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Occupational requirements for Iowa, 1975

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OCCUPATIONAL REQUIREMENTS FOR IOWA, 1975

by

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PREFACE

"The material in this project was prepared under Grant No. 401-21-07 from the Manpower Administration, U.S. Department of Labor under the authority of title I of the Manpower Development and Training Act of 1962. Researchers undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment. Therefore, points of view or opinions stated in this document do not necessarily represent the official position or policy of the Department of Labor."

OBJECTIVES, METHODOLOGY, INTERPRETATION

"Of the various dimensions of manpower projections, it is probably the occupational dimension which arouses the strongest interest". (16, p. 34) The purpose of this study was to develop relevant data on occupational manpower requirements for the state of Iowa for 1975. While several approaches are possible (1, 2, 4, 20, 26, 28, 46) the data presented in Tomorrow's Manpower Needs (59, 60, 61, 62) provided the basic framework for this research. The model involves first, projecting state industrial employment to 1975 and second, analyzing the occupational makeup of industrial employment in 1960 and in 1975. National data were used in both these steps.

Indeed the justifications for this thesis were felt to be (1) that projections of occupational needs at the state level are needed in planning education, training and retraining programs and (2) that such projections are more reliable if made within the context of nationwide economic and technological developments. The Report of the Working Group on Manpower Projections to the President's Committee on Manpower seems to support this view recommending that, "assumptions to be used for specific local area demand-supply relations or detailed occupational requirements should be tied into overall economic models whenever feasible." (87, p. 13) In addition, the variety of detailed occupation by industry data available only on a nationwide basis makes it all but necessary to incorporate such data in any detailed occupation study.

Basically, two approaches are possible using the 1960 and 1975 national industrial-occupational (I-O) matrices presented in Tomorrow's Manpower Needs. (62) The first involves constructing an area I-O

matrix for 1960 and superimposing on that matrix national occupation by industry trends. Each cell of the area I-O matrix will then be multiplied by an individual trend value and the results summed to obtain estimates of total occupational need in 1975. The second method involves developing an overall trend factor for each occupation and using the single trend factors to project occupational requirements to 1975. Although the latter is considerably less time consuming than the former, both methods were utilized so that comparisons could be made.

In addition, the labor force experience of the male population between 1950 and 1960 was examined in order to gain some clues as to entry, retirement and mobility patterns for certain occupation groups.

The detailed steps involved, numerical estimates and conclusions to be drawn are the subjects of the subsequent chapters.

It is appropriate here, however, to discuss the major assumptions and meaning of the work to follow.

Since national data developed by the Bureau of Labor Statistics (BLS) were used extensively in this thesis the assumptions and methodology of their work are of considerable importance. (62) The Bureau assumed that out of a total labor force of 94.2 million, 91.4 million would be civilians. The assumed size of the Armed Forces in 1975, 2.7 million, is consistent with peacetime conditions in the late 1950's and early 1960's. A settlement of the conflict in Vietnam is thus a crucial element in realizing the Bureau's projections. A second major assumption is that of an overall 3% unemployment rate in 1975. Scientific and technological advances of recent years were assumed to continue at about the same rate. Based on these assumptions GNP (in 1958 dollars) was projected to reach $950 billion by 1975. In

addition, it was assumed that the level of defense expenditures would increase between 1965 and 1975 at the same rate as during the 1955-1965 period, again implying that the Vietnam conflict will have been over for some time by 1975.

The Bureau tried a variety of methods to project industrial employment requirements to 1975. Regression equations relating industrial employment of wage and salary workers to GNP, unemployment, population and time as well as to more strategic variables (for example, manufactures of motor vehicles were related to the driving age population) were examined. Employment requirement estimates based on input-output analysis were also developed. In the latter estimates, total output requirements for each industry were computed and related to expected output per man-hour in each industry in order to obtain a projection of industry employment. The results of these calculations as well as qualitative information concerning technology and the structure of the industry were considered in reaching the final employment requirement estimate for each industry. These final projections were then reviewed (1) to reconcile detailed industry employment projections with broad industry employment projections and with the civilian labor force estimate for 1975 and (2) to insure consistency with productivity expectations and expected real GNP.

Since each industry requires a specific mix of occupations, occupational patterns for each industry in the economy were developed for 1960 and projected to 1975. An occupational pattern for an industry shows the percent of employment that each occupation makes up in that industry. The main source of information for the national matrix for 1960 was the U.S. Census Bureau's occupation by industry report based on the 1960 Census.

The BLS I-O table differs from this report, however, in that it has been made consistent with national occupational and industrial data which are available annually from the monthly household survey conducted by the Bureau of Census and published in Employment and Earnings and Monthly Report on the Labor Force (52). The BLS table also uses occupational data from a number of other sources including statistics collected by the Office of Education, regulatory agencies for interstate industries (including railroads, airlines, telephone, telegraph and pipelines), professional societies, BLS employer surveys, BLS community wage surveys, the Post Office Department and the Federal Civil Service Commission.

Projection to 1975 of the occupational structure of each industry was based on examination of historical statistics as well as other relevant information such as description of new machinery and methods, new raw materials, and significant demand variables. In addition, an attempt was made to determine the causes of past changes in occupational structure and the likelihood of their continuance. For some occupations requirements were estimated directly. For example, the number of teachers required was related to the number of pupils. As a result, few of the final occupation ratios which are as large as 1 percent are exact extensions of past trends except by chance. (56)

In the U.S. study each of the industrial employment estimates for 1975 was multiplied by its appropriate occupational pattern to obtain estimates of its employment requirements by occupation. These occupational figures were then summed across all industries to obtain total estimates of requirements for each occupation.

What is the substantive meaning of these projections?

Manpower projections fall into two broad categories. On the one hand estimates are concerned with possibilities for employment, and on the other with workers available for employment. The labels demand and supply are sometimes attached to these two groupings but it is incorrect to interpret the projections as corresponding to the economist's understanding of demand and supply.

While the size of the projected labor force in 1975 was adjusted to reflect the effects of the assumed 3% unemployment level (24) neither the industrial employment estimates nor the estimate of the employed civilian labor force were constrained by price assumptions. Thus neither supply nor demand schedules relating quantities to prices were developed. And while projections of quantity demanded (unconstrained by price) can be made directly for some occupations, (for example, the need for teachers can be estimated on the basis of estimates of school age population and trends in teacher-pupil ratios) in most cases it is employment not demand that is statistically explained and projected. This is true of all the industrial employment series. And while quantity demanded may be synonymous with employment in cases where unemployment exists, the two are not equivalent where there are shortages of labor. As Mangum and Nemore note, "In the absence of job vacancy data to supplement employment data, our knowledge of present and past demand is deficient." (29, p. 6) The label manpower requirements is often attached to both these types of projections, to distinguish them from projections of employment made on the supply side.

Furthermore both the projections on the requirements side as well as on the supply side can be of a normative or a positive variety. (87) Positive projections are intended to show what the variable being projected

is likely to be under given conditions in a future period. Normative projections show what the variable ought to be. For example, estimates of the number of teachers needed on the basis of some "ideal" student-teacher ratio, or of the labor force requiring all people over 62 to retire, or of employment requirements in the automobile manufacturing industry given the constraint that every family owns at least one automobile would all be normative projections. Positive projections would project values for these variables based on past trends as well as any likely future developments but would be free of any predetermined goals or judgements as to what would comprise a desirable situation. Both are legitimate but must be properly identified.

It must also be noted that the initial projection of requirements (whether of the quantity demanded or employment type) or of availables may be modified in the form in which they are presented. Usually the modifications in some way reflect responses to the difference between requirements and availables found in the original projections. Hansen distinguishes between ex ante responses to and ex post reconciliations of the difference between the originally projected requirements and availables. (19) If the projection of the manpower requirements for an industry or occupation are lowered to reflect likely induced factor substitution of capital for labor, or if the projection of availables is increased to reflect likely induced employer or government training programs than the original projections have been modified to reflect ex ante responses. Goldstein refers to this as a "successive-step approach." (15, p. 18) It is to be expected that such modifications will be made. As J. E. Morton puts it, "If manpower forecasting is used as a diagnostic device, and if diagnosis and therapeutics

are responsibilities of the same person or organization, the anticipated effect of therapeutics cannot be ignored." (32, p. 49)

Ex post reconciliations, on the other hand, would include any adjustments in the originally projected requirements or availables made for the purpose of reconciling the two projections. For example, if opportunities for employment by industry or occupation are projected on the basis of expected demand conditions and production techniques and the sum of the projected employments is constrained to equal the size of the projected employed labor force in the year in question then an ex post reconciliation has been made.

At this point mention should be made of a controversy over definitions. While the label requirements is often attached to the final projection presented on the demand or employment side, (which may or may not include ex ante and ex post adjustments), Hansen would like to see this label applied to the original estimate only. He defines a projected requirement as the number of workers needed in view of the assumptions embodied in the projection. The assumptions would relate to such things as the level and composition of final demand, productivity change, and factor substitution. The initial projection of total industrial employment in the previous example would thus be a requirement projection but would no longer be considered a requirement projection once it was constrained to equal the size of the employed labor force. Since the latter constraint would impose an ex post reconciliation between requirements and availables the final projected total of industrial employment should according to Hansen be considered a projection of an "actual". Hansen defines an actual as a projection (1) reflecting ex ante as well as ex post reconciliations

between differences in requirements and availables thus (2) representing some best estimate of the levels of employment and labor force that will be observed in the projection year.

Hansen's discussion and attempt to classify projections by type are very thought provoking. However, the name applied to a projection does not make as much difference as whether or not the assumptions and any modifications to the projection are carefully spelled out. His clarification of some of the conceptual problems should contribute to the latter. Furthermore, while it is true that some of the BLS projections correspond to Hansen's definition of "actuals" this is not true in all cases.

With these qualifications in mind it is useful to consider the approach followed by the BLS in constructing the national estimates presented in Tomorrow's Manpower Needs.

The projections began from a set of "positive" (in the sense defined above) projections of the population and labor force. An unemployment level of 3% was then selected for 1975.

As Mangum and Nemore point out, "because employment levels in modern economies are in large part the consequence of public policy, they are subject to guess, but not to projection." (29, p. 5) The 3% estimate used by the BLS was adopted after consideration of the unemployment experience of the 1960's and the current emphasis on manpower utilization and training programs. Thus it involves a positive rather than a normative judgement. The estimates of both the total labor force (projected population x projected labor force participation rate) as well as the employed labor force (projected labor force x 97%) can be considered as projections of availables. They reflect projections of the stock of workers that will be

on hand. Given the assumed commitment to a 3% unemployment level it is clear that within the model job openings will not be allowed to fall below the level needed to provide employment for the persons available to fill them. It is in this sense that the projection of employed labor force corresponds to Hansen's definition of an "actual". It provides the best estimate of the level of actual total employment that will be observed in 1975 and to which any projections of total employment on the requirements side will be reconciled.

The projections of total employment requirements by major industry division were also of the positive variety. No normative assumptions concerning the relative sizes of industrial sectors were made. The sum of the initial estimates were reconciled ex post to balance with the previously attained estimate of employed labor force. They can still be viewed as requirements but in the sense that they are needed to meet the 97% employment goal by the assumed patterns of demand. (50) Since the industrial employment estimate in total is constrained to equal the availables, the estimate also corresponds to Hansen's definition of "actuals".

While the procedure of constraining the sum of industrial projected employment openings does lead one away from Hansen's pure definition of requirements it is not as arbitrary as it seems. Since the projected level of GNP in the target year is based on the "availability" estimate of the employed labor force and productivity, it does not then appear reasonable to project from the employment openings side, i.e. the requirements side, a greater (or lesser) number of places to fill than people to fill them. It makes no sense to project 100 (or 60) employment openings as needed to be filled to produce a GNP estimated to result from a projected employed

labor force of 80 persons!

On a sector by sector basis, however, there are no constraints in the procedure to insure that the level of employed labor force projected on the requirements side will equal the level of employed workers projected on the availables side were the latter to be made. Other than constraining the overall total level of industrial employment requirements to equal total available to employ, it does not appear that any additional ex ante or ex post adjustments have been made to the individual industrial employment requirement estimates. Whether ex post adjustments have been implicitly made to availables so that the requirement figures are also "actual" figures (in the Hansen sense) is not so easy to discern. Since the main interest in the BLS study is on occupational needs, it is probably true that the estimates of industrial requirements also represent their best guess as to the levels of industrial employment that will actually be achieved. One BLS report warns, for example, that estimates of industrial employment which differ appreciably from those in the study might imply a difference in scale of operations or modification of production methods and therefore a change in the occupational structures required by the industries. (56)

It is doubtful if the BLS would have gone to the time and expense to construct the I-O matrix for 1975 if they did not feel reasonably confident that, at least within the framework of their assumptions, the industrial employment requirements would be fulfilled. The tendency to refer to the projections of industrial employment as "employment" rather than "employment requirements" also supports this view.

Since the purpose of the study was to aid in uncovering imbalances between requirements and availables at different skill levels, their

approach to occupational estimates is of particular interest. Like the industrial projections, the projections of occupational requirements were positive rather than normative since they were based on likely estimates of what will rather than what should happen. Although some occupational requirements were projected directly (teachers, scientists, dentists, registered nurses, television and radio repairmen, and business machine repairmen) and thus came closer to a true estimate in quantity demanded, most of the projections were based on employment trends.

Thus since many of the industry-occupational ratios for 1975 were an extension of the changes in ratio found in past years they embody a continuation of unidentified adjustments to past shortages at least for some of the occupations. Indeed one of the factors which the BLS tried to anticipate were supply-demand conditions which might cause the substitution of workers in one occupation for more urgently needed workers in another, such as technicians for engineers. (61) The projections thus might be said to reflect "ex ante responses" to anticipated shortages in certain occupations. However, the substitutions among occupations revealed in the BLS projections are more reflective of already occurring past trends than they are of responses to original requirements versus available projections. For example, concerning technicians the BLS states that "the increasing emphasis on improved utilization of scientists, engineers,...and the need to relieve these workers of relatively routine tasks...will continue to be the major factors that underlie the increased requirements for technicians." (61, p. 6)

Finally it should be mentioned that the projections of occupational requirements do not correspond to Hansen's concept of "actuals". Although

the total estimate of occupational employment requirements will equal the estimate of the total available for employment, (this is so because it is industrial employment that is allocated to occupations), the BLS employment requirements occupation by occupation were (1) not reconciled on an ex post basis to equal the number available in that occupation nor do they (2) necessarily represent the best guess of the BLS as to what employment levels will actually be in the given year. In developing the ratios, the Bureau points out, no specific consideration was given to the availability of workers with the required skills. (62, p. 10) In regard to occupational requirements the BLS specifically states, "the projections are not meant to represent actual employment levels in 1975." (61, p. 3)

While one might be tempted to say that the projections of requirements equal the best guess of actual employment in the year 1975 in cases where requirements are equal to or less than availables, even this would not necessarily be correct because the whole purpose of the BLS study is to isolate and set off responses to differences between requirements and availables. Thus requirements as well as availables could change for all occupations.

Finally it might be noted that the process of adjustment could change the levels of employment actually attained in industries as well. Factor substitution in response to a shortage in one occupation could cause changes in the level of employment required for the entire industry. Thus even in regard to industrial employment the projections may be successful only to the extent that they are proven false. (50) Since the purpose of the projections is to warn of impending problems, "the warning may permit avoidance of the crisis and invalidate the projection." (29, p. 3)

In conclusion it might be noted that the area of manpower projection is not free of either conceptual or definitional problems. The papers of Hansen, Mangum and Nemore, Goldstein and others have helped to clarify some of the issues.

Because of the fact that the word "employment" brings to mind a concept of a demand-supply point, it seems that one of the most awkward problems in describing projections is to distinguish between projections of employment made from the openings (requirements) side (based on such things as productivity, demand, etc.) from those made on the availables side (based on population patterns of attrition, new entrants, mobility, etc.). While the labels availables or supply are generally satisfactory for the latter, the labels demand or requirements are not without problems for the former. The most important point is, however, that because the two are made independently they need not balance. Because of this fact, it is extremely important to note when it is assumed that they do. The tendency to just use the word projected "employment" in the latter case is not always adequate to convey to the reader that a balance assumption or constraint has been made. Finally, Hansen's important point needs to be repeated. Any modification to initially estimated requirement projections must be spelled out.

The procedure followed for the state estimates was to relate Iowa's industrial employment to that of the United State's and to time. National employment can be considered to represent overall nationwide demand for the products of the industry adjusted to allow for changes in labor productivity, while time would allow for the affect of other factors directly affecting regional employment. Even for industries whose products sell in

a strictly local market, United States industrial employment was felt to be a relevant variable since income trends, tastes and preferences reflected in the U.S. projections are generally similar for all regions of the country. The estimates of industrial employment requirements were then turned into occupational employment requirements by application of national I-O trends. The projections of requirements are thus of an employment rather than a demand variety and are positive rather than normative.

It should be noted that the State projections of industrial employment requirements were not constrained to equal independently made estimates of the state population available for employment. This was felt to be the more reasonable approach since no projection of state GNP was made or incorporated into the estimation procedure. Likewise the unemployment level of any given state is not as easily "guessed" in advance as is that of the nation. Finally, the possibilities of migration into or out of the state in response to the original projections make it less logical to constrain the projection on the requirements side to equal that on the availables side. The state projections thus correspond closely to Hansen's pure definition of requirements.

