations to teachers, the input is more a form of support, rather than a necessity. For child study teams, deadlines are externally imposed (i.e., dictated by federal mandates). For the customer service and task project teams, deadlines also are determined outside the group but they are in the form of general guidelines that allow some flexibility. All teams in this cluster determine their own timing or pacing of activities. In addition, the members of the task project groups determine their own schedules. The schedules of the child study teams and customer response teams are determined by the teams' members in cooperation or coordination with their customers or clients.

In summary, Cluster 2 teams are similar to Cluster 1 teams in that they are characterized by specialized skills, a rather limited scope of responsibility, and long team

life-spans and a high level of external interaction. They also operate under standard procedures that allow some degree of flexibility. However, they differ in that they spend a substantial amount of time working on independent activities rather than with the team. In addition, the pacing of their activities is largely under internal rather than external control. The teams in Cluster 2 exhibit many of the same characteristics as those identified as project/development teams by Sundstrom and Altman (1989).

Cluster 3. Cluster 3 consists of gas construction crews, life-saving teams, mosquito control crews, and flight crews. The members are largely homogeneous with respect to skills, although in some, a few members may have more advanced skills than the others. The level of education required to perform the teams' tasks varies. For example, members of life-saving teams and flight crews require some form of certification. In contrast, the skills required by gas construction crews and mosquito control crews are relatively easy to learn. The need for team training also varies. The gas construction and mosquito control crews receive no team training, whereas the life-saving teams are involved in drills on at least a quarterly basis.

The scope of activity for teams in Cluster 3 is restricted, involving only a single or limited set of responsibilities. Generally some form of physical activity is involved. Activities tend to be fairly repetitive, although for some teams, especially the life-saving teams,

the activities may change because of the different conditions encountered. For example, there are certain standard procedures which must be followed during all emergency calls (e.g., obtaining blood pressure readings), whereas others would depend on the condition of the patient.

The life-span of teams in Cluster 3 tends to be limited in the sense that team membership varies from call to call or day to day. The teams form as needed, so that the same members may not necessarily be together each time. For example, members of a life-saving team are on call for a certain number of hours each month, but the same members may not be on call at the same time. Consequently, the time team members spend together often varies, and for many, team members may be together only as necessary. For example, a life-saving team may respond to a large number of emergencies within a 12 hour period or they may not receive any calls. The members of some teams within this cluster, such as the life-saving teams, may spend more time on individual activities, such as completing paperwork or keeping emergency supplies stocked, than on team activities. However, for the other teams in this cluster, there are no other activities than those that involve the team.

A fairly high degree of external interaction is required for teams in this cluster, with the exception of the mosquito control crews which may not interact with external groups at all. Most of the other teams deal with customers or clients fairly often, or at least on a regular

basis. For the gas construction crews this interaction tends to be tangential whereas for the life-saving teams it is critical. In fact, life-saving teams probably have the highest degree of external interaction within this cluster. They occasionally must deal with the general public and must deal with the government or public agencies on a regular basis. This interaction may be in the form of some sort of assistance to the team, as for example, when a fire-fighting team helps with a rescue operation. The life-saving teams may also interact with other life-saving teams, such as in cases where additional help is needed with the victims of a major accident. They interact with relatives of patients on a regular basis as well as with medical professionals.

The degree of standardization varies within this cluster, depending on the nature of the team's work. Half the teams follow general operating procedures that allow some room for decision-making or adjustment to a given situation, whereas for the other half, standard operating procedures exist and must be followed. For example, life-saving teams follow standard procedures but must be able to make adjustments depending on the situation. Gas construction crews, in contrast, must follow standard operating procedures when working with gas lines. The frequency of unexpected occurrences also varies. For the life-saving teams, the potential for unexpected situations is high. In contrast, the other teams deal with fairly stable conditions where the unexpected rarely occurs.

Most teams in Cluster 3 provide no input to the work of others. The one exception is the gas construction crews which do provide input for others; however, they are not tightly tied to external groups in the sense that if the crews' work is delayed, others may be inconvenienced but the delay does not cause a severe disruption. Most teams in this cluster operate under externally imposed deadlines. However, there are differences. While the deadlines for the gas construction crews are determined externally, they are in the form of general guidelines that allow some flexibility. If the crew is delayed on one job, they simply get to the next one when they can. The life-saving teams, in contrast, operate under what they refer to as the "golden hour." Essentially, an accident victim's chances for survival are enhanced if medical attention is received within an hour of the accident. Consequently, when an emergency call comes in, the life-saving teams must respond immediately. They also must time or pace their activities according to external conditions. Teams such as the gas crews, in contrast, determines their own pacing. Schedules for all teams, however, are determined outside the group.

In summary, Cluster 3 teams are characterized by a somewhat lower level of skill specialization and a much more variable life-span than Clusters 1 and 2. Cluster 3 is similar to Clusters 1 and 2 in that it is characterized by a rather limited scope of responsibility and, with a few exceptions, a high level of external interaction. In

addition, the teams operate under standard procedures that allow some degree of flexibility and, in general, they must pace their activities according to external conditions. Teams in Cluster 3 are similar to teams identified as production/service teams by Sundstrom and Altman (1989). However, for teams in Cluster 3, the emphasis seems to be more on service than production.

Cluster 4. Cluster 4 consists of quality improvement teams, task project teams, and committees. The teams may consist of members with homogeneous skills or they may represent a heterogeneous mixture of skills and education levels, and may draw members from a variety of occupational groups across the organizational hierarchy. Although the individual members may be highly skilled, the skills needed to complete the teams' task are generally easily learned or the tasks may require no special skills.
Team training is not required or is provided only initially. For example, some quality improvement teams may receive training in problem-solving when the teams are formed, whereas committees simply are formed without any training provided.

The scope of activity of teams in Cluster 4 tends to be restricted to a single area of responsibility, generally solving a particular problem. Typically all that is involved at the team level is a discussion of the issue. Activities also tend to be repetitious at the team level, although individual members may engage in a broader variety

of activities on their own. For example, members of a task project team may have a number of assignments to complete on their own. They then report back to the team which uses the information that was provided.

Although some teams in this cluster will be together indefinitely (e.g., a standing committee), others are temporary, lasting only until a given project is completed. Team members spend relatively little time together as a group, generally meeting just a few hours a week, with members spending more time on individual activities than on team activities.

The level of external interactions in Cluster 4 teams tends to be low, with most teams interacting with relatively few, if any, external groups. Any interaction that does occur, typically involves an individual member seeking information.

The level of standardization varies among teams in Cluster 4 and appears to be a function of the organization in which the team operates. For example, most teams follow general guidelines that provide broad limits on how the work is to be done. Others are guided by general operating procedures that allow room for decision-making or adjustment to a given situation. For a few, standard operating procedures exist and must be followed, whereas for others no guidelines exist. In addition, the teams deal with basically stable conditions where unexpected situations rarely occur.

External pacing requirements are low for teams in Cluster 4. Keeping up a certain pace of activity generally is not critical to their work, and most do not provide input to the work of other individuals or departments. For the few that do, it is not so major that a delay in the team's input would be anything more than an inconvenience. Half the teams in this cluster do not need to meet established deadlines, while for the others, deadlines may be externally imposed but they are likely in the form of general time constraints that allow some flexibility. A few teams determine their own deadlines, and a few others must meet externally established deadlines. Whether or not a deadline is imposed or exists, seems to be a function of the problem under consideration by the team and the organization in which the team operates. Finally, all teams in this cluster establish their own schedules.

In summary, Cluster 4 teams are generally characterized by a low need for skill specialization, a limited scope of activity, a limited team-life span, and a low level of external interactions. The level of standardization is largely determined by the organization in which the team operates. Finally, external pacing is not an issue for teams in this cluster. Teams in Cluster 4 have characteristics similar to those identified by Sundstrom and Altman (1989) as advice/involvement teams.

Cluster 5. Cluster 5 consists of sanitation crews, assembly groups, and shipping crews. Members of teams

within this cluster generally are homogeneous with respect to skills, occupations, and education. Skill specialization is low, as the teams' tasks tend not to require special skills or the skills that are needed are easily learned. For example, members of an assembly team may be able to learn their jobs in a matter of hours. Team training is not involved.

The scope of activity for teams in Cluster 5 is limited to a single area of responsibility. The teams' tasks generally involve some type of physical activity but little or no decision-making. Activities also tend to be highly repetitious, for example, assembling the same components or picking up refuse.

The life-span of teams in this cluster is usually long, in fact team members are expected to be together indefinitely. Members work together all day, with most individual members having no other job duties than those that involve the other group members.

External interaction is low for Cluster 5 teams. Most interact only with other personnel or departments within their organization. For example, assembly groups only need to interact briefly with those who bring them supplies. Shipping crews interact mainly with those from whom they need to pick up merchandise. Sanitation crews may need to interact occasionally with equipment maintenance personnel.