In conclusion, it might be interesting to note a few of the uses to which projections can be put. They are, of course, useful in planning (or curtailing) educational programs and in guiding the vocational choices of individuals. Projected imbalances can also be avoided by responses on the job openings side--thus the projections may provide keys to the type of jobs that need to be created. They also help in evaluating the feasibility of undertaking new welfare, research or education oriented programs, or at least is anticipating manpower bottlenecks that the programs may encounter

or create. They can also be useful in business in preparing for anticipated manpower shortages or surpluses, especially where the latter can be alleviated through enlightened use of attrition patterns. Finally, if the view is held that the continued growth of the economy rests on an adequate number of trained and capable scientific and technical manpower to contribute to the expansion of knowledge, then to the extent that manpower projections ensure their presence, the projections move "from merely seeking to prevent an undesirable situation from arising to striving in a positive and systematic fashion to help create the desirable situation." (87, p. 25)

DEVELOPMENT OF THE AREA INDUSTRIAL-OCCUPATIONAL MATRIX, IOWA 1960

The following chapters will describe the techniques used to obtain occupational projections for Iowa for 1975. The method integrates national industry-occupational structure trends with a specially developed area base period industry-occupational matrix. The first step in using this method is the development of the area matrix for 1960. Secondly, an area target year (1975) matrix is computed by applying the 1960 and 1975 national industry-occupational matrices in percentage terms to 1960 and projected 1975 total employment by industry in Iowa. The national relationships enable a ratio to be determined in each cell. When these ratios are multiplied by 1960 Iowa I-O data a projection for 1975 for total employment requirements of each occupation in each industry in Iowa is yielded. When projected occupational employment requirements are summed over all industries a projection of total employment requirements of each occupation in Iowa for 1975 is obtained.

The sections in this chapter will describe the development of the area industrial-occupational matrix for Iowa for 1960.

Size of the Matrix

The Census data from 1960 provides a starting point for the development of the area matrix. (68, Table 125) The industry-occupational (I-O) matrix for Iowa which is reported in the Census contains data for 43 district industries or industry groupings including "industry not reported". Total industrial employment is reported for approximately 150 district industries. (68, Table 126) Occupational data for Iowa is

enumerated in the I-O matrix for 57 and 30 occupations for males and females respectively. An "occupation not reported" group is included for each sex. In addition, occupational employment totals are reported for approximately 600 occupations or occupation groups. (68, Table 120)

The BLS-Census national I-O matrices for 1960 and 1975 include occupational employment patterns for 155 industries covering 190 occupations or occupation groups. (62, Appendix G) An employment pattern for any given industry shows the percent of employment each occupation makes up in that industry. The Iowa Census I-O matrix was expanded to cover 64 of the 155 industries covered in the national matrix and all of the 190 occupations for which employment was positive in 1960.

Aggregate Iowa I-O data was broken down into finer industrial groupings in cases where total employment in the aggregate industry in Iowa was made up of different proportions of individual industries than was total employment in the aggregate industry in the nation. For example, data on agriculture, forestry and fisheries for Iowa indicated that total employment among these industries was distributed differently in Iowa than in the nation so these industries were handled individually in the area matrix. The same was true of federal, state and local government employment.

It was also convenient to work with finer industrial detail in cases where the BLS-Census national employment patterns were available only for these finer industries. For example, the Iowa I-O matrix reports occupational data for durable goods employment in furniture and lumber but the BLS-Census national employment patterns are presented separately for these two industries. This was also true for the other durable goods, other

nondurable goods, other transportation equipment, other transportation, other retail trade and other services groupings found in the Iowa I-O matrix.

Finally, in cases where Iowa I-O data were available but national employment patterns were not, the Census data were combined to correspond to the national grouping. For example, educational services, government were combined with educational services, private to comprise one group.

The industries included in the original matrix are listed in the first column of Table 1. The second column lists the industries as they appear in the final matrix.

Table 1. Industries appearing in Iowa Census Industrial-Occupational matrix and in area matrix

Iowa Census matrix	Area matrix
Agriculture, forestry and fisheries	Agriculture Forestry Fisheries
Mining	Mining
Construction	Construction
Durable goods	Durable goods
Furniture and lumber	Lumber Furniture
Primary ferrous industries Primary non ferrous industries	Primary metals
Fabricated metals	Fabricated metals
Machinery, except electrical	Machinery, except electrical
Electrical machinery	Electrical machinery
Motor vehicles equipment	Motor vehicles equipment
Aircraft	Aircraft
Other transportation equipment	Ship Miscellaneous transportation equipment
Other durable goods	Stone Instruments Miscellaneous manufacturing

Table 1. (Continued)

Iowa Census matrix	Area matrix
Non durable goods	Non durable goods
Food and kindred products	Food
Textiles	Textiles
Apparel	Apparel
Printing	Printing
Chemicals	Chemicals
Rubber	Rubber
Other non durable goods	Tobacco
	Paper
	Petroleum
	Leather
Transportation	Transportation
Railroads	Railroads
Trucking service & warehousing	Trucking service & warehousing
Other transportation	Local transportation
	Ship
	Air
	Pipe
	Transportation service
Communications	Communications
Public utilities	Public utilities
Wholesale	Wholesale
Retail	Retail
Food	Food
General merchandise	General merchandise
Eating	Eating
Other retail trade	Lumber
	Auto & gas
	Clothing
	Furniture
	Miscellaneous retail
Finance, insurance & real estate	Finance, insurance & real estate
Service	Service
Business services	Business services
Repair services	Auto repair
	Miscellaneous repair
Hotels	Hotels
Other personal services including private household	Other personal services including private household
Entertainment and recreation	Motion picture
	Miscellaneous entertainment
Medical	Medical
Educational services, government	Educational services

Table 1. (Continued)

Iowa Census matrix	Area matrix
Educational services, private	
Welfare, religious & non profit	Welfare, religious & non profit
Other professional services	Legal
	Miscellaneous services
Public administration	Public administration
	Postal administration
	Other federal administration
	State administration
	Local administration

Allocation of Industry and Occupation not Reported

The first step undertaken in developing the area matrix was to allocate the approximately 3% of people who did not report industry and/or occupation into an appropriate industry-occupational cell of the matrix. Investigation of Census data revealed that the proportions of those not reporting industry and/or occupation differed by age and sex. (68, Tables 123 and 128)

As Table 2 indicates, "not reporting" was concentrated for males in the 14-19 and 20-24 year old groups while for females it was concentrated in the 14-19 and 65+ age groups. Therefore the number of persons "not reporting" were allocated on the basis of both age as well as sex.

The Census indicates that 15,002 males did not report their industry, 18,447 males did not report their occupation and of these 14,042 males reported neither occupation nor industry. The corresponding figures for females were 10,318, 11,605, and 10,010.

Since the number not reporting industry was less than the number not reporting occupation, the former figure was used as a starting point.

Table 2. Proportions of age groups not reporting industry and/or occupation

	Occupation not reported	Industry not reported
Males by age		
14 and over	.026	.021
14-19	.050	.043
20-24	.042	.032
25-29	.025	.019
30-34	.021	.017
35-44	.020	.015
45-54	.022	.018
55-59	.027	.023
60-64	.022	.019
65+	.021	.021
Females by age		
14 and over	.038	.033
14-19	.050	.046
20-24	.031	.029
25-29	.033	.030
30-34	.034	.031
35-44	.035	.029
45-54	.034	.029
55-59	.044	.039
60-64	.038	.034
65+	.048	.046

The number of males by age not reporting industry were distributed according to the proportions reported for that age group in industries as well as in occupations. The results were then summed across all ages. This yielded marginal totals for 8 occupations and 13 industries. (See Table 3) In order to develop an occupation by industry breakdown of these figures, the proportions in the total male Iowa I-O matrix were used. The occupational totals were distributed into industries according to the total male industrial make-up of occupations to yield an 8 x 13 matrix. The industry totals were then distributed into occupations according to the total male

occupational make-up of industries to yield a second 8 x 13 matrix.

The two matrices differed in certain cells. For males, application of total male Iowa occupation by industry proportions to marginal industry totals based on age led to a greater number of professionals, managers (particularly in agriculture and retail), and sales personnel and to a lesser number of operatives, service and labor employees than marginal occupational totals based on age indicated. Application of total male industrial proportions of the make-up of occupations to marginal occupation totals based on age, led to too few people in the agriculture, public utilities, retail and service industries and to too many people in the construction, durable goods manufacturing, transportation, wholesale and public administration industries.

A similar procedure was followed to obtain marginal totals for females (See Table 3) and to construct two 8 x 13 matrices corresponding to these totals.

For females, application of total occupational proportions to marginal industry totals led to too many professionals, managers, clerical and operative employees and to too few service and sales employees. Application of overall industry proportions to marginal occupational totals led to results quite close to the former totals. Examination of individual cells indicated that the most significant occupational difference between the two matrices was the relatively larger professional figure and smaller service figure allocated to the service industry when service industry employment was allocated to occupations rather than when occupational employment was allocated to industries.

Since the individual cells in the two matrices differed the results

Table 3. Marginal totals from allocating industry "not reported" into industries and occupations by age and by total proportions

	Males by age	Males by total proportions	Females by age	Females by total proportions
Occupations				
Professional	1,095	1,174	1,489	1,561
Management	4,264	4,809	516	518
Clerical	799	783	2,924	3,029
Sales	1,084	1,017	965	944
Craft	2,234	2,395	110	112
Operative	2,543	2,501	1,017	1,064
Service	777	697	2,868	2,668
Labor	2,206	1,626	429	422
Total	15,002	15,002	10,318	10,318
Industries				
Agriculture	4,248	4,181	591	576
Mining	47	46	3	4
Construction	1,047	1,097	71	74
Durable manufacturing	1,647	1,716	577	620
Non durable manufacturing	1,536	1,519	740	777
Transportation	663	795	85	89
Communication	109	105	243	250
Public utilities	284	218	54	58
Wholesale	593	625	233	246
Retail	2,229	2,027	2,413	2,371
Finance, insurance & real estate	386	417	576	594
Service	1,766	1,752	4,411	4,327
Public administration	447	504	321	332
Total	15,002	15,002	10,318	10,318

were prorated several times until matrices consistent with the original marginal totals resulted.

Table 3 also reports the allocation of "not reported" to industries and occupations based on total industry and occupational proportion by sex. This would have led to allocating too many males to the professional,

management and craft occupations and to the construction, durable goods manufacturing, transportation and wholesale industries. Likewise too many females would have been allocated to the professional, clerical and operative occupations and to the durable and nondurable goods manufacturing, wholesale and finance, insurance and real estate industries.

The above procedure resulted in each person being placed in an industry. However, there were still several persons who were in industries but not occupations. This consisted of all those who originally reported an industry but not an occupation. The total number of males for which this was true was 4,405. (This is figured as the 18,447 males who reported no occupation minus the 14,042 males who reported no occupation and no industry.) The corresponding figure for females was 1,595. These people were allocated to occupations according to the occupational makeup of the industry in which they appeared.

The final 8 x 13 matrices of the males and females respectively who did not originally report complete industry-occupational data are contained in Table 4.

Since male and female I-O "not reported" was distributed originally over only 8 occupations and 13 industries, it was necessary to break this data down further. The I-O data contained in each cell of the 8 x 13 matrices were first allocated into finer industrial detail by utilizing the proportion each industry made up of each occupations employment within its appropriate aggregate industry grouping. This was done for the 43 distinct industries for which data appears in the Iowa Census I-O matrix. For example, the durable goods professional employment share of I-O not reported was distributed across the 10 individual durable goods industries

Table 4. Allocation of industry and/or occupation not reported

	Total	Agri-culture	Min-ing	Con-struc-tion	Dura-ble	Non dura-ble	Trans-porta-tion
							Male
Total	19,407	4,276	63	1,262	2,864	2,492	877
Professional	1,492	31	1	49	251	109	7
Management	4,840	3,024	11	104	157	184	56
Clerical	1,120	4	2	15	205	148	105
Sales	1,459	3	-	2	73	254	5
Craft	3,153	5	15	741	705	442	134
Operative	3,782	32	34	103	1,203	1,025	457
Service	1,011	3	-	6	48	52	6
Labor	2,550	1,174	-	242	222	278	107
							Female
Total	11,913	599	3	87	777	1,021	108
Professional	1,648	1	-	4	15	45	1
Management	585	169	-	2	10	17	4
Clerical	3,480	25	3	63	296	332	72
Sales	1,141	3	-	1	1	44	1
Craft	138	-	-	13	23	49	-
Operative	1,310	15	-	-	416	490	23
Service	3,164	2	-	2	11	20	4
Labor	447	384	-	2	11	24	3

Communi-cations	Public utilities	Whole-sale	Retail	Finance, insurance & real estate	Service	Public adminis-tration
133	398	908	2,797	498	2,213	626
25	29	16	47	15	844	68
21	32	205	661	127	150	108
9	41	77	124	87	79	224
7	5	226	651	206	26	1
63	160	58	401	10	389	30
4	71	213	482	3	134	21
3	4	13	209	28	495	144
1	56	100	222	22	96	30
270	86	301	2,821	647	4,809	384
6	3	3	12	7	1,517	34
5	-	15	191	36	98	38
251	79	184	548	536	797	294
2	2	12	1,025	35	15	-
3	-	4	31	-	15	-
-	-	74	91	2	201	2
3	2	5	912	30	2,158	16
-	-	4	11	1	8	-

covered in the Iowa Census I-O according to the proportion that each of these two digit durable goods industries made up of professional employment.

After the data were broken down by industry, the numbers in each cell were broken down into finer occupational detail. The occupations dealt with as well as the proportions used correspond to those in the original Iowa Census I-O.

Development of I-O Column Matrices for 64 Industries

It was noted previously that while the Census I-O enumerates data for 43 distinct industries, the matrix developed for these projections covers 64 industries. Major industrial detail was broken down into finer industrial detail by first multiplying each of the finer Iowa industry employment totals for 1960 by the United States employment pattern for that industry in 1960. This was done for each of the 36 industries to be included in the final matrix but for which no separate I-O data appeared in the Iowa Census. (See column 2 of Table 1)

Once column matrices based on United States data were developed, the occupational figures of the finer industry column matrices were summed, compared with, and prorated to equal the occupational employment figure of the aggregate industry as it appeared in the Iowa Census I-O. In this way each occupational cell for the aggregate industry was spread across the more detailed industries according to the relative way employment of these occupations would occur in Iowa if Iowa's industries followed United States employment patterns. For example, total professional employment in agriculture, forestry and fisheries was spread over these 3

individual industries according to the way it would distribute itself across these industries in the nation if these 3 industries occurred in the nation in the same proportion as in Iowa.

Allocation of occupational totals in this manner can lead to industry employment totals which differ from those appearing in the Census. For this reason, the 8 major occupations were examined first and forced to add to the industry totals. More detailed occupations were then examined. The "all other" group in each occupation for each of the 36 industries was therefore determined as a residual.

Since the number of occupations enumerated in the Iowa Census I-O differed for males and females, this step of the procedure had to be undertaken separately for each sex.

Although this step of the procedure was very time consuming, it was necessary in order to expand I-O detail where Iowa's aggregate industries were made up of different proportions of individual industries than the United States and where United States employment patterns were available only for the finer industries. It would have been possible to handle the latter problem by developing United States employment patterns for larger industry groupings but it is doubtful if this would have been any less time consuming.

One problem that did occur at this stage of preparing the matrix was that of allocating data from the Iowa Census I-O column "other nondurable goods (including not specified manufacturing)". The total employment figure for males in this category 3,158 was first divided between those employed in nondurable industries not separately classified in the Iowa Census I-O, 2,678, and those not employed in these industries, 480. The

latter comprise the group employed in not specified manufacturing industries. They were then allocated to durable and nondurable goods industries in proportion to total employment in these industries and then to occupations according to the proportional makeup of the industry in which they were placed. The occupational data developed for these people was then combined and subtracted from the column matrix for "other nondurable goods, including not specified manufacturing" to yield a new column matrix for "other nondurable goods" only. This latter matrix was then used in developing occupational data for the other nondurable goods industries, tobacco, leather, paper and petroleum. Data on the 8 major occupations (9 for agriculture) for each of the 64 industries which form the final matrix appear in Table 5.

Only the agriculture figures for management, labor and farmers require explanation. The overall management figure for agriculture, forestry and fisheries reported in the Iowa Census I-O matrix for males is 153,947 this includes 153,470 farm managers while 36,923, the overall labor figure for this group, includes 35,861 farm laborers and foremen. After proportionately allocating the figures for occupation "not reported" between farm and non-farm personnel the final totals for males in agriculture, forestry and fisheries were 193,486 farmers and farm workers, 487 non-farm managers and 1,095 non-farm laborers. While the former figure appeared entirely in agriculture, the latter two figures were allocated over agriculture, forestry and fisheries according to United States employment patterns. Addition of corresponding figures for females brought the 3 above figures to 209,355, 523 and 1,136 respectively.

Table 5. Census based Industrial-Occupational Matrix for Iowa, 1960

							Durable		
	Total	Agri-culture	For-estry	Fish-eries	Min-ing	Con-struc-tion	Lumber	Furni-ture	Stone
Total	1,019,002	215,057	82	203	2,432	54,097	4,505	3,004	6,364
Professional	102,402	1,335	35	4	32	2,226	79	69	260
Management	81,016	513	2	8	295	4,794	394	143	543
Clerical	127,708	930	5	1	175	2,268	273	440	320
Sales	76,240	218	-	3	21	93	81	114	208
Craft	116,899	230	2	3	615	32,156	833	703	1,249
Operative	150,771	1,373	2	4	1,274	4,032	2,048	1,465	2,462
Service	112,696	182	-	1	20	157	77	28	95
Labor	41,915	921	36	179	-	8,371	720	42	1,227
Farm management and labor	209,355	209,355							

Table 5. (Continued)

	Durable									
	Primary metals	Fabricated metals	Machinery except electrical	Electrical machinery	Motor vehicles	Aircraft	Ship	Miscellaneous transportation	Instruments	Miscellaneous manufacturing
Total	5,936	14,971	35,685	20,563	1,489	282	228	309	1,948	5,250
Professional	259	1,303	2,861	2,520	30	46	4	5	286	94
Management	237	789	1,444	558	139	8	26	55	112	352
Clerical	565	2,082	4,564	3,134	144	24	17	19	335	815
Sales	94	404	726	213	53	4	0	0	44	155
Craft	1,694	3,330	9,132	3,224	360	95	95	88	400	649
Operative	2,309	5,968	14,901	10,023	676	96	76	113	695	2,972
Service	97	313	572	353	23	4	2	6	25	57
Labor	681	782	1,485	538	64	5	8	23	51	156
Farm management and labor										

Table 5. (Continued)

	Nondurable									
	Food	Tobacco	Textiles	Apparel	Paper	Printing	Chemicals	Petroleum	Rubber	Leather
Total	57,184	88	564	4,194	2,957	18,103	5,147	480	4,594	325
Professional	1,507	1	4	33	75	1,891	492	46	299	1
Management	3,814	7	33	178	215	1,318	408	52	154	12
Clerical	6,068	2	19	335	313	3,486	728	50	512	33
Sales	2,471	13	61	170	241	4,512	603	69	74	15
Craft	6,834	13	25	227	447	5,050	745	109	818	13
Operative	28,963	42	402	3,175	1,459	1,364	1,670	114	2,304	241
Service	1,351	3	9	29	50	288	119	9	92	3
Labor	6,176	7	11	47	157	194	382	31	341	7
Farm management and labor										

Table 5. (Continued)

	Transportation									
	Local	Truck and warehouse	Railroad	Ship	Air	Pipe	Service	Communications	Public utilities	Wholesale
Total	3,870	17,827	16,717	215	775	259	512	12,782	12,834	36,917
Professional	24	109	192	3	67	14	5	1,102	930	616
Management	144	1,345	1,258	49	60	28	96	1,064	945	7,903
Clerical	313	1,608	3,656	16	234	25	196	7,351	2,605	6,969
Sales	7	166	21	2	7	2	29	253	174	7,533
Craft	273	776	4,975	11	186	76	29	2,716	4,653	2,091
Operative	3,007	12,765	3,877	54	140	92	93	57	1,999	8,541
Service	52	45	143	6	46	2	15	199	172	320
Labor	50	1,013	2,595	74	35	20	49	40	1,356	2,944
Farm management and labor										

Table 5. (Continued)

	Retail								
	Lumber	General merchandise	Food & Dairy	Auto & gas	Clothing	Furniture	Eating	Miscellaneous retail	Finance, insurance & real estate
Total	9,565	22,702	25,317	28,215	9,342	7,863	31,944	32,190	37,521
Professional	62	159	34	170	27	63	116	1,533	788
Management	2,178	3,076	4,996	7,327	1,457	1,384	4,641	5,909	6,474
Clerical	959	2,980	5,398	1,199	1,866	1,152	489	4,295	18,107
Sales	2,376	13,172	7,170	3,912	5,094	2,438	286	12,460	9,025
Craft	1,761	831	443	7,160	234	1,789	161	2,415	472
Operative	1,336	789	4,126	7,201	461	749	94	3,794	179
Service	144	1,321	327	227	113	114	26,068	777	1,741
Labor	749	376	2,823	1,019	90	174	89	1,007	735
Farm management and labor									

Table 5. (Continued)

	Service								
	Hotels	Other personal service	Business service	Auto repair	Miscel-laneous repair	Motion picture	Miscel-laneous enter-tainment	Medical	Legal
Total	7,886	1,787	6,594	9,041	5,625	2,340	4,412	43,847	4,274
Professional	111	1,322	584	27	33	360	471	18,393	2,469
Management	1,352	1,021	933	671	337	463	898	1,081	18
Clerical	953	1,186	2,741	404	387	451	420	6,230	1,755
Sales	29	169	564	150	88	143	88	12	4
Craft	211	878	693	6,278	3,815	287	297	1,011	2
Operative	151	5,438	609	979	825	48	39	1,200	2
Service	4,973	7,363	385	60	31	564	1,886	15,719	23
Labor	106	495	85	472	109	24	313	201	1
Farm management and labor									

Table 5. (Continued)

	Service				Public administration			
	Education	Non-profit	Private household	Miscellaneous service	Postal administration	Other federal	State administration	Local administration
Total	65,204	16,235	24,974	3,699	9,167	5,937	5,199	13,275
Professional	44,001	6,546	24	2,460	75	1,171	1,177	1,382
Management	995	1,059	6	120	1,117	696	1,020	2,326
Clerical	6,489	2,559	26	947	7,199	2,894	2,002	3,935
Sales	69	90	7	8	-	7	14	11
Craft	1,358	326	7	73	123	537	272	535
Operative	599	316	208	43	134	202	72	323
Service	11,397	5,149	23,939	41	200	235	575	4,359
Labor	296	190	757	7	319	195	67	404
Farm management and labor								

Adjustment of the Male and Female Matrices to Include the Same Occupations

Since certain occupations were included in the Iowa Census I-O for males but not females and vice versa, it was necessary to adjust the data so that the occupations included were the same for each. The occupations for which adjustments were necessary are listed by sex in Table 6.

The procedure used for males, for example, was to break down the employment figure of the "all other" category for each of the major occupations (for which adjustments were necessary) into employment in missing occupations and a residual. The criterion for the occupational breakdown in each of the 64 industries was that industry's employment pattern in the nation. Missing occupations within each occupation group were assumed to be used in the same relative proportions as in the nation. Occupational totals based on United States patterns were then summed across all industries, compared with and prorated to equal the sum of employment in Iowa in that occupation as reported in the Census.

The alternative to the above approach is to examine the United States distribution of occupational employment across industries.[1] Percentage breakdowns for the latter appear in the BLS-Census publication Tomorrow's Manpower Needs (62, Appendix H). The total of Iowa employment in any occupation can then be spread across industries according to these proportions. The problem with this approach, however, is that the United States percentage distribution of occupations across industries is a function of both the structure as well as the relative sizes of industries. The latter

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[1]This was done in a New York State study (3).

Table 6. Occupations for which male or female Industrial-Occupational data were missing

Male missing data	Female missing data
Professional	Professional
Airplane pilots and navigators (F.0)	Engineers, civil
Social & welfare workers	Engineers, electrical
Geologists & geophysicists (F.0)	Engineers, industrial
Physicists (F.0)	Surveyors
	Architects
	Lawyers and judges
	Personnel and labor relations workers
	Mathematicians (M.0)
Clerical	Clerical
Stenos, secretaries, typists	Shipping and receiving clerks
Office machine operators	
Telephone operators	
Craft	Craft
Brickmasons, stone, tile setters	Carpenters
Roofers & slaters (F.0)	Skilled machinists
Heat treaters (F.0)	Sheet metal workers
Molders, metal (F.0)	Toolmakers, diemakers, setters
Patternmakers (F.0)	Motor vehicle mechanics
Rollers & roll hands	Radio & T.V. mechanics
Locomotive engineers (F.0)	Other mechanics
Glaziers (F.0)	Printing
Inspectors, log & lumber (F.0)	Cabinetmakers
Operative	Operative
Sailors & deck hands (F.0)	Furnacemen, smeltermen, pourers
Sewers & stitchers, Mfg.	Welders & flame cutters
Asbestos & insulation workers (F.0)	Spinners, textile
Blasterers & powdermen (F.0)	

differ considerably between Iowa and the nation.

A word might be said on the necessity for making the male and female matrices the same size at this stage of the procedure. The logic lies in the fact that if the sum of the male and female "all other" categories for

occupations were broken down (according to United States employment patterns) into all those occupations for which male or female data or both were missing, males, for example, would be put into occupations for which their employment share of the "all other" category was zero (since their employment in occupations for which only female I-O data is missing will already have been accounted for). This means that occupations for which male data truly were missing would receive less of a share of "all other" employment. Since the figures based on United States employment patterns are prorated to the Iowa total anyway it might appear that this makes no difference. But it will make a difference if the occupation for which the share of "all other" employment is zero is distributed in a non-uniform way across industries. In this event, predicting a figure for the latter changes the relative predicted distribution of the truly missing occupations across industries and therefore affects the final distribution of occupations across industries.

For the same reason, all those occupations for which male or female employment is zero should be treated as if they appeared in the matrix of the sex for which their employment is zero, and as missing from the sex in which their employment is not zero. Occupations for which female employment was zero are marked (F.0) in Table 6. Occupations for which male employment was zero are marked (M.0) in that table.

Breakdown of "Residual" and Other Occupation Groups into Greater Detail

It was noted at the outset that the original Iowa Census I-O data contained information on 57 occupations for males and 30 occupations for females while the final matrix contains data on 158 distinct occupations.

Besides the adjustments already made, it was necessary to break down the "residual all other" occupation employment totals computed in the previous step (Step 4) to allow for occupational employment in occupations where both male and female Iowa Census I-O data were missing. These occupations are listed in Table 7.

It was also necessary to break down certain other Iowa Census data into finer occupational detail. This included designers and draftsmen, social scientists, managers, and service personnel as well as other occupational groups noted in Table 7. The individual occupations into which the aggregate Iowa Census I-O data were allocated are also listed in Table 7. This table indicates the source of the data which were broken down (i.e. whether Step 4 or the Iowa Census I-O).

The residuals or occupational totals from both sexes were first combined. The criterion for breaking down these combined figures were, again, industrial employment patterns by industry for the nation. The predicted occupational employment figures were again summed across all 64 industries and prorated to equal the Iowa 1960 occupational employment total.

Additional Notes on Preparation of the Matrix Based on Census Data

It might be noted that while the Iowa Census I-O enumerated 57 occupations for men and 30 occupations for females, not all of this information could be utilized. This was the case when occupations were included in the Census I-O but not the BLS-Census United States employment patterns. Or where the occupational grouping listed in the Census I-O did not correspond to groupings included in the BLS-Census United States data.

Male I-O data on public relations men and publicity writers was

Table 7. Occupations for which male and female Industrial-Occupational data were missing

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Professionals

Engineers, other were broken down into:
- Engineers, aeronautical
- Engineers, chemical
- Engineers, metallurgical
- Engineers, mining
- Engineers, other

Source: Male, Iowa Census I-O
Females, Step 4

Natural scientists, other were broken down into:
- Chemists
- Agricultural scientists
- Biological scientists

Source: Male and female, Step 4

Technicians[a], other were broken down into:
- Air traffic controllers
- Technicians, other

Source: Male and female, Iowa Census I-O

Social scientists[b], were broken down into:
- Economists
- Statisticians
- Other

Source: Male and female, Iowa Census I-O

Residual professionals, other were broken down into:
- Dentists
- Dieticians and nutritionists
- Nurses, professional
- Nurses, student
- Optometrists
- Osteopaths
- Pharmacists
- Physicians & surgeons
- Psychologists
- Veterinarians
- Chiropractors & therapists
- Teachers, elementary
- Teachers, secondary

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[a]The Iowa Census I-O does not include radio operators or surveyors in this group, although the BLS-Census occupation grouping includes the latter as technicians, other.

[b]The Iowa Census I-O figure does not include psychologists in this group, although the BLS-Census matrix does.

Table 7. (Continued)

	Teachers, other except college
	Teachers, college
	Artists, athletes, entertainers & authors
	Clergymen
	Editors & reporters
	Librarians
	Photographers
	Professional & technical, NEC
	Source: Male and female, Step 4
Management	
	Conductors, railroad
	Creditmen
	Officers, pilots, engineers, ship
	Purchasing agents
	Source: Male and female, Iowa Census I-O
Clerical & kindred	
	Bank tellers
	Mail carriers
	Postal clerks
	Clerical, NEC
	Source: Male and female, Step 4
Sales	
	Insurance agents
	Real estate agents
	Other sales workers, NEC
	Source: Male and female, Iowa Census I-O
Craft	
	Male repairmen[c]
	Airplane
	Motor vehicle
	Office machine
	Radio & T.V.
	Railroad
	Other
	Source: Male, Iowa Census I-O

[c]Since only 3 kinds of female mechanics were employed in Iowa in 1960, the Iowa female breakdown of mechanics was completed in Step 4.

Table 7. (Continued)

Printing[d]
- Compositors
- Electrotypers & stereotypers
- Engravers
- Photoengravers & lithographers
- Pressmen & plate printers

Source: Male, Iowa Census I-O
Female, Step 4

Other craftsmen
- Cement & concrete finishers
- Excavating, grading machine operators
- Painters & paperhangers
- Plasterers
- Structural metalworkers
- Linemen & servicemen
- Bakers
- Jewelers & watchmakers
- Millers
- Opticians & lens grinders
- Inspectors, other
- Upholsterers
- Craft, NEC

Source: Male and female, Step 4

Operative
- Drivers, bus, truck, tractor
- Deliverymen, routemen, cab drivers
- Brakemen & switchmen, railroad
- Power station operators
- Assemblers A
- Assemblers B
- Inspectors, metalworking class B
- Electroplaters
- Electroplaters helpers
- Knitters, hoppers & toppers
- Weavers, textile
- Attendants, auto parking
- Laundry & dry cleaning workers
- Mine operatives & laborers, NEC

[d]The male Iowa Census I-O includes 391 Bookbinders who are not separately enumerated in the BLS-Census matrix so there was a residual in this group to be combined with Craft NEC.

Table 7. (Continued)

Meat cutters except meatpacking
Operatives NEC
Source: Male and female, Step 4
Service
Private household workers
Firemen, fire protection
Policemen, marshals, sheriffs
Guards, watchmen
Bartenders
Cooks, except private household
Counter & fountain workers
Waiters & waitresses
Airline stewards & stewardesses
Attendants, hospital
Charwomen & cleaners
Janitors & sextons
Nurses, practical
Other service, NEC
Source: Male and female, Iowa Census I-O

combined with other professional and technical workers to yield the "all other" professional figure for males used in Step 4. The breakdown of management personnel into salaried and self-employed was not utilized while stock clerks and storekeepers were combined with other clerical and kindred workers to yield new "all other" figures by industry for the clerical group.

All the male data on crafts workers was utilized. As noted above mechanics and printing craftsmen were further broken down in Step 5.

Of the operative occupations enumerated only (1) furnacemen, smelter-men and heaters, and (2) welders and flame-cutters corresponded to BLS-Census United States categories. The former would have had to be broken down further to isolate heaters except that employment for this group was

0 in 1960. Employment in the other 6 occupational groupings listed was combined with the other operative and kindred worker figures to obtain new "all other" operative figures.

Finally, for the service occupations, only the aggregate number was useful and was the figure broken down in Step 5 above.

Female data on salaried versus self employed managers was not utilized, while only the operative data on sewers and stitchers could be used. The other 3 operative categories listed were combined with other operative and kindred workers to yield a new "all other" figure for operatives. Finally, only the aggregate data on service workers was utilized. Thus data on charwomen, janitors and porters were combined with other service workers to yield the service figure for Step 5.

It should also be noted that the Iowa occupational totals to which the data predicted by use of United States employment patterns in Steps 4 and 5 were prorated were a sum of both total employment in Iowa reported in the Census as well as an adjustment for occupation not reported. (O.N.R.)

While certain individual occupations of an aggregate occupational group received their share of occupation not reported when the latter was allocated to industries and occupations which appear in the Iowa Census, occupations which did not appear in the Iowa Census had no individual shares of O.N.R. Allocation of O.N.R. by industry was made to their aggregate grouping only.

It was decided to break down these aggregate figures in the following manner.

The total number of occupation not reported allocated to the aggregate occupational grouping was divided among the individual occupations of a

group, according to the total proportion that each of the individual occupations comprised of the group.

For example, in Step 4 the total occupation not reported allocated to "other" male clerical workers was summed over all industries and then distributed to individual male clerical occupations which appeared in the female but not the male matrix. It was distributed over these occupations according to the proportion of male employment that each comprised of the total. A proportional allocation was also made to the "residual" other clerical workers figure computed at this step. Corresponding calculations were made for females. In Step 5 the male and female "residual" allocations of occupation not reported calculated in Step 4 were combined and distributed proportionally over the individual clerical occupations for which data were missing for both males and females in the Census I-O.

Adjusting the Matrix to be Consistent with BLS Industry Estimates

Employment by industry of nonagriculture wage and salary workers is available from two sources, the Census and the Bureau of Labor Statistics (BLS) (52, 53, 54). While the former is available at only 10 year intervals, the latter is available monthly.

Methods of collection, as well as availability, differ for the two sources. The Census report which contains information on occupation and industry is based on a 25 percent sample of the population. In 1960, census enumerators left with each sample household a Household Questionnaire containing the sample questions to be answered. Thus self enumeration was partially substituted for the traditional direct interview method of obtaining household information (68, pp. XIX-XXIV).

The BLS times series data, on the other hand, are based on reports from individual business establishments which are collected by the Bureau of Employment Security. These data are based on a sample where sampling is proportionate to the average size of establishments. (54, p. 737-740)

At least in part because of differences in the methods of collection, the job concepts of the two series differ. The data obtained from households provide information about the work status of the whole population without duplication. Thus persons employed at more than one job are counted only once in the Census according to the job at which they worked the greatest number of hours during the Census week. In statistics based on business reports, however, persons who work for more than one establishment may be counted more than once. Moreover, the BLS series does not include data on private household workers, unpaid family workers or self employed persons. Likewise, many persons who had a job but were not at work were excluded from establishment payroll records, even though included in the Census figures.

Two major differences remain. First, the Census includes people based on their place of residence whereas the BLS reports persons at their place of work. Finally, the Census reports government workers in the industry to which their function corresponds. For example, persons employed in hospitals and paid by public funds are classified in medical services rather than in public administration. The BLS, however, reports all government employees in the same group.