Standardization is high for teams in Cluster 5, in fact they have established procedures that must be followed. For

example, assembly crews must follow standard procedures in assembling a product to ensure uniformity. Consequently, most teams work under fairly stable conditions in which unexpected situations rarely occur.

Although external interaction is low for these teams, external pacing demands are high. The assembly groups and shipping crews provide a product or service that is needed by other departments. This product or service must be provided at a specific time so that the activities of others will not be delayed. For example, an assembly group must provide its part of the product at given periods to prevent a delay in production further down the line. Sanitation crews differ along this dimension as they work independently, providing no input to the work of others. However, most teams in this cluster must meet externally imposed deadlines. While the sanitation crews are free to establish their own pace of activities, the assembly teams and shipping crews must keep up a pace of work that is externally established. Finally, the work schedule of teams in this cluster is determined outside the group.

In summary, Cluster 5 teams are characterized by low skill specialization, a limited scope of activity, and a low level of external interaction. In this respect they are similar to teams in Cluster 4. However, they differ in that Cluster 5 teams have long team life-spans, operate under highly standardized conditions, and exhibit a high degree of external pacing. Like teams in Cluster 4, teams in Cluster

5 share characteristics of those referred to as production/ service teams by Sundstrom and Altman (1989). However, teams in Cluster 5 exhibit higher levels of standardization and lower levels of external interaction than teams in Cluster 4. Whereas teams in Cluster 4 seem to be characterized by an emphasis on service, for those in Cluster 5, the emphasis is on production.

Cluster 6. Cluster 6 consists of management or executive teams, staff development groups, research teams, energy efficiency teams, and advisory councils. For most teams in this cluster, the members are heterogeneous with respect to skills. However, there are some exceptions. For example, one management team is comprised of members whose skills are generally similar to each other, whereas another includes managers whose skills differ. The level of expertise required to perform a team's work also varies, but in general, tends to be rather high. For example, the members of a research team must have an education level beyond a four-year college degree. In contrast, members of an advisory council need not have much education but may be highly skilled in some other respects.

The scope of activity tends to be very broad for teams in Cluster 6. They generally operate under a very broad mandate that encompasses a variety of activities. For example, staff development teams have the responsibility of providing support to the entire organization. This may involve numerous types of activities. Within this cluster,

team members typically engage in discussions or attempt to coordinate the activities of other groups and generally have broad decision-making authority. While some repetition may be involved in certain activities (e.g., standing issues must always be addressed) other activities are seldom repeated since the teams often deal with new situations.

The team life-span within Cluster 6 varies. Some groups may be together indefinitely, whereas for others such as advisory councils, the tenure of individual members is limited to a one or two year term. Members of Cluster 6 teams spend little time together, generally just a few hours a week. Instead, much more time is spent on individual activities than those that involve the team as a whole.

The level of external interaction is relatively low for teams in this cluster, with most interacting with only a few external groups. Some teams, such as staff advisory groups, deal with internal customers or clients on a fairly regular basis. In fact, for these teams this interaction is often a critical aspect of their work. Other teams in this cluster, such as management teams or advisory councils occasionally may deal with government or public agencies, usually for the purpose of exchanging information. Most teams must, at least occasionally, interact with other professionals and other personnel or departments within their organization. However, in many cases, this interaction involves exchanging information and, while important, is not highly critical to the teams' work.

Because of the broad scope of activities that teams in Cluster 6 handle, the level of standardization tends to be low. Although a few teams may operate under general guidelines that provide broad limits on how the work is to be completed, for most teams no guidelines exist. For example, a management team may be provided with broad guidelines for a special project they were assigned by upper management. In contrast, research teams are generally free to follow any course they choose. Despite the low level of standardization inherent in the teams' work, most deal with fairly stable conditions and rarely encounter unexpected situations. However, for many the potential for unusual occurrences is always present.

The degree of external pacing in Cluster 6 is low. Most teams in this cluster provide no input to the work of other groups or individuals and those that do generally provide advice or assistance which may be helpful but not critical to others. Cluster 6 teams generally do not work under deadlines or else they impose their own. Occasionally a management team or research team may be given a deadline from an external source but this is usually in the form of general time constraints that allow some flexibility. For example, top management may need information by a certain date. Maintaining an established pace of activity is either not a part of the teams' work or else the team determine their own timing. Finally, the teams in this cluster

generally determine their own schedules, although at times they may need to coordinate with other groups.

In summary, Cluster 6 teams are characterized by a broad scope of activity, few external interactions, a low level of standardization, and low external pacing. The scope of activity for teams in this cluster tends to be broad and members are usually highly skilled individuals. Although the team life-spans vary, in all teams, members spend a relatively small proportion of time together. Teams in Cluster 6 exhibit characteristics of both project/ development and action/negotiation teams in the Sundstrom and Altman (1989) typology.

Environmental Demands

Sundstrom and Altman (1989) proposed that different types of teams place different demands on their environments. These demands can assume four forms: (1) interface demands that involve the accommodation of transactions between the group and nonmembers; (2) barrier demands that involve restrictions in the inflow or outflow of people, goods, or information; (3) interaction demands that involve the accommodation of exchanges among team members; and (4) differentiation demands that involve the accommodation of role differences among team members. As indicated by the results of the MANOVAs, there are some significant differences between clusters on the environmental demands variables, although not to the degree expected.

The six clusters did not differ with respect to interface or barrier demands. In general, for all clusters, the need to provide for transactions between group members and nonmembers was considered important (i.e., means ranged from 1.82 to 2.44, where 0 = Not Important to 4 = Critically Important). Given that only a few teams had no need to interact with external groups at all, this is not surprising. Even for teams in clusters where the level of external interaction is low, there are at least some occasions when such exchanges must occur. For example, Cluster 4, which consists of quality improvement teams, task project teams, and committees, is characterized by a low level of external interaction. However, occasionally members may need to obtain information from someone outside the group.

The six clusters also did not differ with respect to barrier demands. In general, restricting the inflow or outflow of people, goods, or information was of only minor importance (i.e., means ranged from 0.97 to 1.67). One would expect that teams in Cluster 1 (e.g., fire-fighting teams, rescue teams) and Cluster 3 (e.g., life-saving teams, gas construction crews) would have high barrier demands. For example, at a fire or accident scene, spectators need to be kept away from emergency workers. One possible explanation for the relatively low importance of this dimension is the nature of the items that are included in the dimension. Specifically, the dimension encompasses

items pertaining to shielding the team from various distractions as well as keeping outsiders away from the team's work. It may be that the two set of items represent different concepts and should be placed in separate dimensions. An alterative explanation is that in responding to these items teams placed more emphasis on practical rather than ideal conditions. Teams were asked to rate the importance of keeping outsiders away from the team's work area. While this isolation may be possible in an ideal situation, in reality this is just not feasible. For example, gas construction crews set up markers to indicate their work area. However, this is all they can do to keep people out. Given that they work in public areas, they generally have to tolerate a certain number of intrusions.

The interaction demands variable was significantly higher for teams in Cluster 1 than for those in Clusters 2, 3, 4, and 5. For teams in Cluster 1, interacting with other team members is very important (Mean = 3.32). In fact, it would be extremely difficult for the teams to perform successfully without such interaction. Teams in this cluster are engaged in activities such as putting out fires, securing hazardous materials sites, performing rescue operations, competing in sporting competitions, and putting on performances. Such activities demand a great deal of coordination and planning. In order to engage in coordination and planning operations, team members must be able to interact with each other. In addition, the

camaraderie that is engendered from frequent interaction could be expected to lead to a higher level of trust between members. It could also be assumed that members of these teams would need to trust each other, especially those engaging in life-threatening operations.

Role differentiation demands were also significantly higher for teams in Cluster 1 than for those in the other clusters. Members of teams within this cluster often need to assume a particular role during a given operation. For example, when responding to a call, various members of the hazardous materials team assume the roles of decontamination officer, entry officer, and research officer. Members of a sports team may assume various offensive or defensive positions. At such times, status difference become important. However, even for teams in Cluster 1, accommodating role differences among members was of only minor importance (Mean = 1.38).

Behavioral Requirements

Previous research identified seven core components of teamwork: communication, team orientation, team leadership, monitoring, feedback, backup behavior, and coordination (Dickinson et al., 1992; McIntyre et al., 1988). Although derived through work with military teams, it was assumed that certain common dimensions underlie team performance in diverse settings. However, it was hypothesized that certain dimensions may be more important for some types of teams than for others.

In general, all seven components were rated "important" or "considerably important" for all teams. This indicates that the teamwork components do have relevance for a variety of teams. However, monitoring was significantly more important for teams in Cluster 3 than for teams in Clusters 4 and 6. Examination of cluster membership suggests a reason for this finding. Clusters 4 and 6 consist of teams such as task project teams, quality improvement teams, or advisory councils. Generally, members of such teams are assigned individual tasks for which they are responsible. When these teams get together, the individual members present their information for group discussion. Individuals are responsible for their own tasks and are not monitored by the other individuals. In contrast, Cluster 3 comprises teams such as life-saving teams, gas construction crews, and flight crews. Although individual members of such teams may have their own responsibilities, it is important that the members monitor each others' performance. In fact, members of a flight crew are expected to monitor each other's performance as a safety precaution. Therefore, monitoring would be expected to be more important for these teams than for teams in Clusters 4 and 6.

Implications of Findings

One of the most important contributions of the present study is that it demonstrated a feasible method for developing a team classification system. Previous team classifications had been derived through purely rational

means and the proposed distinctions between team types had not been examined empirically. The present research involved the collection of data describing actual teams in an attempt to develop an empirical classification system based on a theoretical framework. The obtained information was used to sort the teams into groups or types through the application of cluster analytic procedures. At a basic level, this involved cluster analyzing two samples on one set of variables, using the cluster centroids from one sample to cluster analyze the second sample, and then examining the resulting clusters on another set of variables (a more detailed summary can be found in Appendix D). Six clusters or "types" were identified based on the attributes of integration and differentiation proposed by Sundstrom and Altman (1989). Further analyses of these clusters indicated differences in the demands placed on their environments and in at least one aspect of team behavior.

The team types identified in the present study are not meant to be definitive. Although some evidence of the obtained classification system's validity was obtained, it is important to realize that the utility of this system, or in fact any system, may be limited. As previously noted, the development of a single, absolute classification scheme that encompasses all conceivable purposes is impossible (Fleishman & Mumford, 1991; Pearlman, 1980). Different systems may be necessary to serve different purposes. For example, it may be possible to classify teams according to

characteristics of the team's task (e.g., level of decision-making, degree of interdependency). This type of classification system may have implications for training or selection purposes or even work group design. By demonstrating the feasibility of developing an empirically-based classification system, the present study may stimulate the development of other alternative systems.

One of the most significant results of the present study is that it demonstrated the possibility of identifying "types" of teams. An implication of this finding is that different types of teams may have different requirements in a number of areas including performance appraisal, selection, and training to name only a few. In the following section, the theoretical implications of team types for various content areas are discussed. This discussion is not intended to be all inclusive, but rather, is meant simply to provide examples where the concept of team "types" may have relevance.

Context conditions. All teams operate in the context of an organizational system. Context conditions refer to characteristics of that system that serve to facilitate or hinder a team's performance and may include factors such as the availability of team rewards and organizational resources such as support or materials. One implication of the present findings is that different types of teams may place different requirements on the organization in which they operate.

For example, it has been suggested that reward systems for teams should be designed so that the emphasis is placed on group effort and results rather than that of the individual (Hackman, 1986). However, the actual composition of such systems may need to vary with respect to the type of team for which it is intended. A strict emphasis on rewarding group results may be effective for teams such as a task project team where members may be drawn from competing organizational units. In this case, the team members might receive a bonus based on the results of their combined efforts. In other cases, such as a research team, certain individuals may provide more critical input than others. Consequently, it may still be necessary to reward group effort but, at the same time, provide some way of recognizing individual contributions. A team classification system based on attributes such as team goals, amount of time allocated to the team's task, distribution of responsibility, and other team characteristics relevant to the establishment of a reward system would need to be considered.

Another aspect of a team's organizational context for which the concept of team types may have relevance is that of task or work design. It has been suggested that the amount of teamwork (e.g., coordination, communication, cohesion) required for effective functioning varies with respect to a number of task factors (Boguslaw & Porter, 1962; Oser, McCallum, Salas, & Morgan, 1989) including

complexity, standardization, criticality, interdependence, time compression, and taskload (Cannon-Bowers et al., 1992). Since such task demands differ among teams, teams classified according to these dimensions could be expected to demonstrate different teamwork needs. The specific configuration of task demands, in other words, how a team's task is designed, could have implications for training or selection of team members. For example, teams whose tasks require a high level of teamwork may benefit by an OD intervention involving team building or a training intervention directed at enhancing members' teamwork skills (Cannon-Bowers et al., 1992).

A specific example of how different types of teams may have different requirements from their organizational contexts can be drawn from the present study. The results indicated that interaction among team members was very important for teams in Cluster 1. According to Sundstrom and Altman (1989), such teams should function most effectively when their physical facilities expedite this interaction. Therefore, organizations employing these teams should accommodate the need for team-member interaction by providing facilities that encourage frequent encounters and dialogue among team members. This may involve making conference rooms available, providing group working areas or informal gathering places, or electronic communication links among members (Sundstrom & Altman, 1989).

Training. As suggested in the preceding section, the concept of team types may have relevance in the area of team training. It has been suggested that teams vary with respect to "team competencies" (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995). Team competencies refer to the knowledge, skills, behaviors, and attitudes required by team members for effective team performance (Cannon-Bowers et al., 1995). The effectiveness of different team types, classified with respect to team competencies, may be a function of the type of training they receive. In other words, different types of teams may require different types of training in order to perform their tasks effectively. Cannon-Bowers and colleagues propose that some teams may benefit by "team-generic" training which is designed to enhance skills that are transportable from one team situation to another. Examples of such "generic" skills include communication or interpersonal skills. Other teams may have a greater need for training in "task-specific" skills which are specific to the particular task or context in which a team must operate. For example, task project teams, in which members come together temporarily, may have stronger needs for team-generic training. This would enable team members to acquire skills which they could then transport to the next team to which they may be assigned. In contrast, members of a rescue squad may have a higher need for task-specific training in the area of specific life-saving techniques.

A direct implication of the current findings to the area of team training is that the seven behavioral components of teamwork have relevance for teams of all types. The results indicated that all seven components were rated "important" or "considerably important" for all teams. One possible application of this finding is to incorporate the teamwork components into training programs of the team-generic variety. Although the teamwork components may have relevance for all teams, the specific manifestation of each component may differ. For example, the use of formally prescribed terms and phrases when communicating with each other may be important for military teams but may be irrelevant for child study teams or committees. However, the importance of communication among team members should still be emphasized.

Performance appraisal. The concept of team types also may have relevance in the area of performance appraisal. Different types of teams may require different performance measures to adequately assess their effectiveness. For example, in situations where teamwork needs are high, it may be important to include a process measure designed to assess the quality of teamwork displayed by team members (Cannon-Bowers et al., 1992; Glickman et al., 1987; Morgan et al., 1986). This might be the case in military or fire-fighting teams. In cases where teamwork needs are low, such as with a committee or advisory council, outcome measures may play a more important role in measuring team performance.

A direct implication of the present study is that the seven teamwork components may have value in assessing team performance, particularly teams in which a process measure of performance is important. One of the informal findings of the present study was that very few teams are actually evaluated as a team. Instead, the members are evaluated as individuals. The seven teamwork components may serve as a foundation upon which a team performance appraisal may be built. For example, a team may be evaluated on how well members communicate with each other, how well they provide feedback to each other, or how well they provide some form of backup behavior. While the specific ways of manifesting each of the seven components may differ among different types of teams, the basic framework would incorporate the seven components.

Selection. Another area where the concept of team types may have relevance is that of selection. It has already been suggested that different types of teams may vary with respect to the amount of teamwork required among members as a function of the teams' specific task demands. Organizations implementing teams that have a high need for teamwork may have to consider interpersonal or group skills in selecting employees. In contrast, for organizations utilizing teams that have a low need for teamwork, it may be more appropriate to place a higher emphasis on task-specific skills in their selection process.

Management and leadership. A final area where the concept of team types may have relevance pertains to that of team management or leadership. If team types can be identified that differ with respect to their level of integration and differentiation with other organizational units or with the level of teamwork demanded by the teams' tasks, it is not unreasonable to assume that these different types of teams would require different leadership behaviors. For example, a manager of a team that is characterized by a high level of external interaction must be able to balance demands placed on the team by outside sources with the need to attend to the team's internal requirements. To clarify further, a manager of an assembly team that supplies other units with a critical component must ensure that the team provides the components on time without sacrificing quality. The leadership behaviors important for a given type of team may be a function of the demands of the team's task, the skills of the individual members, or level of integration with the rest of the organization to name only a few possible factors.

Methodological Issues and Future Research

Although the results of the present research indicated the existence of six types of teams, these clusters are very similar to the four types identified by Sundstrom and Altman (1989) with respect to the attributes of integration and differentiation. The clusters were replicated in a second sample, providing an indication of the classification

systems's stability, internal consistency, and external generalizability. This indicates that the attributes of integration and differentiation provide a meaningful way of distinguishing one type of team from another. This in turn generates a number of research questions. One set of research issues pertains to a refinement of the measures used in the present study. Questions in this area are addressed below through a program of research in which issues are prioritized according to temporal order and importance. A second area of research involves replication of the findings in additional samples. Finally, a third set of research issues concerns a conceptual elaboration of the characteristics of the clusters identified in the present study. This set of research questions involves a broader examination or extension of the concept of team types and is also discussed below.