The relationship between the two series for nonfarm occupations is illustrated as follows:

Census employment

+ dual job holders

- those with a job but not being paid

+ net commutation (commutors in - commutors out)

= self employed, unpaid family workers and domestics

+ BLS wage and salary workers

Table 5 reports 1,019,002 employees in Iowa in 1960, of whom 809,647 were in nonfarm occupations. Using the 1960 national rate of multiple job holding (18),4.6%, increases this figure to 846,890, while subtraction of net commutation which is out of Iowa, 6,306, reduces the figure to 840,584. (67, 68, 69, 70, 71, 72, Tables 132) This is 8,534 above the figure for BLS employment, 832,050, where the latter has been adjusted to include nonfarm self employed, unpaid family workers and domestics. The difference of 8,534 can be considered an estimate of those with a job but not being paid. The latter would correspond to a rate slightly below the national rate of 1.5% (62, p. 26).

Since BLS industrial data is generally felt to be more reliable than the industrial data contained in the Census, it was necessary to shift the area matrix to a BLS basis. This required that the BLS figures be corrected to include self-employed, unpaid family workers and domestics. In addition, government employees had to be reallocated by function. Since no adjustment was made for dual job holders, this meant that the area matrix was shifted from a one job per man basis to a total jobs concept.

Although United States rates of multiple job holding are available by industry and occupation, no occupation by industry data are available. For this reason it was felt that a correction of total occupational data to a

one man-one job basis would be as satisfactory as a correction of industry totals to a one man-one job basis at this point.

Table 8 records the industrial employment reported in the BLS time series for 1960. Where no separate time series information was available for a given industry, say Industry A, employment was figured as:

$$\text{employment in the aggregate industry of which Industry A is a part} \times \frac{\text{Census employment in Industry A}}{\text{total Census employment in the aggregate industry}}$$

For example, the 2,200 figure for transportation equipment reported in the BLS series was divided between motor vehicle, aircraft, ship and miscellaneous transportation equipment according to their respective shares of Census employment. In some cases, the number broken down was a residual. For example, the BLS figure for retail general merchandising employment, 20,100, was subtracted from the overall BLS retail figure of 127,500 and the remainder 107,400 was divided proportionately among the remaining 6 retail industries.

Industrial employment figures computed in this manner are listed in Table 8 to the right in the column headed BLS employment. (Those employment figures available directly from the BLS series are listed to the left in this column.)

Table 8 also reports the correction factor used to adjust the BLS figures as discussed above. These correction factors were based on Census data (68, Table 129) and are the ratio of:

$$\frac{\text{total employment in an industry}}{\text{employment of private wage and salary workers}}$$

Table 8. Industrial employment 1960

Industry	Private wage & salary workers BLS employment: From series	Private wage & salary workers BLS employment: Estimates	Correction factor	Total employment 1960	Figure used if different
Mining	3,300		1.109	3,660	3,351
Construction	36,600		1.701	62,260	
Durable					
Lumber		4,605	1.105	5,093	5,054
Furniture		2,895	1.047	3,026	3,004
Primary metals	6,400		1.010	6,460	
Fabricated metals	9,600		1.213	11,640	
Machinery except electrical	33,600		1.013	34,100	
Electrical machinery	19,400		1.008	19,560	
Motor vehicles		1,417	1.011	1,430	
Aircraft		272	1.014	280	282
Ship		211	1.128	238	228
Miscellaneous transportation		300	1.019	310	309
Stone	6,800		1.042	7,090	6,913
Instruments		2,363	1.055	2,490	
Miscellaneous manufacturing		6,237	1.022	6,550	
Nondurable					
Food	53,400		1.034	55,220	
Textiles		485	1.318	640	
Apparel	3,800		1.023	3,890	
Printing	11,900		1.344	16,000	
Chemicals	5,100		1.013	5,170	
Rubber		3,912	1.006	3,940	
Tobacco		69	1.050	73	
Paper		2,556	1.012	2,590	
Petroleum		405	1.036	420	
Leather		273	1.050	290	

Table 8. (Continued)

Industry	Private wage & salary workers BLS employment: From series	Private wage & salary workers BLS employment: Estimates	Correction factor	Total employment 1960	Figure used if different
Transportation					
Railroad	15,700		1.009	15,840	
Truck & warehouse		11,626	1.425	16,570	
Local		2,521	1.649	4,150	
Ship		139	1.571	220	215
Air		515	1.337	690	
Pipe		167	1.056	180	
Service		330	1.486	490	
Communications	12,900		1.014	13,080	
Public utilities	9,700		1.326	12,860	
Wholesale	42,400		1.159	49,140	
Retail					
Food		18,870	1.290	24,350	25,521
General merchandise	20,100		1.069	21,490	
Eating		23,619	1.336	31,560	
Lumber		7,260	1.285	9,330	
Auto & gas		20,438	1.441	29,450	
Clothing		6,733	1.226	8,260	
Furniture		5,896	1.381	8,140	
Miscellaneous retail		24,584	1.752	34,050	
Finance, insurance & real estate	31,600		1.170	36,970	
Service					
Business service[a]		4,576	1.277	5,844	
Auto repair		6,240	1.562	9,747	

[a]The sum of "service" categories in Table 8 is equal to 83,200 which is figured as 92,600 - 9,400, i.e. the BLS service figure minus a preliminary estimate for non-profit industry employment.

Table 8. (Continued)

Industry	Private wage & salary workers BLS employment		Correction factor	Total employment 1960	Figure used if different
	From series	Estimates			
Miscellaneous repair		3,827	2.388	9,139	
Hotels		5,408	1.270	6,868	
Other personal service		12,563	1.824	22,915	
Motion picture		1,581	1.278	2,020	
Miscellaneous entertainment		3,078	1.278	3,934	
Medical		30,118	1.660	49,996	
Education[b]		10,234	5.500	56,290	
Legal		2,912	2.235	6,508	
Miscellaneous service		2,662	1.479	3,937	
Public administration					
Postal administration		12,460	.949	11,830	
Other federal		8,040	.644	5,180	
State administration		26,500	.240	6,360	
Local administration		70,800	.178	12,630	

[b]Education's share of the 83,200 service workers was calculated to allow only for the 14,472 employees in educational services, private because this is the type of educational employment included in the BLS time series service group.

where total employment in the industry is the sum of private wage and salary workers, unpaid family workers, self employed and government workers.

These ratios were not readily available for all industries. For example, a correction factor could be computed directly from Census Table 129 for "other Transportation Equipment" but not for Ship and Miscellaneous Transportation separately. In this case the correction factors were calculated in the following manner. Aggregate employment of private wage and salary workers was divided between these two industries in proportion to their known total Census employment. Employment of non-private wage and salary workers was divided in proportion to their separately reported national correction factors weighted by their relative industry sizes. The individual correction factors were then computed as the ratio of computed total employment to wage and salary employment.

Calculations of this sort were also necessary to develop correction factors for instruments vs miscellaneous manufacturing, local, pipe and transportation service, lumber vs miscellaneous retail, and legal vs miscellaneous service. The correction factors reported for movies and miscellaneous entertainment are the same since their was only one national factor reported for these two industries.

In education the correction factor was figured as the ratio of the sum of all employees in educational services, private and government to the sum of only private wage and salary workers in educational services private.

Finally in government, the correction factors were designed to isolate those persons in administrative government jobs from those in jobs corresponding to private industry. What was desired was a ratio such as:

$$\frac{\text{employees of Government serving strictly government administrative functions}}{\text{employees of Government serving all functions}}$$

The data in the Census enabled figures of this sort to be developed. The employees in Postal administration, other federal, state, and local administration who serve strictly a governmental administration function are separately listed in the Census. These figures were converted to total employment figures by use of national correction factors. The totals computed were then prorated to equal the 112,443 total governmental worker figure reported in the Census. The ratio of Census functional employment to total estimated employment was then taken as the correction factor for Iowa. Table 9 records these calculations.

Table 9. Correction factors for government

	Census government administration functional employment	National correction factor	Estimated total employment	Estimated correction factor
Postal administration	8,964	.97	9,441	.949
Other federal administration	5,782	.75	8,974	.644
State administration	5,033	.28	20,976	.240
Local administration	13,031	.21	13,052	.178
Total	32,810		112,443	

Total employment in 1960 is figured as private wage and salary employment times the correction factor and is recorded in Table 8.

The area matrix was adjusted to these industrial figures by multiplying

each column by an appropriate ratio equal to:

$$\frac{\text{BLS adjusted employment}}{\text{Census employment}}$$

Because of possible imprecision in both the BLS figures as well as the correction of these figures, it was decided to use the original Census data in cases where the BLS adjusted figure was very close to the original Census figure.

This was true for durable goods manufacturing employment in furniture, aircraft, ship and miscellaneous transportation equipment and transportation employment in the shipping industry. The Census figures used are separately reported in Table 8.

In certain cases it was also found that use of the national correction factor gave results closer to the Census employment figure than did use of the Iowa correction factor. This was true for mining employment, durable goods employment in lumber, and stone, and retail employment in food. The national correction factors used for these industries are respectively 1.0154, 1.0976, 1.0166, and 1.3203. Their employment estimates based on these figures are also reported in Table 8 in the column marked Figure used if different.

Table 8, based on BLS industrial employment estimates does not report data for several industries. Agriculture, forestry[1] and fisheries[2] data were obtained from other sources (80). The time series figures were

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[1]Weiler, Helen. U.S. Forest Service, Washington, D.C. Forestry data. Private communication. 1969.

[2]Rielly, M. Department of the Interior, Washington, D.C. Fisheries data. Private communication. 1968.

examined and used to obtain 1975 projections. For 1960, however, the figures reported in the Census for Iowa were corrected in the same ratio as between the U.S. national matrix and the U.S. Census (66) to put them on a comparable basis. The relevant data are recorded in Table 10.

Table 10. Agriculture, forestry and fishery employment estimates

	Original Iowa Census total	Ratio of U.S. national matrix to U.S. Census	Adjusted Iowa employment
Agriculture	210,503	1.344	282,916
Forestry	81	1.004	81
Fisheries	203	.9934	202

Data on private household workers is not included in the BLS series so the Census figure, 24,974, was used for this industry. Finally, it was decided to use Census data for the nonprofit service industry since there is difficulty estimating this figure by means of employer reports.[1] The Census figure used was 16,235.

The total industrial figures used, as well as the major occupation by industry breakdown of these figures are listed in Table 11.

Adjusting the matrix from a Census base to a BLS base resulted in new occupational row totals. This amounts to assuming that the industrial-occupational information developed through the use of Census materials indicates the correct structure of the individual industries but not

[1]Hines, Joseph. U.S. Bureau of Labor Statistics, Kansas City, Mo. Measurement problems. Private communication. 1969.

Table 11. BLS based Industrial-Occupational Matrix for Iowa, 1960

							Durable		
	Total	Agri-culture	For-estry	Fish-eries	Min-ing	Con-struc-tion	Lumber	Furni-ture	Stone
Total	1,107,465	282,916	81	202	3,351	62,260	5,054	3,004	6,913
Professional	102,999	1,756	35	4	44	2,562	89	69	282
Management	84,747	675	2	8	406	5,519	442	143	590
Clerical	131,466	1,223	5	1	241	2,610	306	440	348
Sales	77,659	287	-	3	29	107	91	114	226
Craft	123,948	303	2	3	847	37,008	934	703	1,357
Operative	153,937	1,806	2	4	1,756	4,640	2,298	1,465	2,674
Service	113,040	239	-	1	28	181	86	28	103
Labor	44,254	1,212	35	178	-	9,633	808	42	1,333
Farm management and labor	275,415	275,415							

Table 11. (Continued)

	Durable									
	Primary metals	Fabricated metals	Machinery except electrical	Electrical machinery	Motor vehicles	Aircraft	Ship	Miscellaneous transportation	Instruments	Miscellaneous manufacturing
Total	6,460	11,640	34,100	19,560	1,430	282	228	309	2,490	6,550
Professional	282	1,013	2,734	2,397	29	46	4	5	366	117
Management	258	613	1,380	531	133	8	26	55	143	439
Clerical	615	1,619	4,361	2,981	138	24	17	19	428	1,017
Sales	102	314	694	203	51	4	0	0	56	193
Craft	1,843	2,589	8,726	3,067	346	95	95	88	511	810
Operative	2,513	4,641	14,239	9,533	650	96	76	113	889	3,708
Service	106	243	547	336	22	4	2	6	32	71
Labor	741	608	1,419	512	61	5	8	23	65	195
Farm management and labor										

Table 11. (Continued)

	Nondurable									
	Food	Tobacco	Textiles	Apparel	Paper	Printing	Chemicals	Petroleum	Rubber	Leather
Total	55,220	73	640	3,890	2,590	16,000	5,170	420	3,940	290
Professional	1,455	1	5	31	66	1,671	494	40	256	1
Management	3,683	6	37	165	188	1,165	410	46	132	11
Clerical	5,859	2	22	311	274	3,081	731	44	439	29
Sales	2,386	11	69	158	211	3,988	606	60	63	13
Craft	6,599	11	28	211	391	4,463	748	95	702	12
Operative	27,969	33	457	2,943	1,279	1,206	1,677	100	1,977	215
Service	1,305	3	10	27	44	255	120	8	79	3
Labor	5,964	6	12	44	137	171	384	27	292	6
Farm management and labor										

Table 11. (Continued)

	Transportation									
	Local	Truck and warehouse	Railroad	Ship	Air	Pipe	Service	Communications	Public utilities	Wholesale
Total	4,150	16,570	15,840	215	690	180	490	13,080	12,860	49,140
Professional	26	101	182	3	60	10	5	1,128	932	820
Management	154	1,250	1,192	49	53	19	92	1,089	947	10,520
Clerical	336	1,494	3,464	16	208	17	188	7,522	2,610	9,277
Sales	8	154	20	2	6	1	28	259	174	10,027
Craft	293	721	4,715	11	166	53	28	2,779	4,663	2,783
Operative	3,223	11,867	3,673	54	125	65	88	58	2,003	11,369
Service	56	42	135	6	41	1	14	204	172	426
Labor	54	941	2,459	74	31	14	47	41	1,359	3,918
Farm management and labor										

Table 11. (Continued)

	Retail								
	Lumber	General merchandise	Food & Dairy	Auto & gas	Clothing	Furniture	Eating	Miscellaneous retail	Finance, insurance & real estate
Total	9,330	21,490	25,521	29,450	8,260	8,140	31,560	34,050	36,970
Professional	60	149	34	177	24	65	115	1,621	776
Management	2,124	2,912	5,036	7,647	1,288	1,433	4,585	6,250	6,379
Clerical	935	2,821	5,441	1,251	1,650	1,193	483	4,543	17,843
Sales	2,319	12,469	7,227	4,083	4,503	2,524	283	13,182	8,892
Craft	1,718	787	447	7,473	207	1,852	159	2,554	465
Operative	1,303	747	4,160	7,518	408	775	93	4,013	176
Service	140	1,250	330	237	100	118	25,754	822	1,715
Labor	731	356	2,846	1,064	80	180	88	1,065	724
Farm management and labor									

Table 11. (Continued)

	Service								
	Hotels	Other personal service	Business service	Auto repair	Miscel-laneous repair	Motion picture	Miscel-laneous enter-tainment	Medical	Legal
Total	6,868	22,915	5,844	9,747	9,139	2,020	3,934	49,996	6,509
Professional	97	1,695	518	29	54	311	420	20,972	3,759
Management	1,177	1,309	827	723	548	400	801	1,233	27
Clerical	830	1,521	2,429	436	629	389	374	7,103	2,673
Sales	25	217	500	162	143	123	78	14	6
Craft	184	1,126	614	6,768	6,198	248	265	1,153	4
Operative	132	6,972	540	1,055	1,340	41	35	1,368	3
Service	4,331	9,440	341	65	50	487	1,682	17,924	35
Labor	92	635	75	509	177	21	279	229	2
Farm management and labor									

Table 11. (Continued)

	Service				Public administration			
	Education	Non-profit	Private household	Miscellaneous service	Postal administration	Other federal	State administration	Local administration
Total	56,290	16,235	24,974	3,937	11,830	5,180	6,360	12,630
Professional	39,940	6,546	24	2,618	97	1,022	1,440	1,315
Management	767	1,059	6	128	1,441	607	1,248	2,213
Clerical	5,004	2,559	26	1,007	9,290	2,526	2,449	3,744
Sales	53	90	7	9	-	6	17	10
Craft	1,047	326	7	78	159	468	333	509
Operative	462	316	208	46	173	176	88	307
Service	8,789	5,149	23,939	44	258	205	703	4,148
Labor	228	190	757	7	412	170	82	384
Farm management and labor								

necessarily the correct size of the industries.

The Census is known to have errors in the reporting of occupational as well as industrial data (57). Household respondents may answer imprecisely, indulge in upgrading the job or be poorly informed. (The use of questionnaires in place of direct interviews was designed partly to increase the amount of information obtained from the worker himself rather than from whoever happened to be home.)

The Census Bureau as part of its Evaluation and Research Program (76) compared a sample of employer responses on occupation to the occupational data contained in the Census. Their report indicates that the former are considered to be more accurate than the latter.

Table 12 indicates the major nonfarm occupational row totals for Iowa based on Census data (adjusted to include dual job holders) as well as those obtained when the matrix was adjusted to the BLS industrial totals. The Table, in addition, reports the U.S. Census occupational totals as a percent of those obtained from the employer record check. The information for Iowa has also been computed on a percentage basis to facilitate comparison.

Table 12 indicates that the adjustment of the Iowa area matrix to be consistent with BLS industrial employment totals led to changes in the occupational row totals which were, for most occupations, in the direction indicated by the error of the U.S. Census in relation to the employer record check. This was especially true for the professional, clerical and operative groups. Only the craft and service groups changed in the wrong direction, the latter increasing and the former decreasing.