Refinement of measures. The first modification of the present study that should be considered in future efforts is to focus on refining the measures used to classify teams. For example, it has already been suggested that a possible explanation for the relatively low importance ratings obtained for the dimension "barrier demands" is the nature of the items that were included. Specifically, this dimension encompasses items pertaining to shielding the team from various distractions as well as keeping outsiders away from the team's work. It may be that the two sets of items represent different concepts and should be placed in

separate dimensions. Therefore, conceptual elaboration or refinement of the dimensions for environmental demands may be one area for examination in future studies. The inclusion of additional items for each dimension may also result in an increase in the internal consistency estimates for the various scales.

A second area of measurement refinement would involve reliability assessment of the measures used in the present study. For example, in this study, responses were obtained from only one member of each team in the sample. Obtaining responses from two or more members of each team would allow an assessment of inter-rater reliability. Another possibility would be to obtain information about the team from the same person at two different points in time. This would allow for the assessment of test-retest reliability. A third option would be to use archival data, such as team schedules, meeting notes, etc., to verify information obtained during the interview. Any of these methods could be used to improve the reliability of the data and help to ensure its accuracy.

A third possible refinement of the measures used in the present study might involve the creation of a questionnaire for obtaining supplemental team information. In this study, information was obtained through an interview conducted with someone familiar with a particular team. Although this provided a rich source of information, it was time-consuming and somewhat limiting in that participants were restricted

to those individuals and teams that were immediately accessible. The use of a questionnaire may make it possible encompass a larger number and wider range of teams by including groups outside the immediate geographic area.

Replication of results. Once the measures used in the present study have been refined, a second area of research would involve an attempt to replicate the clusters in additional samples. For example, it is acknowledged that the team types obtained in the present study were partially a function of the particular sample used. If a narrower range of teams had been included in the sample, less than six clusters may have been identified. If a broader range of groups, including those that did not meet the definition of a "team" had been included, more than six clusters may have been identified. Future research efforts may involve collecting the same information obtained from teams in the present study but from a sample that includes different kinds of teams or groups than those involved here.

Conceptual elaboration of team types. In addition to the methodological issues discussed above, a second distinct avenue of research involves examining the clusters identified in the present study for additional differences. The research areas previously discussed have involved measurement refinement. In contrast, this second line of research would involve a conceptual extension of the notion of team types. This research could be conducted either after the measures were refined or as a parallel line of

research. For example, a number of models of team effectiveness have been proposed (Gladstein, 1984; Hackman, 1983; Morgan et al., 1986; Nieva et al., 1978; Salas et al., 1992). One question that might be addressed is, do these theories differ with respect to their relevance for different types of teams? For example, does one of these theories more adequately account for team performance in any of the six clusters identified in the present study? To examine these questions, a measure of team effectiveness could be obtained for each of the teams in the study. Collection of additional information for each team, specifically information pertaining to the conditions necessary for successful completion of the team's task, would make it possible to examine whether these conditions differed among clusters.

As previously mentioned, numerous models of team effectiveness have been proposed with each encompassing a unique set of variables. An alternative research question would focus on whether the attributes examined in any one of these theories could serve as the basis of a team classification system? Gladstein (1984), for instance, included variables pertaining to group composition, group structure, group task demands, and group process. What would the resulting system look like if the teams in the present study were classified according to these variables? How would it compare to those obtained in the present study?

Another set of conceptual issues involve a specific examination of the variables included in the current research. For example, of the variables comprising the attribute sets of differentiation and integration, is there a subset of variables that contributes in a more important way to the obtained clusters? What implications do the clusters have with respect to other sets of attributes, for example, attributes related to training, selection, team development, or productivity? In addition, would the same clusters be duplicated in additional samples of teams?

An additional set of conceptual issues pertain specifically to Sundstrom and Altman's (1989) theory. Sundstrom and Altman suggested that four classes of work groups with their different characteristics of integration and differentiation would display different requirements for environmental support. However, this proposition, as well as the taxonomic system, had not been directly tested (Sundstrom & Altman, 1989). Because the present study demonstrated the development of a team classification system based on the Sundstrom and Altman (1989) framework, it also provided information to test the assumption stated above. Specifically, the results indicated some differences between clusters with respect to the environmental demands. Interaction demands and role differentiation demands were significantly higher for teams in Cluster 1 than for those in Clusters 2, 3, 4, and 5. At a more general level, the classification exhibited some discriminatory power in

variable domains other than those used to create the original categories. This provides some evidence of the classification's generalizability and also an indication of its meaningfulness or utility. However, research is still needed to examine further the specific hypotheses proposed in the theory. Specifically, it has yet to be determined whether an environment in which these demands are met actually facilitates team performance. For example, when environmental support is provided to facilitate interaction among team members, what is the effect on team productivity? Is the effect consistent across different types of teams?

A final set of conceptual issues pertain to the behavioral requirements. The present research indicated that the seven behavioral teamwork components were considered important or considerably important for all teams. This indicates that the components have relevance for a variety of teams. However, monitoring was significantly more important for teams in Cluster 3 than for teams in Clusters 4 and 6. As previously explained, Clusters 4 and 6 consist of teams such as task project teams, in which members are assigned individual tasks for which they are responsible. Individuals are responsible for their own tasks and are not monitored by the other team members. In contrast, Cluster 3 comprises teams such as life-saving teams and flight crews. In such teams, it is important that members monitor each others' performance. Although monitoring was the only team behavioral dimension

that obtained significance, a number of the other components approached significance. Future research may examine whether these dimensions differ among team types in other samples. Research may also examine whether certain combinations of the seven components are more relevant for certain types of teams than for others.

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Appendix A

Work Group Interview

WORK GROUP INTERVIEW

Date: _____

Name of Interviewer: _____

Name of Interviewee: _____

Name of Organization: _____

WORK GROUP INTERVIEW

This interview is part of a study of work groups. We are trying to find out how work groups differ from each other, so we ask questions about characteristics of the groups, their work, their working conditions, and the way they act. Because we are trying to get information on all kinds of groups, some of the questions may not seem relevant to your particular group. However, it is important that you answer them as best you can. Your answers will help us find the best ways to help different kinds of groups.

The interview consists of four parts. I'll tell you more about each part as we come to it.

Certain words will come up frequently. It is important that they are understood the same way by everyone.

-- Organization means the larger group to which your group belongs. For example, a company, a hospital, a university, a public agency, an association, etc.

-- The group's work means the main activities of your group or the reason your group exists. For example, a group's work can be playing a basketball game, performing a surgical operation, producing a product, solving a particular problem, etc.

-- Input or materials mean the things your group works with. For example cases, people, written material, physical objects, etc.

-- Output or products mean the outcome or results of your group's work. For example, performances, decisions, products, services, reports, etc.

Your answers to the questions will be used only for the purposes of this study.

This first group of questions asks you to describe some common characteristics of your group.

What is your group called?

_____

How many members are in your group? _____

What is your relation to the group? _____

_____

How long have you been associated with this group?

_____

Which of the following best describes the major type of work performed by your group?

____ a. Production: Creating an identifiable product.
____ b. Service: Providing a specifiable service.
____ c. Decision making: Making a choice among alternatives.
____ d. Problem solving: Creating a solution to an identifiable problem.
____ e. Performance: Executing athletic, dramatic or musical performances.
____ f. Mixed: (specify) _____
____ g. Other: (specify) _____

Who is considered the leader of the group?

_____

Screening Questionnaire

For the next few questions, please give me the number of the response that best describes your work group.

A. Groups are often formed to achieve a common goal. To what extent are members of your group working toward the same goal? _____

1 -- Each member is working toward a different goal.
2 -- The goal is unclear or of little importance to some members.
3 -- All members are working towards the same goal.

B. Group members depend on one another to get their work done. Members may share information, tools or materials, or they may work together on common activities. Which of the following best describes your group? _____

1 -- Individuals work mostly independently of one another. There is not much exchange of information, tools or materials among members.
2 -- Members depend on one another in some activities or sometimes exchange information, tools or physical materials. They sometimes help one another to get the group's work done.
3 -- Members regularly depend on one another to get things done. Members often help one another in order to achieve the group's goal. Members frequently exchange information, support or physical materials.

C. In many groups, the work is divided so that each member has a different role or set of responsibilities. To what extent do members of this group have different roles or responsibilities? _____

1 -- Everyone performs the same basic activities.
2 -- Some responsibilities are the same but others are different.
3 -- Each member has distinctly separate responsibilities. Some members always do certain things and never do other things.

SECTION ONE
WORK CHARACTERISTICS

The next group of questions asks you to describe the work your group does.

DIFFERENTIATION

Specialization

1. What are the major responsibilities or activities of your group?

_____

_____

_____

_____

_____

_____

_____

_____

2. Are there other groups within your organization that have the same responsibilities or perform the same activities as your group?

_____ Yes _____ No _____ Other
(Please explain)

3. Different skills are needed to perform different types of work. What do you consider to be the most important skills needed to perform your group's work?

_____

_____

_____

_____

_____

SECTION ONE, continued

4. Are the skills of your group's members more similar to or more different than each other's?

   _____ More similar _____ More different

   Describe _____

_____

_____

5. Different types of work require different education or training. What type of training or education is needed to perform your group's work or activities?

_____

_____

_____

6. Is the same type of training or education needed by all group members?

   _____ Yes _____ No

   If no, explain: _____

_____

_____

7. In some cases, group members must be trained together, as a unit, in order to achieve or maintain a certain level of performance or expertise. In order to perform your group's activities, is it necessary that group members be trained together?

   _____ No _____ Yes

   If yes, how long did this training take?

_____

_____

_____

SECTION ONE, continued

8. If your group's best performer or most essential member left, would you be able to find a replacement within your organization that would allow your group to maintain a satisfactory level of performance, or would you need to look elsewhere?

_____ Available within organization.
_____ Need to look elsewhere.

Activity scope

9. Most work involves a cycle of activities, from the time the work begins to the time it ends. What is involved in your group's cycle of activities? (i.e., what does it begin with, what comes next, etc.)

10. Approximately how long does it take to complete a single cycle of your group's activities?

11. How often is your group's cycle of activities repeated?

SECTION ONE, continued

12. Some group's have greater freedom in making decisions than other groups. Which of the following apply to your group?

____ a. The group determines how the work will be done.
____ b. The group determines who will do what part of the work.
____ c. The group keeps track of its own progress.
____ d. The group solves its own problems.
____ e. The group sets its own goals.
____ f. The group schedules its own work.

Temporal scope

13. Some groups are formed to accomplish a specific goal and once the goal is accomplished, the group disbands. Other groups are involved in ongoing work and remain together indefinitely. Will the members of your group remain together indefinitely?

_____ No _____ Yes

If no, how long is the group expected to remain together?

_____

_____

_____

14. Some groups work together continuously throughout the day, while other groups work together only periodically. How often does your group work together?

_____

_____

_____

_____

_____

SECTION ONE, continued

15. When not working on group activities, do the members of your group have other responsibilities, within the organization, that have nothing to do with the group?

_____ No _____ Yes

If yes, is the amount of time spent on those activities equal to, greater than or less than the amount of time spent on group activities?

_____ Greater than time spent on group activities
_____ Equal to time spent on group activities
_____ Less than time spent on group activities

INTEGRATION

Frequency of external interactions

16. Some groups must deal or interact with other groups or individuals in order to perform their activities. Is it necessary for your group to interact or work with other groups or individuals?

_____ No _____ Yes

17. What other groups or individuals must your group deal with?

_____

_____

_____

_____

18. How frequent is your group's contact with these other groups or individuals?

_____

_____

_____

_____

SECTION ONE, continued

19. For what purposes must your group interact or deal with other groups or individuals?

20. Does your group's work serve as input to the work of another group or other individuals inside the organization?

_____ No _____ Yes

If yes, what type of input does your group provide?

SECTION ONE, continued

Standardization

21. In some types of work, procedures, rules or instructions are provided that specify how the work is to be completed. In other cases, the group performing the work must decide how to proceed. In performing your group's activities, which of the following best describes your group?

_____A The group is provided with and must follow established procedures that specify exactly how the work is to be completed.
_____B The group is provided with general guidelines that provide broad limits on how the work is to be completed.
_____C The group is not provided with any type of guidelines or instructions on how to proceed.
_____D Other (please describe)

_____

_____

_____

_____

22. Sometimes unexpected or uncontrollable situations occur so that the usual way of doing things does not work. In such cases, the usual procedures may need to be changed or new ones must be developed. Which of the following best describes your group's experiences with such situations?

_____A The group often encounters unexpected or uncontrollable situations.
_____B The group sometimes encounters unexpected or uncontrollable situations.
_____C The group rarely encounters unexpected or uncontrollable situations.
_____D Other (please describe)

_____

_____

_____

SECTION ONE, continued

23. Groups may produce different products or provide different services. What products are produced or services are provided by your group?

_____

_____

_____

24. In some cases, it is easy to evaluate a group's product or service because clearly defined standards are available. What standards are used to evaluate the product of your group's work?

_____

_____

_____

_____

External pacing

25. Many groups work under deadlines or time constraints. Who determines the deadlines or time constraints for your group?

_____

_____

26. Some groups must maintain a certain pace of work. For other groups, the timing of activities is important. Is pacing or timing a part of your group's work?

_____ No _____ Yes

If yes, who determines the timing or pacing or your group's activities?

_____

_____

_____

SECTION ONE, continued

27. Does your group need to adjust its activities in response to the activities of other groups or individuals?

_____ No _____ Yes

Coordination demands with outside groups

28. Some groups are free to determine their own schedules while others must coordinate their schedules with others. Who determines your group's schedule?

_____

_____

29. In some cases, groups exist to support the work of others by providing them with a product, service or assistance. Does your group provide support to others within the organization?

_____ No _____ Yes

If yes, what type of support does your group provide?

_____

_____

_____

_____

30. In order to accomplish its goals, does your group require support by other groups or individuals within the organization?

_____ No _____ Yes

If yes, what type of support does your group require?

_____

_____

_____

SECTION TWO
WORKING CONDITIONS

The next set of questions asks you to describe the specific WORKING CONDITIONS needed by your work group to perform its work successfully. For example some groups need a place to meet with others while other groups need a place to work undisturbed.

On this group of cards, you will find different working conditions that might be needed by different groups. Please sort the cards into 5 piles according to this 5-point rating scale.

TO PERFORM YOUR GROUP'S ACTIVITIES:

Interface demands (INTFACE1 TO INTFACE9)

____ 1. Other groups or individuals must be aware of the group's identity or existence.
____ 2. Other groups or individuals must be aware of the group's duties or purpose.
____ 3. Other groups or individuals must be aware of the group's status or standing in the organization in relation to other groups.
____ 4. Non-members, such as visitors, clients, or customers, must easily be able to find the group.
____ 5. Individuals delivering incoming materials must be able to meet with someone from the group.

____ 6. Individuals coming to receive the group's finished output or product must be able to meet with someone from the group.
____ 7. The group must be able to meet face-to-face with nonmembers such as visitors, clients or customers.
____ 8. The group needs a staging or performance area where its performance can be observed by others.
____ 9. Group members must have access to nonmembers through communications equipment (e.g., telephone, computer, etc.).

SECTION TWO, continued

Barrier demands (BAR1 TO BAR10)

____ 10. The group must be shielded from noise.
____ 11. The group must be shielded from visual distractions.
____ 12. The group must be shielded from possible disruptions.
____ 13. The group must use equipment that can only be used by group members.
____ 14. The group must keep information private or confidential.

____ 15. Group activities must not be seen by others outside the group.
____ 16. Group activities must not be heard by others outside the group.
____ 17. Access to the group by nonmembers must be restricted to limit disturbance.
____ 18. The group needs a working area that is separate or distinct from the working areas of other groups or individuals.
____ 19. The group must be able to keep nonmembers away from its activity area.

Interaction demands (INTACT1 TO INTACT8)

____ 20. The group must hold work-related conferences or meetings that involve discussions among all group members.
____ 21. The group must hold work-sessions with all group members present.
____ 22. Group members must have easy access to each other to exchange tools, information, materials, etc.
____ 23. The group's work benefits from informal, face-to-face interactions among group members.
____ 24. Communication equipment linking group members with each other is necessary.

____ 25. The group must practice together before the actual performance of its work.
____ 26. The group must be trained together on important parts of its work.
____ 27. The group must get together to make plans or preparations before performance of its work.

SECTION TWO, continued

Role differentiation demands (ROLEDIF1 TO ROLEDIF5)

____ 28. The group must maintain separate or distinct individual roles among group members.
____ 29. Differences in status or rank among group members must be indicated.
____ 30. Separate, well-defined work-stations are needed for each group member.
____ 31. Each group member needs an enclosed individual work-space.
____ 32. Each group member must be able to perform his or her independent activities undisturbed by other group members.

SECTION THREE
WORK GROUP BEHAVIOR

The next set of questions asks you to describe the specific ACTIONS that are necessary for your work group to perform its work successfully. For example, for some groups it is important that members exchange information with each other, for others it is more important that members be able to perform each other's jobs.

On this group of cards, you will find different actions that might be important to different groups. The cards should be sorted to indicate how important each action is to the successful performance of the group's activities. Please sort the cards into 5 piles according to this 5-point rating scale.

TO PERFORM YOUR GROUP'S WORK SUCCESSFULLY, GROUP MEMBERS MUST:

Communication (COMM1 TO COMM8)

____ 1. Inform other members of their intentions before taking action.
____ 2. Verbally acknowledge that they have received information from another member.
____ 3. Confirm that another member has received information they were sent.
____ 4. Acknowledge and repeat messages to ensure understanding.
____ 5. Use formally prescribed terms and phrases when communicating with each other during performance of the group's activities.

____ 6. Ask for further information or explanation when necessary.
____ 7. Ensure that when messages are sent they are understood as intended.
____ 8. Avoid unnecessary and distracting messages when communicating during performance of the group's activities.