The above provides only a very rough check on the reasonableness of the matrix as corrected. It is the occupation by industry distribution of

Table 12. Census versus BLS occupational totals

	Adjusted Iowa Census	Iowa BLS	$\frac{\text{Iowa Census}}{\text{BLS}} \times 100$	$\frac{\text{U.S. Census}}{\text{employer record check}} \times 100$
Total	832,050	832,050	100	100
Professional	106,565	102,999	104	109
Management	82,800	84,747	96	84
Clerical	129,903	131,466	98	97
Sales	78,695	77,659	101	111
Craft	120,544	123,948	98	103
Operative	154,365	153,937	101	101
Service	116,109	113,040	103	95
Labor, nonfarm	43,069	44,254	98	78

employment that is relevant for the occupational projections and little is known on the errors contained in the Census on an occupation by industry basis.

While several occupational sources (56) allowed control totals to be developed for the national matrix, this occupational detail is not available on a state basis (57). A few sources were available and provided a basis for checking certain individual occupational totals.

Data from the U.S. Office of Education's Digest of Educational Statistics (85) indicated that there were approximately 17,268 and 13,067 elementary and secondary teachers in the 1959-60 school year. Both these categories were therefore adjusted slightly upwards in the area matrix as was the estimate of college teachers based on data from a report on faculty and other professional staff in Institutions of higher education (86). The adjustments were made within the framework of the overall matrix and were

at the expense of the professional, NEC group in the education industry.

Independent sources on the health professions also indicated some adjustments. Their data, adjusted for inactive membership, indicated 1,433 dentists, 8,400 professional nurses, 2,863 licensed practical nurses, 1,720 pharmacists, 3,200 physicians and 1,119 veterinarians in Iowa (9, 30, 37, 38, 49). Based on these results the matrix estimates of professional nurses and dentists were lowered while that of pharmacists was increased. The latter seemed called for even though a check on the U.S. Census indicated about a 5% overcount on pharmacists for the nation as a whole (38).

Table 13 reports 3 types of occupational row totals for the occupations included in the study. These include the original Census totals adjusted for occupation and industry not reported and corresponding to the data in Table 5. These totals were further adjusted to reflect dual job holding after net commutation and those with a job but not being paid were allowed for. The adjustment factors for dual job holding were based on the national proportion of secondary jobs by occupation (18). The effect of the adjustments was to make the Census and BLS based nonfarm occupational totals identical. Table 13 also reports the occupational totals which resulted when the matrix was shifted to the BLS base. The latter totals are consistent with those in Table 11. (For a reconciliation between the occupational titles as they appear in the Census and in the final area matrix see Appendix F, Tomorrow's Manpower Needs (62)).

Table 13. Nonfarm occupational totals

	Census	Census adjusted for dual job holding	BLS
Total nonfarm	809,647	832,050	832,050
Professional, technical & kindred	102,415	106,565	102,999
Engineers, technical	-	-	-
Engineers, aeronautical	25	26	22
Engineers, chemical	154	160	152
Engineers, civil	1,595	1,660	1,722
Engineers, electrical	1,323	1,377	1,303
Engineers, industrial	1,169	1,216	1,127
Engineers, mechanical	1,558	1,621	1,484
Engineers, metallurgical	77	80	74
Engineers, mining	8	8	9
Engineers, other technical	1,149	1,196	1,162
Natural scientists	-	-	-
Chemists	506	527	482
Agricultural scientists	213	222	208
Biological scientists	135	140	122
Geologists & geophysicists	28	29	27
Mathematicians	7	7	7
Physicists	47	49	40
Other natural scientists	24	25	24
Technicians, except medical & dental	-	-	-
Draftsmen	1,923	2,001	1,870
Surveyors	769	800	832
Air traffic controllers	45	47	39
Radio operators	254	264	280
Technicians, other	3,250	3,382	3,186
Medical & other health workers	-	-	-
Dentists	1,453	1,512	1,558
Dieticians & nutritionists	271	282	286

Table 13. (Continued)

	Census	Census adjusted for dual job holding	BLS
Nurses, professional	9,297	9,674	10,059
Nurses, student	1,307	1,360	1,490
Optometrists	264	275	299
Osteopaths	264	275	301
Pharmacists	1,288	1,340	1,768
Physicians & surgeons	3,025	3,148	3,427
Psychologists	149	155	142
Technicians, medical & dental	1,880	1,956	2,111
Veterinarians	920	957	1,182
Chiropractors & therapists	953	992	1,063
Teachers	-	-	-
Teachers, elementary	18,403	19,149	17,206
Teachers, secondary	10,430	10,853	13,052
Teachers, other except college	1,440	1,498	1,168
Teachers, college	3,569	3,714	3,752
Social scientists	-	-	-
Economists	131	136	131
Statisticians & actuaries	138	144	136
Other social scientists	11	11	10
Other professional, technical & kindred	-	-	-
Accountants & auditors	5,134	5,342	5,260
Airplane pilots & navigators	131	136	141
Architects	268	279	281
Artists, athletes, entertainers & authors	6,950	7,232	5,407
Clergymen	4,524	4,707	4,526
Designers, except design draftsmen	415	432	431
Editors & reporters	1,711	1,780	1,530
Lawyers & judges	2,744	2,855	3,973
Librarians	1,461	1,520	1,194

Table 13. (Continued)

	Census	Census adjusted for dual job holding	BLS
Personnel & labor relations workers	1,045	1,087	1,052
Photographers	640	666	735
Social & welfare workers	1,116	1,161	1,149
Professional, technical, kindred, NEC	6,824	7,100	6,407
Managers, officials & proprietors	81,050	82,800	84,747
Conductors, railroad	691	706	654
Creditmen	621	634	648
Officers, pilots, engineers, ship	49	50	48
Purchasing agents	1,585	1,619	1,617
Postmasters & assistants	1,118	1,142	1,441
Managers, officials, proprietors, NEC	76,986	78,648	80,337
Clerical & kindred workers	127,653	129,903	131,466
Stenographers, typists, secretaries	27,367	27,849	27,992
Office machine operators	3,448	3,509	3,454
Other clerical & kindred workers	-	-	-
Accounting clerks	-	-	-
Bookkkepers, hand	18,278	18,600	19,310
Bank tellers	1,783	1,814	1,757
Cashiers	7,831	7,969	7,766
Mail carriers	3,388	3,448	4,372
Postal clerks	3,398	3,458	4,385
Shipping & receiving clerks	2,726	2,774	2,791
Telephone operators	5,949	6,054	6,030
Clerical & kindred, NEC	53,485	54,428	53,609
Sales workers	76,240	78,695	77,659
Insurance agents & brokers	6,082	6,214	5,992
Real estate agents & brokers	2,514	2,568	2,477
Other sales workers, NEC	67,644	69,913	69,190
Craftsmen, foremen & kindred workers	116,894	120,544	123,948
Construction craftsmen	-	-	-

Table 13. (Continued)

	Census	Census adjusted for dual job holding	BLS
Carpenters	13,232	13,645	14,950
Brickmasons, stone, tile setters	2,098	2,164	2,401
Cement & concrete finishers	314	324	361
Electricians	3,859	3,979	4,165
Excavating, grading machine operators	4,061	4,188	4,672
Painting & paperhangers	4,832	4,983	5,376
Plasterers	525	541	596
Plumbers & pipefitters	4,220	4,352	4,610
Roofers & slaters	570	588	654
Structural metalworkers	621	640	703
Foremen, NEC	14,386	14,835	14,484
Metalworking craftsmen except mechanic	-	-	-
Skilled machining workers	5,524	5,696	5,292
Blacksmiths, forgerer, hammermen	476	491	650
Boilermakers	140	144	140
Heat treaters, annealers, tempers	203	209	195
Millwrights	513	529	513
Molders, metal (except coremakers)	712	734	696
Patternmakers, metal & wood	317	327	332
Rollers & roll hands	25	26	26
Sheet metal workers	1,312	1,353	1,296
Toolmakers, diemakers, setters	1,489	1,535	1,404
Mechanics & repairmen	-	-	-
Airplane mechanics & repairmen	209	216	205
Motor vehicle mechanics	12,619	13,013	13,365
Office machine mechanics	371	383	439
Radio & television mechanics	1,703	1,756	2,344
Railroad & car shop mechanics	515	531	492
Other mechanics & repairmen	17,567	18,116	18,821

Table 13. (Continued)

	Census	Census adjusted for dual job holding	BLS
Printing trades craftsmen	-	-	-
Compositors & typesetters	2,923	3,014	2,609
Electrotypers & stereotypers	112	115	99
Engravers except photoengravers	58	55	55
Photoengravers & lithographers	239	246	211
Pressmen & plate printers	1,207	1,245	1,073
Transportation & public utility craftsmen	-	-	-
Linemen & servicemen	4,054	4,180	4,120
Locomotive engineers	1,084	1,118	1,036
Locomotive firemen	842	868	801
Other craftsmen & kindred workers	-	-	-
Bakers	1,736	1,790	1,682
Cabinetmakers	1,145	1,181	1,275
Cranemen, derrickmen, hoistmen	1,054	1,087	1,133
Glaziers	244	252	267
Jewelers & watchmakers	541	558	630
Loom fixers	-	-	-
Millers	482	497	474
Opticians & lens grinders	217	224	239
Stationary engineers	2,471	2,548	2,430
Inspectors, log & lumber	75	77	84
Inspectors, other	1,151	1,187	1,196
Upholsterers	637	657	793
Craftsmen & kindred workers NEC	4,210	4,341	4,559
Operatives & kindred workers	150,765	154,365	153,937
Selected Transportation & utility operators	-	-	-
Drivers, bus, truck, tractor	37,198	38,086	38,744
Deliverymen, routemen, cab drivers	8,506	8,709	8,841
Brakemen & switchmen, railroad	2,450	2,509	2,327

Table 13. (Continued)

	Census	Census adjusted for dual job holding	BLS
Power station operators	338	346	341
Sailors & deck hands	34	35	36
Semiskilled metalworking occupations	-	-	-
Assemblers, metalworking Class A	1,705	1,746	1,638
Assemblers, metalworking Class B	6,479	6,634	6,242
Furnacemen, smeltermen, pourers	334	342	348
Heaters, metal	-	-	-
Inspectors, metalworking Class B	2,371	2,428	2,259
Welders & flame cutters	6,186	6,334	6,342
Electroplaters	144	147	124
Electroplater helpers	263	269	226
Semiskilled textile occupations	-	-	-
Knitters, hoppers & toppers	32	33	36
Spinners, textile	15	15	17
Weavers, textile	154	158	167
Sewers & stitchers, manufacturing	2,350	2,406	2,239
Asbestos & insulation workers	200	205	223
Other operative & kindred workers	-	-	-
Attendants, auto parking	7,561	7,742	7,899
Blasterers & powdermen	30	31	37
Laundry & dry cleaning workers	5,166	5,289	6,419
Mine operatives & laborers NEC	801	820	1,104
Meat cutters except meatpacking	2,622	2,685	2,707
Other operatives, NEC	65,826	67,398	65,621
Service workers	112,696	116,109	113,040
Private household workers	22,151	22,373	22,151
Protective service workers	-	-	-
Firemen, fire protection	1,368	1,505	1,302
Policemen, marshals, sheriffs	2,835	3,119	2,752

Table 13. (Continued)

	Census	Census adjusted for dual job holding	BLS
Guards, watchmen	2,147	2,362	2,129
Waiters, cooks & bartenders	-	-	-
Bartenders	2,855	2,941	2,807
Cooks, except private household	11,617	11,969	11,084
Counter & fountain workers	1,617	1,666	1,522
Waiters & waitresses	17,375	17,901	16,957
Other service workers	-	-	-
Airline stewards & stewardesses	26	27	22
Attendants, hospital & others	9,151	9,428	10,346
Charwomen & cleaners	2,798	2,883	2,756
Janitors & sextons	12,100	12,466	10,972
Nurses, practical	2,983	3,073	3,307
Other service workers, NEC	23,673	24,390	24,933
Laborers, except farm & mine	41,919	43,069	44,254

DEVELOPMENT OF THE AREA INDUSTRIAL-OCCUPATIONAL MATRIX, IOWA 1975

Regression Equations

The next step in developing occupational projections for 1975 was to calculate regression equations to use in predicting industrial employment requirements for 1975. The basic data were the BLS industrial time series which report employment of nonagriculture wage and salary workers as well as time series data for agriculture, forestry and fisheries (52, 53, 54, 80). The following four models were used:

$$(1) \quad Y = a + bX + cT$$

$$(2) \quad Y = a + b\ln X + cT$$

$$(3) \quad \ln Y = a + bX + cT$$

$$(4) \quad \ln Y = a + b\ln X + cT$$

where Y = Iowa employment in a given industry, X = U.S. employment in the same industry and T = time.

For each industry, the model which yielded the closest fit was used to obtain its employment projection. The 34 industries for which time series data were available are listed in the first column of Table 14. The model used is also indicated.

The second column reports the number of years entering the regression. In most cases these years corresponded to those for which the time series were available but in several cases previous work indicated that a shorter period yielded a closer fit (36). The fourth column contains the coefficients of determination (adjusted for sample size). The regression equations appear in Column 5. Columns 6 and 7 report projected industrial employment requirements in the United States (X) (62, Appendix 11) and in

Table 14. Regression data

Industry	Years	Model	R^2	Regression equation	U.S. (X) 1975	Iowa (Y) 1975
Mining	1958-68	3	.6815	-0.12348 + .0018 X + .01994 T	620,000	3,867
Construction	1939-68	1	.8587	3.2718 + .01133 X - .03987 T[a]		
	1939-68	1	.773	1.44967 + .0117 X[b]	4,190,000	50,473
Durable goods	1947-67	3	.9241	3.3403 + .00012 X + .00587 T	11,480,000	133,800
Lumber &	1950-67	2	.5798	-15.201 + 3.3651 lnX - .0851 T[c]		
furniture	1950-67	2	.6026	-49.1563 + 8.2743 lnX - .0872 T[d]	1,060,000	6,216
Stone	1947-67	4	.7660	-1.5535 + .5109 lnX - .00782 T	655,000	7,290
Primary metals	1959-67	3	.9349	1.1695 + .00054 X + .03113 T	1,290,000	10,970
Fabricated metals	1947-67	3	.9009	1.1479 + .00088 X + .00612 T	1,460,000	13,600
Machinery except electrical	1958-67	2	.9622	-419.32 + 62.5357 lnX - 0.7499 T	2,050,000	44,054
Electrical	1947-67	1	.9814	-0.6192 + .0191 X + .0666 T[e]		
machinery	1947-67	1	.9819	-10.764 + .0205 X	2,000,000	30,236

[a]Durbin-Watson value (.9696) indicates autocorrelation, time variable not significant at 75% level.

[b]Durbin-Watson value indicates no autocorrelation.

[c]Durbin-Watson value (.6951) indicates autocorrelation.

[d]Durbin-Watson value in inconclusive range.

[e]Time variable not significant at 75% level.

Table 14. (Continued)

Industry	Years	Model	R^2	Regression equation	U.S. (X) 1975	Iowa (Y) 1975
Transportation	1947-67	1	.8903	-3.2374 + .0048 X - 0.115 T[f]		
equipment	1947-67	1	.7463	-1.9690 + .00328 X	1,730,000	3,688
Nondurable	1950-67	3	.9418	3.6719 + .00009 X + .00204 T	8,240,000	91,300
Food	1956-67	2	.8364	-290.19 + 45.8894 lnX - .0882 T	1,665,000	48,434
Apparel	1954-67	3	.3113	.5045 + .00071 X - .00501 T	1,525,000	4,380
Paper	1961-67	2	.9829	-63.663 + 10.3169 lnX - .00164 T[g]		
		2	.9863	-63.196 + 10.2434 lnX	775,000	4,952
Printing	1947-67	2	.9482	-64.326 + 11.3234 lnX - .07435 T[h]		
		2	.8594	-73.588 + 12.7567 lnX - .1092 T[i]	1,100,000	12,581
Chemicals	1947-67	3	.8960	1.1529 + .00038 X + .01580 T[j]		
		3	.6330	1.0208 + .00043 X + .0228 T[k]	1,125,000	8,720

[f] Time variable leads to poor results (1,848).

[g] Time variable not significant.

[h] Durbin-Watson value (.8316) indicates autocorrelation.

[i] Durbin-Watson value indicate no autocorrelation (1.33).

[j] Durbin-Watson value (.5532) indicates autocorrelation.

[k] Durbin-Watson indicate no autocorrelation (1.81).

Table 14. (Continued)

Industry	Years	Model	R^2	Regression equation	U.S. (X) 1975	Iowa (Y) 1975
Rubber	1961-67	3	.9575	-0.7551 + .00632 X - .0729 T	580,000	6,150
Transportation	1947-68	2	.9624	-266.68 + 39.6735 lnX - 0.6854 T[1]		
Communication & public utilities		2	.9586	-243.05 + 36.9628 lnX - .7511 T[m]	4,580,000	46,746
Transportation	1958-67	2	.9021	-266.17 + 38.0801 lnX - 0.4435 T	2,935,000	29,896
Railroad	1947-67	4	.9944	-1.5600 + .6769 lnX - .0199 T	810,000	10,980
Public utilities	1947-67	4	.9081	-11.496 + 2.1739 lnX - .0146 T	625,000	7,970
Communication	1958-67	1	.8952	2.8393 + .0127 X - 0.3087 T	1,020,000	10,234
Wholesale	1947-67	2	.8811	-253.57 + 37.4935 lnX - 0.3089 T[n]		
		2	.7816	-81.858 + 23.6571 lnX - .12868 T[o]	4,135,000	48,154
Retail	1952-67	1	.9659	-31.324 + .0203 X - 1.2522 T	11,980,000	181,187
General merchandise	1958-67	2	.9796	-170.09 + 26.0014 lnX - 0.3931 T	2,610,000	27,390

[1]Durbin-Watson value (.7604) indicates autocorrelation.