SECTION THREE, continued

Team orientation (TMOR1 TO TMOR9)

____ 9. Participate in all relevant aspects of the group's work such as training, practice, etc.
____ 10. Place group goals ahead of their personal goals and interests.
____ 11. Display pride in their duties and the group.
____ 12. Display trust in other group members.
____ 13. Display a "team spirit" or an awareness that they are part of a group and that teamwork is important.

____ 14. Resolve conflict among members by finding mutually agreeable solutions to areas of disagreement.
____ 15. Resolve interpersonal conflicts among members.
____ 16. Generate norms or standards for appropriate levels of performance that all group members accept.
____ 17. Define the group's objectives to ensure that members are working toward common goals.

Monitoring of other group members' work (MON1 TO MON5)

____ 18. Keep aware of the performance of the group members with whom they interact closely.
____ 19. Recognize when a group member makes a mistake in the way he or she performs an activity.
____ 20. Keep track of other group members' work activities while carrying out their own activities.
____ 21. Observe or listen to the performance of other group members to make sure they are following procedures correctly.
____ 22. Question the course of action taken by others, including the actions of the group leader.

Feedback (FEEDBK1 TO FEEDBK8)

____ 23. Give feedback to other members when they ask for it.
____ 24. Give feedback to group members even when they didn't ask for the information.
____ 25. Give feedback to other group members about what they need to do to improve their performance.
____ 26. Give feedback to other group members about their interaction with other group members.
____ 27. Ask for advice on the proper procedures that should be followed.

SECTION THREE, continued

____ 28. Ask for feedback about their performance and where they need to improve.
____ 29. Ask for suggestions about how they could improve their interaction with other group members.
____ 30. Accept feedback about performance.

Backup behavior (BACK1 TO BACK10)

____ 31. Provide help to those who need it when asked.
____ 32. Ask for help when needed.
____ 33. Accept help when needed.
____ 34. Provide help to others who are having difficulty, even when they did not ask for help.
____ 35. Be able to perform others' jobs within the group.

____ 36. Have a basic understanding of, but not necessarily be able to perform, each others' jobs within the group.
____ 37. Perform another group member's duties when that member is unable to do so.
____ 38. Be ready with equipment or materials when needed by another group member.
____ 39. Adjust one's own activities to compensate for another member's performance.
____ 40. Support other members by taking on additional duties that were not specifically assigned.

Coordination (COORD1 TO COORD11)

____ 41. Synchronize activities of all members.
____ 42. Plan the timing or pacing of each member's activities in relation to the activities of other members.
____ 43. Establish signals for starting activities in the specified order or at a specified time.
____ 44. Adjust or change the speed of performance in response to changing conditions.
____ 45. Adjust the time involved in completing specific activities in order to effectively accomplish the overall goal.

SECTION THREE, continued

____ 46. Control conditions which <u>determine</u> the pace of group activities.
____ 47. Control conditions which may <u>disrupt</u> the pace of group activities.
____ 48. Sequence the activities of individual members with the activities of each other.
____ 49. Change the <u>sequence</u> of activities in response to changing conditions.
____ 50. Redistribute resources (i.e., equipment, materials, manpower) in response to changing conditions.

____ 51. Adjust the activities of the group to compensate for a member's mistake in performing his or her activities.

<u>Team leadership</u> (LEAD1 TO LEAD9)

____ 52. The group leader must avoid interfering in the group's performance by allowing and encouraging group members to make decisions on their own.
____ 53. The group leader must explain to other group members exactly what is needed from them during practice, performance, etc.
____ 54. The group leader must review the situation and take action quickly when the group becomes overwhelmed.
____ 55. The group leader must obtain information about available resources or restrictions and share it with other group members.

____ 56. The group leader must allow group members to function independently, interrupting only when problems arise.
____ 57. The group leader must assign duties, responsibilities or tasks to specific members before the group begins its work.
____ 58. The group leader must make sure that all members are aware of the specific responsibilities of other members before the group begins its work.
____ 59. The group leader must define or explain the group's goals before the group performs its work.
____ 60. The group leader must reassign or adjust the activities of individual members to ensure that performance standards will be met.

Working Conditions

4 -- Critically important. This condition is critical for effective group performance. It is impossible for the group to perform its work successfully if this condition is not met.

3 -- Considerably important. This condition is of considerable importance for effective group performance. It is extremely difficult for the group to perform its work successfully if this condition is not met.

2 -- Important. This condition is important for effective group performance. It is difficult for the group to perform its work if this condition is not met.

1 -- Of minor importance. This condition is not very important for effective group performance. Although this condition is helpful, it is possible for the group to perform its work successfully if this condition is not met.

0 -- Not at all important. This condition is not related at all to effective group performance. This condition has no effect on successful group performance.

Work Actions

4 -- Critically important. This behavior is critical for effective group performance. It is impossible for the group to perform its work successfully without this behavior.

3 -- Considerably important. This behavior is of considerable importance for effective group performance. It is extremely difficult for the group to perform its work successfully without this behavior.

2 -- Important. This behavior is important for effective group performance. It is difficult for the group to perform its work successfully without this behavior.

1 -- Of minor importance. This behavior is not very important for effective group performance. Although this behavior is helpful, it is possible for the group to perform its work successfully without this behavior being displayed.

0 -- Not at all important. This behavior is not related at all to effective group performance. This behavior condition has no effect on successful group performance.

Appendix B

Items Eliminated After Preliminary Analysis of Scales Measuring Environmental Demands and Behavioral Requirements

Interface demands

8. The group needs a staging or performance area where its performance can be observed by others.

Barrier demands

13. The group must use equipment that can only be used by group members.

Interaction demands

24. Communication equipment linking group members with each other is necessary.

Role differentiation demands

32. Each group member must be able to perform his or her independent activities undisturbed by other group members.

Monitoring of other group members' work

22. Question the course of action taken by others, including the actions of the group leader.

Feedback

27. Ask for advice on the proper procedures that should be followed.

Team leadership

52. The group leader must avoid interfering in the group's performance by allowing and encouraging group members to make decisions on their own.

55. The group leader must obtain information about available resources or restrictions and share it with other group members.

Appendix C

Coding Scheme for Work Team Interviews

Interview Scoring Criteria

Differentiation

Specialization

Question #2 -- Number of other groups with same responsibilities
(SPOTHGRP)

3 = 5 or less
2 = more than 5 less than 20
1 = 20 or more

Question #4 -- Similar/different skills as related to the group's task (SPSKILLS)

3 = All have members have essentially the same skills (all meet the same minimum requirements, i.e., certification in a given area)
2 = Some are the same, some are different
1 = All have different skills (have different educational backgrounds/or come from different occupational areas; this score would be given to groups whose members have different occupational roles)

Question #5 -- Education/training requirements as required for the group's task (SPEDREQ)

6 = Education beyond a 4 yr. college degree
5 = 4-yr college degree
4 = Varies
3 = Special training or certification
2 = Trade skills/years of experience
1 = Skills are easily learned/skill involve basic problem-solving processes/can be learned in less than 6 months
0 = No special skills

Question #7 -- Team training (SPTMTRG)

4 = Team trains/practices at least once a week
3 = Team trains more than quarterly but less than once a week
2 = Team trains on a quarterly basis
1 = Team trained together briefly when team first formed
0 = No team training/practice required

Activity Scope

Question #1 -- Number of major responsibilities/activities (ASPRSP)

3 = Very broad responsibilities that encompass a variety of activities and/or involve "whole pieces of work"
2 = Limited area of specific responsibilities but with the possible need of having to adapt to varying circumstances
1 = Single area of responsibility

Question #9 -- Repetition (ASREP)

4 = Some activities may be repeated but there are long periods of time between repetitions; other activities are different due to different inputs, cases or conditions under which group works
3 = Some activities are repeated every time group meets, others are different due to different inputs or conditions under which group works
2 = Same activities are repeated every time group meets but various aspects change such as location, topics covered, etc.
1 = Same activities repeated every time group meets; very short work cycles (i.e., activities repeated a number of times per hr.)

Temporal Scope

Question #13 -- Amount of time group will be together
(TSLIFE)

4 = Indefinitely, no projected time limit; group membership is relatively permanent
3 = Although an actual group may be in existence indefinitely, the tenure of individual members is limited
2 = The group is temporary, lasting only until a given project is completed
1 = Membership may vary from call to call/day to day; group forms as needed, same members may not necessarily be together each time

Question #14 -- Amount of time members work together
(TSTIME)

9 = Varies, could be from 8 to 40 hours per week
8 = More than 30 hrs. per week
7 = More than 25 hrs. but no more than 30 hrs. per week
6 = More than 20 hrs. but no more than 25 hrs. per week
5 = More than 15 hrs. but no more than 20 hrs. per week
4 = More than 10 hrs. but no more than 15 hrs. per week
3 = More than 5 hrs. but no more than 10 hrs. per week
2 = At least 2 hrs. but no more than 5 hrs. per week
1 = Less than 2 hrs per week/only when called

Question #15 -- Other activities (hrs. with group per wk./40)
(TSOTHACT)

3 = No other activities
2 = Less than time spent on group activities (less than .5)
1 = Greater than time spent on group activities (more than .5)

Integration

Frequency of External Interactions

Question #16 -- Are external interactions necessary

If no, #17, #18 & #19 = 0
If yes, #17, #18 & #19 scored as follows

Question #17 -- Number of other groups team must interact with (Add up number of groups team interacts with) (EXINT)

Type of other groups team must interact with

A Customers/clients/patients (EXCUST)	1 = Yes	0 = No
B General public (EXPUB)	1 = Yes	0 = No
C Government/public agencies (EXGOV) (i.e. police, health agencies, etc.)	1 = Yes	0 = No
D Relatives of clients/patients (EXREL)	1 = Yes	0 = No
E Other teams of the same type (EXTMS)	1 = Yes	0 = No
F Professionals (e.g. doctors, scientists, etc.) (EXPROF)	1 = Yes	0 = No
G Contractors/personnel from other companies (EXCONT)	1 = Yes	0 = No
H Other personnel or departments within the organization (EXDEPT)	1 = Yes	0 = No

Question #18 -- Frequency or extent of interaction with other groups

How often must the team interact with each group

3 = Often/several times a day/every time group is together
2 = Frequently/not necessarily every time group is together but on a regular basis
1 = Occasionally/only as needed/frequent but minimal contact as in delivering supplies
0 = Never

A Customers/clients/patients (FREQCUST)
B General public (FREQPUB)
C Government/public agencies (FREQGOV) (i.e. police, health agencies, etc.)
D Relatives of clients/patients (FREQREL)
E Other teams of the same type (FREQTMS)
F Professionals (e.g. doctors, scientists, etc.) (FREQPROF)
G Contractors/personnel from other companies (FREQCONT)
H Other personnel or departments within the organization (FREQDEPT)

Question #19 -- Importance of interactions with other groups to team's work

4 = Interaction is critical/central to group's purpose (i.e., without it there would be no need for the group to exist; interaction provides needed materials)
3 = Interaction facilitates group's work; without it group's work would be more difficult or less effective; interaction may result in some type of direct assistance to team
2 = Interaction provides information to be used by the team/interaction involves exchange of important information
1 = Interaction occurs in course of group's work but is more or less tangential to it, i.e., it does not necessarily hinder or help the group

A Customers/clients/patients (IMPCUST)
B General public (IMPPUB)
C Government/public agencies (IMPGOV)
(i.e. police, health agencies, etc.)
D Relatives of clients/patients (IMPREL)
E Other teams of the same type (IMPTMS)
F Professionals (e.g. doctors, scientists, etc.) (IMPPROF)
G Contractors/personnel from other companies (IMPCONT)
H Other personnel or departments within the organization (IMPDEPT)

Standardization

Question #21 -- Degree of standardization (STNDZN)

4 = Established procedures exist and must be followed; members have no opportunity for decision-making
3 = Standard operating procedures exist but they allow some room for decision-making or adjustment to a given situation
2 = General guidelines that provide broad limits on how work is to be done are provided
1 = No guidelines exist

Question #22 -- Frequency of unexpected situations that necessitate a change in procedures (STUNEXP)

4 = Rarely occur
3 = Sometimes occur but group deals with basically stable or consistent conditions
2 = Frequency varies but potential is high because of nature of work (e.g., dealing with difficult personal issues, volatile situations, conditions that are not under group's control)
1 = Often occur

Question #23 -- Team's product

This item provides supplemental information -- it is not scored.

External Pacing/Coordination Demands with Outside Groups

Question #20 -- Is input provided to others (input can be in the form of a tangible product, a service that must be installed before service can begin, etc.; refers to input that has to be provided at a regular time/interval) (XPINPUT)

2 = Input must be provided at a specified time so that the activities of others will not be delayed
1 = Input is provided so that a delay in the group's input or activities may be inconvenient but does not cause a severe disruption in the activities of others
0 = This type of input is not provided

Question #25 -- Deadlines/time constraints (deadlines refer to established dates when a report or product must be delivered or a certain date by which certain activities must be completed or a time within which certain activities must be performed) (XPDEADL)

3 = Deadlines are determined outside the group/not at all under group's control; deadlines are not flexible (e.g., deadlines or time constraints imposed by regulations, conditions outside the group's control, etc.)
2 = Deadlines are determined outside the group but they are more in the form of general goals/time constraints/guidelines; some flexibility is possible
1 = The group determines its own deadlines
0 = Meeting established deadlines is not part of the group's work

Question #26 -- Importance of external timing/pacing (i.e., keeping up a certain speed of performance/timing actions so that certain things occur at certain times) (XPACE)

2 = Timing is determined by conditions outside the group's control; they must constantly monitor and adjust to various conditions (e.g., production schedules, actions of another team, conditions at an accident or fire scene, condition of a patient, etc.)
1 = The group determines its own timing or pace of activities (i.e., given certain deadlines, the group establishes when specific actions will occur)
0 = Keeping up a certain pace is not an essential part of the group's work

Question #28 -- Determination of schedule (i.e., who determines when group must work together) (XPSCHED)

2 = Determined outside group/depends on call for group's services
1 = Determined by group with cooperation of others
0 = Determined entirely by group members

From Questions #20, #29 & #30 -- What is the nature/purpose of interactions with others

0 = No 1 = Yes

A = Provides direct assistance with an activity (PROVASST)
B = Receives direct assistance with an activity (RECASST)
C = Provides recommendations/suggestions through face-to-face interactions (RECFACE)
D = Provides recommendations/suggestions indirectly through written report (RECREP)
E = Provides a direct service to a customer/client (i.e., works on client/patient) (DIRSERV)
F = Directly receives raw materials or supplies needed for group's work (RECMAT)
G = Directly delivers raw materials or supplies needed for another group's work (DELMAT)
H = Receives information to be used by group through face-to-face interaction (INFOFACE)
I = Provides information to others directly (PROVINFO)
J = Provides information (other than recommendations or suggestions) to others indirectly (i.e, via paperwork, reports, etc.) (INFOREPT)
K = Obtains maintenance of equipment used by group (involving face-to-face interaction) (OBMAINT)
L = Provides presentation or performance observed by others (PRESTN)
M = Plays or competes with others (PLAYS)
N = Participates in training exercises with other teams (TRAINS)
O = Obtains approval from others before continuing (APROV)

Organization (ORG)
01 VA Beach Fire Dept.
02 Suffolk S.D.
03 Newport News Shipbuilding
04 Virginia Natural Gas Co.
05 Virginia Power Co.
06 City of Norfolk
07 Ford Assembly Plant
08 Sentara Hospital
09 Vocational-Technical H.S.
10 Canon Virginia, Inc.
11 VA Beach Emergency Medical Services
12 Norfolk Little Theater
13 Old Dominion University
14 Salvation Army
15 City of Virginia Beach
16 VA Beach Police Dept.
17 Norfolk Redevelopment Housing Authority
18 SouthTech
19 U.S. Marines
20 Doorway Singers
21 Norfolk Southern Corporation
22 Coke
23 Celtica

Work Type (WORKTYPE)
1 Production
2 Service
3 Decision-Making
4 Problem-Solving
5 Performance
6 Mixed
7 Other

Relation to Team (RELAT)
1 Member
2 Leader
3 Facilitator/ Coordinator
4 Supervisor/ Coach

Length of time with team = code in months (LENGTH)
99=more than 9 years

Team Type (TEAM)
01 Fire Fighting Team
02 Child Study Team
03 Quality Improvement Team
04 Gas Construction Crew
05 Customer Response Team
06 Management Team/Executive Committee
07 Task Team/Project Team
08 Energy Efficiency Team
09 Committee
10 Staff Development Team
11 Assembly Group/Manufacturing Group
12 Hazardous Materials Team
13 Technical Rescue Team
14 Advanced Life-Saving Team
15 Squad Truck Team
16 Surf Rescue Team
17 Dive Team
18 Basic Life-Saving Team
19 Field Hockey
20 Advisory Council
21 LaCrosse Team
22 Mosquito Control Crew
23 Hostage Negotiation Team
24 SWAT Team
25 Shipping Team
26 Research Team
27 Sanitation Crew
28 Combat Fire Team
29 Musical Group
30 Basketball Team
31 Flight Crew

Appendix D

Summary of Steps Followed in Study

and

Summary of Variables Used in Study

Summary of Steps in Followed in Study

Phase 1: Derivation Phase

Cluster analyze Sample A by means of Ward's minimum variance method; integration and differentiation components scores are used. Centroids for clusters computed for use in next phase.

Cluster analyze Sample B by means of Ward's minimum variance method; integration and differentiation components scores are used.

Guidelines followed to identify the number of clusters present:

1) Positive values of the cubic clustering criterion mean that the obtained $\underline{R^2}$ is greater than would be expected if the sample was drawn from a uniform distribution, and therefore, indicates the possible presence of clusters (Sarle, 1983).