[m]Durbin-Watson indicates no autocorrelation (1.71).

[n]Durbin-Watson value (.8394) indicates autocorrelation.

[o]Durbin-Watson indicates no autocorrelation (2.015).

Table 14. (Continued)

Industry	Years	Model	R^2	Regression equation	U.S. (X) 1975	Iowa (Y) 1975
Finance, insurance & real estate	1939-68	1	.9937	5.3771 + .007594 X + .2677 T[p]		
			.9769	2.68534 + .0103 X + .0559 T[q]	3,725,000	43,121
Service	1939-68	1	.9928	-6.8375 + .01749 X - 1.4099 T[r]		
			-	-7.1223 + .0174 X -1.3556 T[s]	12,950,000	167,442
Medical	1961-67	3	.9981	2.8880 + .00027 X + .0166 T	3,400,000	57,700
Federal government	1959-67	2	.7600	-1.8422 + 2.7433 lnX + .1739 T[t]		
			.7828	19.214 + + .2283 T	-	23,095
State government	1959-67	3	.9832	3.1838 - .00006 X + .0474 T[u]		
			.9845	3.1787 + + .0459 T	-	52,400
Local government	1959-67	3	.9941	3.4605 + .00018 X - .00499 T[v]	8,195,000	129,700
			.9944	3.5300 + .000163 X		

[p]Durbin-Watson value (.6722) indicates autocorrelation.

[q]Durbin-Watson indicates no autocorrelation (1.3594).

[r]Durbin-Watson value (.8013) indicates autocorrelation.

[s]Durbin-Watson inconclusive (1.178).

[t]U.S. industrial variable not significant.

[u]U.S. industrial variable not significant.

[v]Time variable not significant.

Table 14. (Continued)

Industry	Years	Model	R^2	Regression equation	U.S. (X) 1975	Iowa (Y) 1975
Agriculture	1956-66	4	.9860	-4.1120 + 1.0913 lnX + .0211 T	3,744,900	198,000
Forestry	1960-66	2	.5916	21.561 - 2.9100 lnX + .2632 T	70,001	250
Fisheries	1954-66	1	.8147	-258.55 + .0174 X - 13.3898 T	60,000	469

Iowa (Y) respectively. The footnotes to Table 14 report additional information in those cases where it was not felt that the initial results were adequate. In these cases the models were rerun and the new results are reported directly below the initial results for that industry.

For example, there were eight industries for which the Durbin-Watson values indicated autocorrelation. The data were adjusted to remove the autocorrelation and new Durbin-Watson values were calculated. In 6 of the 8 cases the new Durbin-Watson values indicated that the adjusted variables were free of autocorrelation, while the other 2 cases were inconclusive (11). There were 4 industries for which the time variable was not significant and the models were rerun without this variable. In one industry, transportation equipment, the presence of the time variable led to results at odds both with U.S. experience as well as with more recent experience in Iowa. For this reason the time variable was not included. Finally, in 2 industries, federal government and state government, the U.S. industrial variable was not significant and was therefore not included.

Considering the results as a whole, Models 2 and 3 were used most frequently, eleven times each. Model 1 was used 9 times and Model 4 was used 4 times. The R^2's were generally satisfactory. Of the 34 regressions computed, there were 20 cases in which the independent variables explained more than 90% of the variance of the dependent variable and an additional 8 in which they explained over 75%. In almost all cases the T and F values were highly significant. In those cases where the T value for either of the independent variables was not significant at a high level the models were rerun as described above.

Additional Industrial Estimates of Employment Requirements

Since time series were available for only a limited number of the 64 industries, it was necessary to use additional information in order to project industrial employment requirements for all of the industries for 1975. In most cases national trends were applied to the 1960 wage and salary employment figures for the individual industries and the results prorated to equal the projected employment level of the aggregate industry as obtained from its regression equation. Any individual industry estimates based on individual regression equations were first allowed for. For example, the estimate of medical employment based on regression was subtracted from the overall service estimate and the remainder was allocated to the other 11 service industries covered by the BLS employment statistics. A similar procedure was followed in allocating transportation equipment manufacturing, transportation, retail, and federal employment projections to individual industries.

Durable goods time series of employment were available for 7 two digit industries but were not available for instruments manufacturing or for miscellaneous manufacturing. When the total of projected employment in the 7 industries for which data were available was subtracted from the total projection of durable goods employment, the remainder, 17,746, was quite a bit higher than the 11,012 projected for these industries on the basis of national trends. Since the overall durable goods national trend would also lead to a smaller overall employment level of private wage and salary workers, the smaller figure for instruments and miscellaneous manufacturing was used.

It was also necessary to break down the lumber and furniture durable goods employment projection into two separate figures. Since the R^2 for the lumber and furniture industry regression was not very high, the 4,045 and 3,855, projected employment figures derived by use of national trends were used in the lumber and furniture industries respectively.

For nondurable goods, regressions were not available for the tobacco, textile, petroleum or leather industries while the regression for the apparel industry did not provide a very close fit (R^2 = .3113). National trends were therefore applied to 1960 employment in these industries to yield a total employment projection of 5,791. On the other hand, subtraction of the total employment of private wage and salary workers in the industries for which regressions were used from projected employment in nondurable goods industries taken as a whole left a remainder of 10,463 to be allocated to these 5 industries. Subtraction of 5,791 from this figure left 4,672 persons still unallocated. Since the 5 industries were relatively small industries whose employment (except for apparel) was falling, these 4,672 persons were distributed over the industries whose predictions were based on time series in proportion to their overall predictions.

The final estimates of private wage and salary employment requirements for 1975 are reported in Table 15.

Total Employment Requirements, 1975

It was now necessary to correct the data on wage and salary workers to include unpaid family workers, government workers and the self employed. The correction factors were computed as follows:

$$\text{Iowa correction factor 1975} = \text{Iowa correction factor 1960} \times \frac{\text{U.S. correction factor 1975}}{\text{U.S. correction factor 1960}}$$

Use of this formula assumes that the trend in Iowa's correction factor is the same as that in the nation. U.S. correction factors for 1960 and projected for 1975 are available in the publication, Tomorrow's Manpower Needs, Volume IV, Appendix G (62). These are conceptually the same as the correction factors used for Iowa but in addition they serve to remove employment of secondary job holders. Each man is assumed to have only one job. Since the correction factors for Iowa do not allow for this, the trends in the United States will not be completely comparable to those in Iowa. This also means that the U.S. factor can fall below 1. The latter was taken as the lower limit for Iowa's correction factors except for the government industries from which workers were removed. For certain industries the U.S. correction factor was used in 1960 rather than the Iowa correction factor. In these cases the U.S. correction factor was again used in 1975. For agriculture, forestry and fisheries the total predicted employment for 1975 was taken directly from the regression equation, since the U.S. projections for these industries were for total employment. Likewise the national trend used to project employment of service workers in the private household industry was based on total U.S. employment figures and thus no correction factor was needed for Iowa in this industry. Finally, for the nonprofit service industry the correction factor was based on the ratio between the Census figure used in 1960 and the estimate of BLS service employment allocated to that industry in 1960.

The correction factors used and the final estimates of total employment

Table 15. Industrial employment requirements for 1975

	Wage and salary employment	Correction factor	Total employment requirements 1975	Total employment 1960
Agriculture	-	-	198,000	282,916
Forestry	-	-	250	81
Fisheries	-	-	469	202
Mining	3,867	1.0323	3,992	3,351
Construction	50,473	1.6338	82,463	62,260
Durable				
Lumber	4,045	1.1182	4,523	5,054
Furniture	3,855	1.0650	4,106	3,004
Stone	7,290	1.0305	7,512	6,913
Primary metals	10,970	1.0267	11,263	6,460
Fabricated metals	13,600	1.2673	17,235	11,640
Machinery except electrical	44,054	1.0308	45,411	34,100
Electrical machinery	30,236	1.0271	31,055	19,560
Motor vehicles	2,158	1.0318	2,227	1,430
Aircraft	355	1.0040	356	282
Ship	480	1.0000	480	228
Miscellaneous transportation	695	1.0149	705	309
Instruments	3,403	1.0000	3,403	2,490
Miscellaneous manufacturing	7,609	1.0358	7,881	6,550
Nondurable				
Food	51,234	1.0485	53,719	55,220
Tobacco	59	1.0612	63	73
Textile	462	1.3408	619	640
Apparel	4,700	1.0333	4,857	3,890
Paper	5,238	1.0387	5,441	2,590
Printing	13,308	1.345	17,893	16,000
Chemicals	9,224	1.0206	9,414	5,170
Petroleum	307	1.0454	321	421
Rubber	6,505	1.0288	6,692	3,940
Leather	263	1.0721	282	290
Transportation				
Local	2,354	1.6784	3,951	4,150
Truck and warehouse	15,134	1.3549	20,520	16,570
Railroad	10,980	1.0025	11,007	15,840
Ship	100	1.7320	173	215
Air	590	1.3474	786	690
Pipe	132	1.1731	155	180
Service	605	1.3424	812	490
Communication	10,234	1.1134	11,371	13,080

Table 15. (Continued)

	Wage and salary employment	Correction factor	Total employment requirements 1975	Total employment 1960
Public utilities	7,970	1.6906	13,474	12,860
Wholesale	48,154	1.1312	54,472	49,140
Retail				
Lumber	7,928	1.2845	10,184	9,330
General merchandise	27,390	1.0888	29,822	21,490
Food	26,958	1.2027	32,422	25,521
Auto and gas	29,058	1.4027	40,760	29,450
Clothing	7,973	1.1942	9,521	8,260
Furniture	6,924	1.4294	9,897	8,140
Eating	38,328	1.2494	47,887	31,450
Miscellaneous retail	36,628	1.7797	65,187	34,050
Finance, insurance and real estate	43,121	1.1699	50,447	36,970
Service				
Hotels	8,476	1.3111	11,113	6,868
Other personal service	17,072	1.9165	32,718	22,915
Business service	11,524	1.2862	14,822	5,844
Auto repair	10,825	1.3999	15,154	9,747
Miscellaneous repair	6,619	1.9874	13,155	9,139
Motion picture	1,715	1.2265	2,103	2,020
Miscellaneous entertainment	7,293	1.4556	8,945	3,934
Medical	57,700	1.4556	83,988	49,996
Legal	5,787	1.8924	10,951	6,509
Education	21,293	4.8746	103,795	56,290
Non-profit	12,526	1.6204	20,263	16,235
Private household	-	-	31,045	24,974
Miscellaneous service	5,612	1.5107	8,478	3,937
Public administration				
Postal administration	12,948	.9533	12,343	11,830
Other federal	10,147	.6847	6,948	5,180
State administration	52,400	.2510	13,152	6,360
Local administration	129,770	.1912	24,812	12,630

requirements are reported in Table 15. Total employment in 1960 is also reported in this table to facilitate comparison.

Employment requirements for 1975 are estimated to be larger than

employment in 1960 for all major industry groupings except for agriculture, and communications. All of the individual retail, government, and service industries, as well as the durable goods industries except for lumber show increases in their employment requirements. Of the eleven nondurable goods industries, however, only five will increase in requirements. These include paper, printing, chemicals, apparel and rubber. Of those estimated to decrease requirements, only the nondurable food industry is a large source of employment. Finally of the seven transportation industries only trucking, air, and transportation service are projected to increase requirements as compared to employment in 1960.

The Area Matrix for 1975

Once the 1960 Iowa industrial-occupational matrix consistent with BLS 1960 industrial employment figures and the 1975 projections of industrial employment requirements were completed, it was necessary to multiply both the 1960 and 1975 industrial employment figures by U.S. employment patterns. Each industry total in Iowa was multiplied by the U.S. percentage occupation distribution for that industry. Since this was done both for 1960 as well as for 1975 two 165 x 64 matrices were yielded. Each industry-occupation cell of the 1975 matrix based on U.S. employment patterns was then divided by the corresponding cell in the 1960 matrix. The result was a single 165 x 64 matrix each cell of which represented the trend of a particular occupation within a particular industry. The trend was affected by two factors, the growth of industrial employment in Iowa as well as the change in occupation structure for the United States as a whole. The method used assumes that the latter is relevant for Iowa.

The matrix of trend factors thus developed was then multiplied by the 1960 Iowa industrial-occupational area matrix to yield an estimated I-O matrix for 1975. Since the sums of industrial employment resulting from the above multiplications in most cases did not equal the industrial employment totals obtained from regression analysis, it was necessary to prorate the industrial totals to these figures.

The final I-O matrix consistent with 1975 projected industrial employment requirements is presented in Table 16. Only data on major occupations are included in this table.

Summation of estimated occupational employment across industries then enabled projections of overall employment requirements in each occupation in Iowa for 1975 to be obtained. These sums are reported in Table 17 of the next chapter.

Table 16. Projected Industrial-Occupational Matrix for Iowa, 1975

	Total	Agri-culture	For-estry	Fish-eries	Min-ing	Con-struc-tion	Durable		
							Lumber	Furni-ture	Stone
Total	1,347,266	198,000	250	469	3,992	82,463	4,523	4,106	7,512
Professional	163,775	2,278	156	15	63	2,707	125	430	507
Management	108,355	549	5	68	452	8,508	328	165	651
Clerical	192,742	956	17	17	299	3,934	290	553	356
Sales	100,417	376	-	39	38	162	92	130	279
Craft	170,681	358	8	18	1,168	48,302	939	834	1,731
Operative	202,588	1,549	9	49	1,937	8,160	2,179	1,929	3,033
Service	175,306	198	-	11	35	263	93	29	87
Labor	42,809	1,143	55	252	-	10,427	477	36	868
Farm management and labor	190,593	190,593							

Table 16. (Continued)

	Durable									
	Primary metals	Fabricated metals	Machinery except electrical	Electrical machinery	Motor vehicles	Aircraft	Ship	Miscellaneous transportation	Instruments	Miscellaneous manufacturing
Total	11,263	17,235	45,411	31,055	2,227	356	480	705	3,403	7,881
Professional	648	1,834	4,660	5,105	59	74	10	11	671	203
Management	400	896	2,153	648	239	12	59	131	172	436
Clerical	1,066	2,395	5,415	4,093	211	30	33	38	502	1,249
Sales	226	412	651	276	70	4	-	-	32	188
Craft	3,395	3,877	10,632	5,276	481	109	177	199	676	1,277
Operative	4,515	6,958	20,087	14,736	1,097	120	186	278	1,261	4,314
Service	130	244	527	422	24	4	3	11	30	55
Labor	883	619	1,286	499	46	3	12	37	59	159
Farm management and labor										

Table 16. (Continued)

	Nondurable									
	Food	Tobacco	Textiles	Apparel	Paper	Printing	Chemicals	Petroleum	Rubber	Leather
Total	53,719	63	619	4,857	5,441	17,893	9,414	321	6,692	282
Professional	2,003	1	5	85	181	1,926	1,296	42	578	1
Management	3,507	6	40	197	335	1,365	679	33	204	10
Clerical	6,398	2	27	436	574	3,569	1,220	41	762	36
Sales	2,369	11	106	235	522	4,835	1,095	47	113	13
Craft	6,679	12	32	335	1,025	4,250	1,470	72	1,356	14
Operative	28,371	24	394	3,487	2,612	1,581	3,319	70	3,255	201
Service	1,050	3	7	33	71	215	129	5	98	3
Labor	3,342	4	8	49	121	152	206	11	327	4
Farm management and labor										

Table 16. (Continued)

	Transportation									
	Local	Truck and warehouse	Railroad	Ship	Air	Pipe	Service	Communications	Public utilities	Wholesale
Total	3,951	20,520	11,007	173	786	155	812	11,371	13,474	54,472
Professional	38	125	178	3	48	10	7	1,307	1,040	1,327
Management	93	1,097	883	24	35	18	133	1,196	910	11,186
Clerical	236	1,950	2,238	35	228	19	418	5,289	2,152	10,566
Sales	9	237	21	4	5	1	66	264	135	10,656
Craft	244	1,043	3,138	19	176	41	50	3,117	4,785	4,414
Operative	3,255	15,266	3,236	43	238	58	95	47	2,930	12,491
Service	47	39	56	9	37	1	22	132	125	374
Labor	29	763	1,257	36	19	7	21	19	1,397	3,458
Farm management and labor										

Table 16. (Continued)

	Retail								
	Lumber	General merchandise	Food & dairy	Auto & gas	Clothing	Furniture	Eating	Miscellaneous retail	Finance, insurance & real estate
Total	10,184	29,822	32,422	40,760	9,521	9,897	47,887	65,187	50,447
Professional	62	211	46	195	27	81	206	2,633	1,061
Management	2,088	3,522	5,056	8,062	1,272	1,474	5,603	10,182	10,305
Clerical	978	5,496	9,971	1,492	2,144	1,431	947	9,402	24,503
Sales	2,012	14,914	7,230	5,204	5,037	2,673	444	25,279	11,489
Craft	2,384	1,891	579	11,920	353	2,773	327	6,773	681
Operative	1,795	1,409	5,551	12,382	475	1,136	238	7,912	202
Service	127	1,847	427	259	125	136	40,005	1,268	1,328
Labor	738	532	3,562	1,246	88	193	117	1,738	878
Farm management and labor									

Table 16. (Continued)

	Service								
	Hotels	Other personal service	Business service	Auto repair	Miscel-laneous repair	Motion picture	Miscel-laneous enter-tainment	Medical	Legal
Total	11,113	32,718	14,822	15,154	13,155	2,103	8,945	83,988	10,951
Professional	194	1,664	1,428	51	90	373	821	31,953	5,570
Management	2,098	1,341	1,502	941	609	411	1,536	2,273	56
Clerical	1,416	2,193	6,496	786	966	461	842	12,613	5,253
Sales	29	187	1,267	194	171	112	170	8	8
Craft	346	1,894	1,601	9,980	9,023	310	781	1,758	6
Operative	296	7,636	1,434	2,349	1,970	37	88	1,772	6
Service	6,576	17,286	894	82	92	387	4,092	33,468	49
Labor	158	517	200	771	234	12	615	143	3
Farm management and labor									

Table 16. (Continued)

	Service				Public administration			
	Education	Non-profit	Private household	Miscellaneous service	Postal administration	Other federal	State administration	Local administration
Total	103,795	20,263	31,045	8,478	12,343	6,948	13,152	24,812
Professional	64,879	7,835	37	5,704	133	1,681	3,808	3,275
Management	2,037	957	7	253	1,082	903	2,429	4,533
Clerical	16,692	3,598	62	2,086	10,099	3,061	4,566	7,538
Sales	101	100	7	21	-	8	20	13
Craft	2,098	435	7	198	274	749	711	1,100
Operative	841	362	195	106	143	196	132	555
Service	16,793	6,843	29,389	99	193	205	1,396	7,318
Labor	354	133	1,341	11	419	145	90	480
Farm management and labor								

COMPARISON OF TWO METHODS AND EMPLOYMENT REQUIREMENT PROJECTIONS

Comparison of Two Methods

It was noted in the first chapter that the national data reported in Tomorrow's Manpower Needs were adaptable to two methods of local projections. The method (B) in which an area matrix was developed with each cell being multiplied by its individual national occupation by industry trend was the subject of the second and third chapters. The second method (A) is distinguished by the relative ease by which projections of occupational requirements may be obtained. In this method each industry's total employment in 1960 was multiplied by its national occupational employment pattern for 1960. Each projected industrial total for 1975 was likewise multiplied by its projected national occupational employment pattern for 1975. The occupational results were summed across all industries in 1975 and in 1960. These sums were then divided to yield a single trend figure for each occupation. The latter reflect both the change in the size of Iowa's industries between 1960 and 1975 as well as the change in the structure of the nation's industries between 1960 and 1975. Each occupation's trend was then multiplied by the total employment in that occupation in 1960 to yield a final projection of employment requirements for 1975.