2) To identify the optimal number of clusters in the data, look for the highest obtained value of the cubic clustering criterion or the pseudo $\underline{F}$ statistic (Milligan & Cooper, 1985). However, in some cases both criteria tend to increase as the number of clusters increases. In this situation, it is more appropriate to look for large jumps in these statistics than to consider the highest value overall in determining the number of clusters (Ray, 1982).

3) A cubic clustering criterion exceeding 2 or 3 is considered strong evidence of clusters (Sarle, 1983).

Cluster analyze Sample A by means of Ward's minimum variance method; score means for environmental demands variables are used.

Cluster analyze Sample B by means of Ward's minimum variance method; score means for environmental demands variables are used.

Cluster analyze Sample A by means of Ward's minimum variance method; score means for behavioral requirements variables are used.

Cluster analyze Sample A by means of Ward's minimum variance method; score means for behavioral requirements variables are used.

Phase 2: Replication Phase

Cluster analyze Sample B by means of nearest centroid clusters obtained from cluster analysis of Sample A in derivation phase.

Compare centroid clustering of Sample B with original clustering of Sample B that occurred in derivation phase.

Phase 3: External Validation Phase

Combine Samples A and B. Teams in Sample A classified according to clusters obtained in derivation phase. Teams in Sample B classified according to nearest centroid clusters obtained in replication phase.

Combined sample examined with respect to environmental demands variables and behavioral requirements variables by means of MANOVAs.

Summary of Variables Used in Study

Differentiation Variables

- Specialization
- Scope of Activity
- Temporal Scope

Integration Variables

- Frequency of External Interactions
- Standardization
- External Pacing of Work

Environmental Demands Variables

- Interface Demands
- Barrier Demands
- Interaction Demands
- Differentiation Demands

Behavioral Requirements Variables

- Communication
- Team Orientation
- Team Leadership
- Monitoring
- Feedback
- Backup Behavior
- Coordination

Appendix E

BASIC Program for Computing the Adjusted Rand Statistic

```
' RAND INDEX PROGRAM (cf. Hubert & Arabie)
' To read output file from SAS Cluster Analysis (CX.LIS)
' G. D. Coates 10/15/95
'
SCREEN 9: COLOR 14, 1
DEFDBL D, N
OPEN "i", 1, "cx.lis": OPEN "o", 2, "cx.ran"
PRINT #2, "Cluster Summary by Observation from CLUSTERX SAS"
PRINT #2,
10 IF EOF(1) THEN CLOSE #1: GOTO 99
J = J + 1
LINE INPUT #1, A$
IF J = 1 THEN r$ = MID$(A$, 37, 7): C$ = MID$(A$, 48, 7)
PRINT #2, A$
GOTO 10
99 PRINT #2, CHR$(12)
OPEN "i", 1, "cx.lis"
LINE INPUT #1, A$
LINE INPUT #1, A$
20 IF EOF(1) THEN 88
INPUT #1, NOB, NS, JX, JY
IF JX > MAXR THEN MAXR = JX
IF JY > MAXC THEN MAXC = JY
NCL(JX, JY) = NCL(JX, JY) + 1
NR(JX) = NR(JX) + 1
NC(JY) = NC(JY) + 1
NT = NT + 1
GOTO 20

88 PRINT #2, "Frequency Contingency Table": PRINT #2,
PRINT #2, TAB(20); C$
PRINT #2, TAB(5);
FOR I = 1 TO MAXC
PRINT #2, USING "    #  "; I;
NEXT: PRINT #2, : PRINT #2, r$
FOR J = 1 TO MAXR
PRINT #2, TAB(2); : PRINT #2, USING "#"; J;
FOR I = 1 TO MAXC
PRINT #2, USING "  #####"; NCL(J, I);
N = NCL(J, I): GOSUB COMB: CCL(J, I) = cm
tcl = tcl + cm
NEXT:
PRINT #2, USING "     #####"; NR(J)
N = NR(J): GOSUB COMB: CR(J) = cm
tcr = tcr + cm
NEXT
PRINT #2, : PRINT #2, TAB(3);
FOR I = 1 TO MAXC
PRINT #2, USING "  #####"; NC(I);
N = NC(I): GOSUB COMB: CC(I) = cm
tcc = tcc + cm
NEXT:
PRINT #2, USING "     #####"; NT
```

```
N = NT: GOSUB COMB: ct = cm
PRINT #2, : PRINT #2,
PRINT #2, "Combinations Contingency Table": PRINT #2,
PRINT #2, TAB(20); C$
PRINT #2, TAB(5);
FOR I = 1 TO MAXC
PRINT #2, USING "    #  "; I;
NEXT: PRINT #2, : PRINT #2, r$
FOR J = 1 TO MAXR
PRINT #2, TAB(2); : PRINT #2, USING "#"; J;
FOR I = 1 TO MAXC
PRINT #2, USING "  #####"; CCL(J, I);
NEXT:
PRINT #2, USING "     #####"; CR(J)
NEXT
PRINT #2, : PRINT #2, TAB(3);
FOR I = 1 TO MAXC
PRINT #2, USING "  #####"; CC(I);
NEXT:
PRINT #2, USING "     #####"; ct
PRINT #2, : PRINT #2,
num = tcl - (tcr * tcc / ct)
den = (tcr + tcc) / 2 - (tcr * tcc / ct)
r = num / den
ru = (ct + 2 * tcl - (tcc + tcr)) / ct
rx = 1 + 2 * ((tcr * tcc) / ct ^ 2) - (tcr + tcc) / ct
PRINT #2, "Rand Index = "; : PRINT #2, USING "###.#####"; ru
PRINT #2, "Expected Rand Index = "; : PRINT #2, USING
"###.#####"; rx
PRINT #2, "Maximum Rand Index = "; : PRINT #2, USING
"###.#####";
1
PRINT #2, "Corrected Rand Index = "; : PRINT #2, USING "
###.#####"; r

END
COMB:
IF N < 1 THEN cm = 0: RETURN
num = 1: den = 1
FOR K = N TO 1 STEP -1
num = num * K
NN = num
NEXT
L = N - 2: IF L = 0 THEN 77
FOR K = L TO 1 STEP -1
den = den * K
NEXT
77 den = den * 2
cm = num / den
RETURN
```

Appendix F

Marginally Significant

Behavioral Requirements Dimensions

The six clusters obtained during the derivation phase were compared on the variables pertaining to behavioral requirements by means of a MANOVA. The results for the MANOVA showed an overall main effect of cluster membership, Wilks' Lambda = .3777, F (7,35) = 2.4671, $p < .001$.

To clarify which particular variables differed among clusters, univariate analyses of variance (ANOVAs) were computed for the seven behavioral requirements variables. The results indicated that the six clusters differed on the communication, monitoring, backup behavior, and coordination dimensions. Consequently, post hoc analyses were conducted to determine among which clusters differences existed. In order to be considered significant, a difference between clusters had to be indicated by Scheffe's Test at the $p < .05$ level. This reliance on a conservative post hoc test served to reduce the number of dimensions considered significant. Specifically, only monitoring was considered significant on the basis of the post hoc tests. For purposes of future hypothesis testing, the three dimensions that showed only marginal results are presented below. These results are based on Duncan's Multiple Range Test, the Bonferroni T Tests, and the Student-Newman-Keuls Test.

Communication. Responses from teams in Cluster 1 (M = 2.93) and Cluster 3 (M =2.91) indicated stronger needs for communication than that indicated by teams in Cluster 6 (M = 2.04).

Back-up behavior. Responses from teams in Cluster 3 (M = 3.09) indicated stronger needs for back-up behavior than that indicated by teams in Cluster 2 (M = 2.37).

Coordination. Responses from teams in Cluster 1 (M = 2.70) indicated stronger needs for coordination than that indicated by teams in Cluster 2 (M = 1.82).

AUTOBIOGRAPHICAL STATEMENT

Ann Marie Yanushefski was born on March 26, 1957 in Wilkes-Barre, Pennsylvania. She obtained a B.A. in Psychology in 1979 from Wilkes College, a M.Ed in Human Development in 1981 and an Ed.S. in School Psychology in 1982 from Lehigh University, and a Ph.D. in Industrial/ Organizational Psychology in 1995 from Old Dominion University.

Dr. Yanushefski spent six years as a school psychologist in the Dallastown Area School District. She has worked on a number of research projects including a federally funded child abuse study conducted by the Center for Social Research at Lehigh University and studies concerning team effectiveness conducted by the Center for Applied Psychological Studies at Old Dominion University. She participated in the Langley Aerospace Research Summer Scholars Program and served as an independent research contractor for Battelle. In addition, Dr. Yanushefski completed an internship in the Personnel Selection and Research department at NYNEX and has worked on consulting projects with Virginia Natural Gas Company, Canon Virginia, Inc., and Norfolk Southern Corporation. She has also served as an assessor for Personnel Assessment Systems and as an instructor at Old Dominion University.

Dr. Yanushefski is a member of the Honor Society of Phi Kappa Phi and Psi Chi National Psychology Honor Society.

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