The results of the two methods are reported in Tables 17 and 18. The column marked Overall trend projection reports the total requirement for each occupation for 1975 computed by Method A. In addition, the difference between these projected figures and 1960 adjusted Census employment (see Table 13) is also reported. Likewise the area matrix projection (B) and difference between 1960 (see Table 13) and 1975 employment is also

Table 17. Occupational requirements in Iowa, 1975

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Total			1,347,266		
Professional technical & kindred	180,550	73,987	163,775	60,776	37,378
Engineers, technical	-	-	-	-	-
Engineers, aeronautical	60	34	44	22	5
Engineers, chemical	293	133	252	100	27
Engineers, civil	2,755	1,095	2,800	1,078	475
Engineers, electrical	2,588	1,211	2,190	887	235
Engineers, industrial	2,676	1,460	2,230	1,103	264
Engineers, mechanical	2,772	1,151	2,427	943	363
Engineers, metallurgical	173	93	133	59	18
Engineers, mining	12	3	13	4	2
Engineers, other technical	2,487	1,291	2,469	1,307	334
Natural scientists	-	-	-	-	-
Chemists	1,116	589	954	472	116
Agricultural scientists	426	204	378	170	58
Biological scientists	323	183	315	193	44
Geologists & geophysicists	61	32	65	38	6
Mathematicians	21	14	24	17	6
Physicists	132	83	98	58	14
Other natural scientists	42	17	27	3	3
Technicians, except medical & dental	-	-	-	-	-
Draftsmen	3,321	1,320	3,420	1,550	336
Surveyors	1,552	752	1,737	905	221
Air traffic controllers	57	10	48	9	-
Radio operators	468	204	461	181	-
Technicians, other	7,609	4,227	7,122	3,936	-

Table 17. (Continued)

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Medical & other health workers	-	-	-	-	-
Dentists	1,905	393	2,074	516	421
Dieticians & nutritionists	347	65	344	58	171
Nurses, professional	14,704	5,030	15,835	5,776	7,443
Nurses, student	1,197	-163	1,296	-194	831
Optometrists	349	74	371	72	-
Osteopaths	305	30	331	30	-
Pharmacists	1,876	536	2,577	809	519
Physicians & surgeons	4,690	1,542	5,057	1,630	2,055
Psychologists	371	215	308	166	44
Technicians, medical & dental	4,851	2,895	5,175	3,064	1,431
Veterinarians	1,225	268	1,531	349	394
Chiropractors & therapists	1,815	823	1,876	813	-
Teachers	-	-	-	-	-
Teachers, elementary	25,085	5,936	22,292	5,086	11,023
Teachers, secondary	17,163	6,310	20,514	7,462	4,543
Teachers, other except college	2,952	1,453	2,278	1,110	621
Teachers, college	9,136	5,422	9,230	5,479	1,268
Social scientists	-	-	-	-	-
Economists	207	71	219	88	48
Statisticians & actuaries	225	82	229	93	52
Other social scientists	27	15	26	16	5
Other professional technical & kindred	-	-	-	-	-
Accountants & auditors	7,425	2,083	7,809	2,549	2,359
Airplane pilots & navigators	185	49	185	44	-
Architects	438	159	458	177	171

Table 17. (Continued)

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Artists, athletes, entertainers & authors	12,294	5,062	9,169	3,762	-
Clergymen	6,448	2,741	5,616	1,090	1,614
Designers, except design draftsmen	786	354	741	310	140
Editors & reporters	1,994	214	1,714	184	541
Lawyers & judges	4,140	1,285	5,824	2,351	2,520
Librarians	2,539	1,019	1,962	768	627
Personnel & labor relations workers	1,925	837	1,811	759	380
Photographers	713	47	691	-44	194
Social & welfare workers	2,171	1,010	2,156	1,007	611
Professional technicak, kindred, NEC	10,905	3,805	7,397	2,890	-
Managers, officials & proprietors	105,156	22,356	108,355	23,608	4,180
Conductors, railroad	558	-148	508	-146	333
Creditmen	1,262	628	1,308	660	279
Officers, pilots, engineers, ship	79	29	86	38	20
Purchasing agents	2,801	1,182	2,754	1,137	578
Postmasters & assistants	822	-320	1,082	-359	-
Managers, officials, proprietors, NEC	99,883	21,235	102,615	22,278	-
Clerical & kindred workers	189,658	59,755	192,742	61,276	78,800
Stenographers, typists, secretaries	43,167	15,317	44,521	16,529	19,900
Office machine operators	8,140	4,632	8,508	5,054	2,562
Other clerical & kindred workers	-	-	-	-	-

Table 17. (Continued)

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Accounting clerks	-	-	-	-	-
Bookkeepers, hand	23,808	5,208	24,532	5,222	11,470
Bank tellers	3,393	1,579	3,320	1,563	869
Cashiers	16,177	8,208	14,905	7,139	5,342
Mail carriers	4,447	1,000	5,572	1,200	1,703
Postal clerks	3,250	-207	4,076	-309	1,183
Shipping & receiving clerks	2,746	-28	2,865	74	694
Telephone operators	5,932	-121	5,137	-893	3,190
Clerical & kindred, NEC	76,743	22,315	79,306	25,697	-
Sales workers	99,699	21,809	100,417	22,758	40,273
Insurance agents & brokers	7,518	1,305	7,287	1,295	3,042
Real estate agents & brokers	3,467	899	3,378	901	1,758
Other sales workers, NEC	89,049	20,041	89,752	20,562	-
Craftsmen, foremen & kindred workers	160,324	39,780	170,681	46,733	45,861
Construction craftsmen	-	-	-	-	-
Carpenters	14,191	546	15,559	609	5,501
Brickmasons, stone, tile setters	2,423	260	2,694	293	617
Cement & concrete finishers	499	175	559	198	99
Electricians	4,974	995	5,224	1,059	1,291
Excavating, grading machine operators	6,491	2,303	7,344	2,672	1,154
Painting & paperhangers	5,232	249	6,122	746	2,115
Plasterers	628	87	693	97	162
Plumbers & pipefitters	5,614	1,262	6,038	1,428	1,508
Roofers & slaters	782	194	852	198	-
Structural metalworkers	999	359	1,086	383	-
Foremen, NEC	21,659	6,824	20,983	6,499	5,162

Table 17. (Continued)

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Metalworking craftsmen except mechanic	-	-	-	-	-
Skilled machining workers	6,038	342	5,654	362	1,415
Blacksmiths, forgerers, hammermen	344	-147	368	-282	356
Boilermakers	180	36	128	-12	73
Heat treaters, annealers, tempers	253	44	253	58	527
Millwrights	767	238	654	141	190
Molders, metal (except coremakers	984	250	937	241	106
Patternmakers, metal & wood	516	190	452	120	113
Rollers & roll hands	40	14	39	13	8
Sheet metal workers	1,745	392	1,647	351	328
Toolmakers, diemakers, setters	1,720	184	1,557	153	375
Mechanics & repairmen	-	-	-	-	-
Airplane mechanics & repairmen	313	97	337	132	180
Motor vehicle mechanics	18,869	5,856	18,826	5,461	3,335
Office machine mechanics	685	302	767	328	78
Radio & television mechanics	2,564	808	3,393	1,049	417
Railroad & car shop mechanics	435	-96	402	-90	182
Other mechanics & repairmen	34,057	15,942	36,273	17,452	7,429
Printing trades craftsmen	-	-	-	-	-
Compositors & typesetters	2,381	-633	2,142	-467	645
Electrotypers & stereotypers	60	-55	51	-48	22
Engravers except photoengravers	68	14	69	14	20
Photoengravers & lithographers	530	283	462	251	75
Pressmen & plate printers	1,494	249	1,304	231	296
Transportation & public utility craftsmen	-	-	-	-	-

Table 17. (Continued)

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Linemen & servicemen	4,472	292	4,700	580	832
Locomotive engineers	939	-179	861	-175	645
Locomotive firemen	104	-764	141	-660	60
Other craftsmen & kindred workers	-	-	-	-	-
Bakers	1,486	-304	1,425	-257	567
Cabinetmakers	1,511	331	1,475	200	532
Cranemen, derrickmen, hoistmen	1,891	804	1,956	823	380
Glaziers	478	226	396	129	59
Jewelers & watchmakers	893	335	1,380	750	374
Loom fixers	-	-	-	-	-
Millers	333	-164	320	-154	131
Opticians & lens grinders	403	179	442	203	88
Stationary engineers	2,854	306	2,598	168	837
Inspectors, log & lumber	108	30	100	16	28
Inspectors, other	1,685	499	1,982	786	564
Upholsterers	979	322	1,280	487	354
Craftsmen & kindred workers, NEC	7,294	2,952	8,756	4,197	-
Operatives & kindred workers	200,776	50,011	202,588	48,651	55,223
Selected transportation & utility operators	-	-	-	-	-
Drivers, bus, truck, tractor	47,989	9,902	49,392	10,648	7,976
Deliverymen, routemen, cab drivers	11,409	2,700	11,102	2,261	2,040
Brakemen & switchmen, railroad	2,408	-100	2,228	-79	620
Power station operators	346	-	341	-	105
Sailors & deck hands	45	10	32	-4	7
Semiskilled metalworking occupations	-	-	-	-	-
Assemblers, metalworking Class A	2,653	908	2,441	803	612
Assemblers, metalworking Class B	8,956	2,322	8,358	2,116	2,186

Table 17. (Continued)

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Furnacemen, smeltermen, pourers	513	171	522	174	103
Heaters, metal	-	-	-	-	-
Inspectors, metalworking Class B	3,204	777	2,956	697	-
Welders & flame cutters	9,691	3,357	9,803	3,461	1,604
Electroplaters	202	55	168	44	-
Electroplater helpers	337	67	276	50	-
Semiskilled textile occupations	-	-	-	-	-
Knitters, hoppers & toppers	34	1	37	1	14
Spinners, textile	12	-3	10	-7	6
Weavers, textile	150	-8	164	-3	64
Sewers & stitchers, manufacturing	2,767	361	2,551	312	1,044
Asbestos & insulation workers	285	80	304	81	-
Other operative & kindred workers	-	-	-	-	-
Attendants, auto parking	13,703	5,961	13,419	5,520	2,134
Blasterers & powdermen	37	7	43	6	8
Laundry & dry cleaning workers	6,241	952	7,550	1,131	4,064
Mine operatives & laborers, NEC	837	16	1,109	5	314
Meat cutters except meatpacking	3,544	859	3,354	647	1,016
Other operatives, NEC	88,965	21,567	86,428	20,807	-
Service workers	176,486	60,377	175,306	62,266	40,836
Private household workers	27,294	4,922	27,571	5,420	16,803
Protective service workers	-	-	-	-	-
Firemen, fire protection	2,423	918	2,033	731	320
Policemen, marshals, sheriffs	5,863	2,744	5,110	2,358	952
Guards, watchmen	3,023	661	2,603	474	1,187
Waiters, cooks & bartenders	-	-	-	-	-
Bartenders	4,442	1,500	4,176	1,369	867

Table 17. (Continued)

	(A) Overall trend projection 1975	(A) Overall trend difference 1975-1960	(B) Area matrix projection 1975	(B) Area matrix difference between 1960 & 1975	(B) Area matrix replacements needed between 1960 & 1975
Cooks, except private household	19,030	7,062	17,590	6,506	5,592
Counter & fountain workers	4,148	2,482	2,619	1,097	523
Waiters & waitresses	29,000	11,099	27,353	10,396	8,019
Other service workers	-	-	-	-	-
Airline stewards & stewardesses	35	8	29	7	-
Attendants, hospital & others	19,705	10,277	21,427	11,081	6,561
Charwomen & cleaners	4,266	1,384	4,150	1,394	1,256
Janitors & sextons	14,586	2,119	12,762	1,790	5,572
Nurses, practical	5,901	2,827	6,299	2,992	1,807
Other service workers, NEC	38,292	13,902	41,592	16,659	-
Laborers, except farm & mine	44,004	435	42,809	-1,453	13,152
Farmers & farm workers	150,141	-67,455	190,593	-84,814	99,022

Table 18. Occupational trends for Iowa, 1975

	Overall trend (Trend A)	Area matrix trend (Trend B)	Trend A-1 / Trend B-1	Difference A / Difference B
Professional technical & kindred	1.69	1.59	1.17	1.21
Engineers, technical	-	-	-	-
Engineers, aeronautical	2.31	2.00	1.31	1.55
Engineers, chemical	1.83	1.66	1.26	1.33
Engineers, civil	1.66	1.62	1.07	1.02
Engineers, electrical	1.88	1.68	1.29	1.37
Engineers, industrial	2.20	1.98	1.22	1.32
Engineers, mechanical	1.71	1.64	1.11	1.22
Engineers, metallurgical	2.16	1.80	1.45	1.58
Engineers, mining	1.39	1.44	0.89	0.81
Engineers, other technical	2.08	2.12	0.96	0.99
Natural scientists	-	-	-	-
Chemists	2.12	1.98	1.14	1.25
Agricultural scientists	1.92	1.82	1.12	1.20
Biological scientists	2.30	2.58	0.82	0.95
Geologists & geophysicists	2.10	2.41	0.78	0.84
Mathematicians	2.87	3.43	0.77	0.80
Physicists	2.69	2.45	1.17	1.42
Other natural scientists	1.70	1.12	5.83	5.83
Technicians, except medical & dental	-	-	-	-
Draftsmen	1.66	1.83	0.80	0.85
Surveyors	1.94	2.09	0.86	0.83
Air traffic controllers	1.22	1.23	0.96	1.14
Radio operators	1.77	1.65	1.18	1.12
Technicians, other	2.25	2.24	1.01	1.07
Medical & other health workers	-	-	-	-
Dentists	1.26	1.33	0.78	0.76
Dieticians & nutritionists	1.23	1.20	1.15	1.12
Nurses, professional	1.52	1.57	0.91	0.87

Table 18. (Continued)

	Overall trend (Trend A)	Area matrix trend (Trend B)	Trend A-1 / Trend B-1	Difference A / Difference B
Nurses, student	0.88	0.87	0.92	0.84
Optometrists	1.27	1.24	1.12	1.03
Osteopaths	1.11	1.10	1.10	1.00
Pharmacists	1.40	1.46	0.87	0.66
Physicians & surgeons	1.49	1.48	1.02	0.95
Psychologists	2.39	2.17	1.19	1.30
Technicians, medical & dental	2.48	2.45	1.02	0.94
Veterinarians	1.28	1.30	0.93	0.77
Chiropractors & therapists	1.83	1.76	1.09	1.01
Teachers	-	-	-	-
Teachers, elementary	1.31	1.30	1.03	1.17
Teachers, secondary	1.63	1.57	1.10	0.85
Teachers, other except college	1.97	1.95	1.02	1.31
Teachers, college	2.46	2.46	1.00	0.99
Social scientists	-	-	-	-
Economists	1.52	1.67	0.78	0.81
Statisticians & actuaries	1.57	1.68	0.84	0.88
Other social scientists	2.35	2.60	0.84	0.97
Other professional technical & kindred	-	-	-	-
Accountants & auditors	1.39	1.48	0.81	0.82
Airplane pilots & navigators	1.36	1.31	1.16	1.12
Architects	1.57	1.63	0.90	0.90
Artists, athletes, entertainers & authors	1.70	1.70	1.00	1.35
Clergymen	1.37	1.24	1.54	2.51
Designers, except design draftsmen	1.82	1.72	1.14	1.14
Editors & reporters	1.12	1.12	1.00	1.16
Lawyers & judges	1.45	1.68	0.66	0.55
Librarians	1.67	1.64	1.05	1.33

Table 18. (Continued)

	Overall trend (Trend A)	Area matrix trend (Trend B)	Trend A-1 / Trend B-1	Difference A / Difference B
Personnel & labor relations workers	1.77	1.72	1.07	1.10
Photographers	1.07	0.94	-1.17	-1.06
Social & welfare workers	1.87	1.88	0.99	1.00
Professional technical, kindred, NEC	1.54	1.63	0.86	1.32
Managers, officials & proprietors	1.27	1.28	0.96	0.95
Conductors, railroad	0.79	0.78	0.95	1.02
Creditmen	1.99	2.02	0.97	0.95
Officers, pilots, engineers, ship	1.58	1.79	0.73	0.76
Purchasing agents	1.73	1.70	1.04	1.04
Postmasters & assistants	0.72	0.75	1.12	0.89
Managers, officials, proprietors, NEC	1.27	1.28	0.96	0.95
Clerical & kindred workers	1.46	1.47	0.97	0.98
Stenographers, typists, secretaries	1.55	1.59	0.93	0.93
Office machine operators	2.32	2.46	0.90	0.92
Other clerical & kindred workers	-	-	-	-
Accounting clerks	-	-	-	-
Bookkeepers, hand	1.28	1.27	1.04	1.00
Bank tellers	1.87	1.89	0.98	1.01
Cashiers	2.03	1.92	1.12	1.15
Mail carriers	1.29	1.27	1.07	0.83
Postal clerks	0.94	0.93	0.86	0.67
Shipping & receiving clerks	0.99	1.03	-0.33	-0.37
Telephone operators	0.98	0.85	0.13	0.14
Clerical & kindred NEC	1.41	1.48	0.85	0.87
Sales workers	1.28	1.29	0.97	0.96
Insurance agents & brokers	1.21	1.22	0.95	1.01
Real estate agents & brokers	1.35	1.36	0.97	1.00
Other sales workers, NEC	1.29	1.30	0.97	0.97

Table 18. (Continued)

	Overall trend (Trend A)	Area matrix trend (Trend B)	Trend A-1 / Trend B-1	Difference A / Difference B
Craftsmen, foremen & kindred workers	1.33	1.38	0.86	0.85
Construction craftsmen	-	-	-	-
Carpenters	1.04	1.04	1.00	0.90
Brickmasons, stone, tile setters	1.12	1.12	1.00	0.89
Cement & concrete finishers	1.54	1.55	0.98	0.88
Electricians	1.25	1.25	1.00	0.94
Excavating, grading machine operators	1.55	1.57	0.96	0.86
Painting & paperhangers	1.05	1.14	0.36	0.33
Plasterers	1.16	1.16	1.00	0.89
Plumbers & pipefitters	1.29	1.31	0.94	0.88
Roofers & slaters	1.33	1.30	1.10	0.98
Structural metalworkers	1.56	1.54	1.04	0.94
Foremen, NEC	1.46	1.45	1.02	1.05
Metalworking craftsmen except mechanic	-	-	-	-
Skilled machining workers	1.06	1.07	0.86	0.94
Blacksmiths, forgerers, hammermen	0.70	0.57	0.70	0.52
Boilermakers	1.25	0.91	-2.78	-3.01
Heat treaters, annealers, tempers	1.21	1.30	0.70	0.76
Millwrights	1.45	1.27	1.67	1.69
Molders, metal (except coremakers)	1.34	1.35	0.97	1.04
Patternmakers, metal & wood	1.58	1.36	1.61	1.58
Rollers & roll hands	1.54	1.50	1.08	1.07
Sheet metal workers	1.29	1.27	1.07	1.12
Toolmakers, diemakers, setters	1.12	1.11	1.09	1.20
Mechanics & repairmen	-	-	-	-
Airplane mechanics & repairmen	1.45	1.64	0.70	0.73
Motor vehicle mechanics	1.45	1.41	1.10	1.07
Office machine mechanics	1.79	1.75	1.05	0.92
Radio & television mechanics	1.46	1.45	1.02	0.77

Table 18. (Continued)

	Overall trend (Trend A)	Area matrix trend (Trend B)	Trend A-1 / Trend B-1	Difference A / Difference B
Railroad & car shop mechanics	0.82	0.82	1.00	1.06
Other mechanics & repairmen	1.88	1.93	0.95	0.91
Printing trades craftsmen	-	-	-	-
Compositors & typesetters	0.79	0.82	1.17	1.36
Electrotypers & stereotypers	0.52	0.52	1.00	1.15
Engravers except photoengravers	1.25	1.25	1.00	1.00
Photoengravers & lithographers	2.15	2.19	0.97	1.13
Pressmen & plate printers	1.20	1.22	0.91	1.08
Transportation & public utility craftsmen	-	-	-	-
Linemen & servicemen	1.07	1.14	0.50	0.50
Locomotive engineers	0.84	0.83	0.94	1.02
Locomotive firemen	0.12	0.18	1.07	1.16
Other craftsmen & kindred workers	-	-	-	-
Bakers	0.83	0.85	1.13	1.18
Cabinetmakers	1.28	1.16	1.75	1.65
Cranemen, derrickmen, hoistmen	1.74	1.73	1.01	0.98
Glaziers	1.90	1.48	1.88	1.76
Jewelers & watchmakers	1.60	2.19	0.50	0.45
Loom fixers	-	-	-	-
Millers	0.67	0.68	1.03	1.07
Opticians & lens grinders	1.80	1.85	0.94	0.88
Stationary engineers	1.12	1.07	1.71	1.82
Inspectors, log & lumber	1.39	1.19	2.05	1.89
Inspectors, other	1.42	1.66	0.64	0.63
Upholsterers	1.49	1.61	0.80	0.66
Craftsmen & kindred workers, NEC	1.68	1.92	0.74	0.70
Operatives & kindred workers	1.33	1.32	1.03	1.03
Selected transportation & utility operators	-	-	-	-
Drivers, bus, truck, tractor	1.26	1.27	0.96	0.93

Table 18. (Continued)

	Overall trend (Trend A)	Area matrix trend (Trend A)	Trend A-1 / Trend B-1	Difference A / Difference B
Deliverymen, routemen, cab drivers	1.31	1.26	1.19	1.19
Brakemen & switchmen, railroad	0.96	0.96	1.00	1.01
Power station operators	1.00	1.00	-	-
Sailors & deck hands	1.30	0.89	-2.73	-2.50
Semiskilled metalworking occupations	-	-	-	-
Assemblers, metalworking Class A	1.52	1.49	1.06	1.13
Assemblers, metalworking Class B	1.35	1.34	1.03	1.10
Furnacemen, smeltermen, pourers	1.50	1.50	1.00	0.98
Heaters, metal	-	-	-	-
Inspectors, metalworking Class B	1.32	1.31	1.03	1.11
Welders & flame cutters	1.53	1.55	0.96	0.97
Electroplaters	1.37	1.35	1.06	1.24
Electroplater helpers	1.25	1.22	1.14	1.35
Semiskilled textile occupations	-	-	-	-
Knitters, hoppers & toppers	1.03	1.03	1.00	1.00
Spinners, textile	0.78	0.59	0.54	0.43
Weavers, textile	0.95	0.98	2.50	2.67
Sewers & stitchers, manufacturing	1.15	1.14	1.07	1.16
Asbestos & insulation workers	1.39	1.36	1.08	0.99
Other operative & kindred workers	-	-	-	-
Attendants, auto parking	1.77	1.70	1.10	1.08
Blasterers & powdermen	1.22	1.16	1.38	1.13
Laundry & dry cleaning workers	1.18	1.18	1.00	0.84
Mine operatives & laborers, NEC	1.02	1.00	-	3.20
Meat cutters except meatpacking	1.32	1.24	1.33	1.33
Other operatives, NEC	1.32	1.32	1.00	1.04
Service workers	1.52	1.55	0.95	0.97
Private household workers	1.22	1.24	0.92	0.91

Table 18. (Continued)

	Overall trend (Trend A)	Area matrix trend (Trend B)	Trend A-1 / Trend B-1	Difference A / Difference B
Protective service workers	-	-	-	-
Firemen, fire protection	1.61	1.56	1.09	1.26
Policemen, marshals, sheriffs	1.88	1.85	1.02	1.16
Guards, watchmen	1.28	1.22	1.27	1.39
Waiters, cooks & bartenders	-	-	-	-
Bartenders	1.51	1.49	1.04	1.10
Cooks, except private household	1.59	1.59	1.00	1.09
Counter & fountain workers	2.49	1.72	2.07	2.26
Waiters & waitresses	1.62	1.61	1.01	1.07
Other service workers	-	-	-	-
Airline stewards & stewardesses	1.30	1.32	0.94	1.14
Attendants, hospital & others	2.09	2.07	1.01	0.93
Charwomen & cleaners	1.48	1.51	0.94	0.99
Janitors & sextons	1.17	1.16	1.06	1.18
Nurses, practical	1.92	1.90	1.02	0.94
Other service workers, NEC	1.57	1.67	0.85	0.83
Laborers, except farm & mine	1.01	0.97	-0.33	-0.35
Farmers & farm workers	0.69	0.69	1.00	0.80

reported in Table 17.

While Method A depends on the development of one trend factor for each occupation, Method B requires the use of a different trend factor for each occupation within each industry. Nevertheless, one can take the ratio of the employment requirement for 1975 calculated by Method B to 1960 total employment in the given occupation as representative of the total Method B trend in that occupation. The column marked Overall trend (Trend A) in Table 18 reports the trends for Method A, while the column marked Area matrix trend (Trend B) contains the trends implicit in Method B.

Since training programs are geared to incremental needs by occupation, the rates of growth calculated by the two methods are compared in the column marked Trend A-1/Trend B-1. Finally the differences between 1960 and 1975 employment levels calculated by the two methods are compared in the final column of Table 18.

Comparing the 1975 projected levels of employment requirements for the major occupation groups, one finds that while the projections of professional, service and labor employment requirements are larger for Method A than for Method B, those for management, clerical, sales, craft, and operative are smaller. (Because farm occupational employment in 1960 was not reconciled between the Census and BLS, the estimates for farm employment differ for the two methods. Since farm occupational employment is concentrated in one cell of the matrix a reconciliation of the two would have led to identical projections for the two methods.)

While the total projection of professionals is larger under Method A than under Method B, this is not true for all the individual professional occupations. The projections for both draftsmen and surveyors are smaller,

as are almost all of the health occupations. This same finding is true for all of the other occupation groups. The method which gives the larger projection for the total of the group does not necessarily give the larger projection for the individual occupations included in the group. The differences in projections reflect two factors. They reflect differences between the two methods in calculating trends as well as differences in estimating 1960 employment by occupation. Both trends depend on the size of industrial employment in 1960 and 1975. But while the trend for Method A is independent of both the size of occupational employment in 1960 as well as the local distribution of occupational employment across industries, the trend calculated for Method B is dependent upon the latter. The trend in Method B can be described as a weighted sum of the national occupation by industry trends where each industry's weight is its share of that occupation's total 1960 employment.

The trends can be represented mathematically as follows:

$$\text{Trend } Aj = \frac{\sum_{i=1}^{n} fij(75)Li(75)}{\sum_{i=1}^{n} fij(60)Li(60)}$$

$$\text{while Trend } Bj = \frac{\sum_{i=1}^{n} \frac{fij(75)Li(75)}{fij(60)Li(60)} Lij(60)}{\sum_{i=1}^{n} Lij(60)}$$

where fij represents the national fraction which occupation j makes up of industry i, Li equals total local employment in industry i, Lij represents local employment of occupation j in industry i, and n equals the total

number of industries.

The trends calculated by Method A and Method B will vary if (1) the 1960 distribution of local employment of occupation j across industries is different than that estimated by application of national occupational employment patterns to industry totals and if (2) the ratios of calculated 1975 to 1960 occupational employment ($\frac{fij(75)Li(75)}{fij(60)Li(60)}$) vary by industry. If the latter are the same for each industry the differences in occupational distribution across industries between Iowa and the United States will not be reflected and Methods A and B will yield identical trends. Inspection of Tomorrow's Manpower Needs, Volume IV, Appendix J (62) which reports fractions representing the change in the national occupational structure of industries (change factors) between 1960 and 1975 for selected occupations and industries reveals that, at least for the occupations included, the change factors vary a great deal from industry to industry.

Likewise application of 1960 national occupational employment patterns to Iowa's industry totals indicates that local employment patterns do differ from national, at least in some industries. Table 19 reports the major nonfarm occupational totals that would be observed (1) if Iowa's occupations were distributed as in the United States (62), (2) if Iowa's industries followed national employment patterns and (3) as they were estimated for the BLS based matrix. The differences between the first and third of these distributions reflect both differences in industry mix as well as differences in employment patterns while the second and third differ only because of employment patterns. The latter differences are rather large especially for management, sales, and labor. If the relative difference in use of an occupation between Iowa and the United States is

Table 19. Nonfarm occupational totals computed under varying assumptions

	Application of United States distribution	Application of United States occupational employment pattern	Iowa estimates for BLS I-O matrix
Professional	98,181	100,344	102,999
Management	107,334	105,568	84,747
Clerical	125,640	133,243	131,466
Sales	63,236	63,151	77,659
Craft	118,151	118,659	123,948
Operative	160,586	148,029	153,937
Service	97,350	110,893	113,040
Labor	61,572	52,163	44,254
Total	832,050	832,050	832,050

the same for all industries, then it is possible that employment patterns may differ between Iowa and the nation and nevertheless the distribution of the occupation across industries will be the same as that estimated by application of national occupational employment. But inspection of Iowa's original Census I-O does not reveal this to be the case. Both prerequisites for discovering differences in trends between the two methods appear to be satisfied.

Comparison of the results obtained for Iowa by use of Methods A and B indicates that of the 165 trends reported only 5 were less than 1.00 for one of the methods and greater than 1.00 for the other. These cases included photographers, sailors and deck hands, boilermakers and laborers which had trends greater than 1.00 for Method A and shipping and receiving

clerks which had a trend of greater than 1.00 for Method B.

Method B yielded larger trends for five of the eight major nonfarm occupational groupings. Only the professional, operative and labor trends were greater when calculated by Method A. A significant finding is that only the professional trends calculated by the two methods vary by more than 5 percentage points (four of the eight vary by only 1 percentage point) and here the spread is only 10 percentage points, the professional trend for Method A being 106% of that for Method B.

Note should also be made of the labor trend which is less than 1.00 for Method B and greater than 1.00 for Method A and the craft trend which for Method A is only 96% of that for Method B. Evidently the professional and labor distributions of occupational employment in Iowa are centered in industries which have lower ratios of calculated 1975 to 1960 employment $(\frac{fij(75)Li(75)}{fij(60)Li(60)})$ while the opposite is true for craft occupations. Table 20 summarizes the trend results for major occupations.

Table 20. Major occupation trends

	Trend A	Trend B	Trend A/Trend B
Professional	1.69	1.59	1.06
Management	1.27	1.28	0.99
Clerical	1.46	1.47	0.99
Sales	1.28	1.29	0.99
Craft	1.33	1.38	0.96
Operative	1.33	1.32	1.01
Service	1.52	1.55	0.98
Labor	1.01	0.97	1.04

As was true for the total projections the results vary within occupation groups and the method yielding the larger trend for the total occupation group does not necessarily yield the larger trend for any individual occupation within that group. For example, the professional trends for draftsmen, surveyors, social scientists, dentists and nurses were all higher for Method B, while of the craft occupations, boilermakers, millwrights, patternmakers and glaziers all had higher trends for Method A.

Table 21 summarizes by occupation an additional comparison of the results obtained by the two methods. It indicates how many of the trends varied by as much as 5 percentage points 10, 20, or more. The great majority of the trends varied by .10 or less, 123 out of 164. Thirty-three of those varying by more than .10 were in the professional or craft occupations. And it is further interesting to note that 19 of the 21 professional occupations varying by .10 or more were either separately reported in the original Iowa Census I-O or were calculated from groupings separately reported such as engineers and natural scientists. However, this is true of only 5 of the 12 craft occupations.

Table 21. Number of cases in which Trends A and B varied by a given amount

Difference between Trend A & Trend B	Professional	Management	Clerical	Sales	Craft	Operative	Service	Labor	Total
.05 or less	22	6	7	4	32	19	12	1	103
.10 or less	11		1		4	3	1		20
.20 or less	9		3		6		1		19
more than .20	12	1			6	2	1		22
Total	54	7	11	4	48	24	15	1	164

It might be pointed out that although, in preparing the area matrix, the disaggregation of occupational data within industries was based on national occupational employment patterns, the national employment patterns of individual occupations within a group were expressed as a percentage of the total national employment pattern in that group and the results were applied to occupation by industry totals. This means that to the extent that occupational group totals differ from that indicated by application of national patterns to industry totals the distribution of any individual occupations employment across industries will also be different from that calculated by application of national occupational employment patterns to industry totals.

Table 18 also reports the ratio of Trend A-1 to Trend B-1. In this way the relative difference between the growth rates calculated by the two methods is isolated. This tends to magnify the percentage point differences found between the calculated trends. For example, the professional trend for Method A, 1.69, is 106% of that calculated for Method B, 1.59, but the growth rate for Method A, 69%, is 117% of the growth rate implied by Method B. Nevertheless, this was felt to be a relevant measure since it enables one to quantify the percentage differences in the incremental rates implied by the two measures. For example, in the professional occupations, 69 new people per 100 already in the occupation in 1960 will have to be drawn into the occupation to achieve the requirement projected for 1975 by Method A, but only 59 per 100 will have to be found to achieve the requirement projected by Method B. Of the 31 occupations in which the ratio of the growth rate of Method A to Method B is greater than 1.25 or less than 0.75, 14 are in the craft group, 7 in the professional group, and 5 in the

operative group.

Finally, since the incremental needs associated with the two sets of projections vary both because of differences in the 1960 occupational employment estimates as well as because of differences in trend, the incremental need determined by Method A was expressed as a ratio to that determined by Method B. The results are reported in the last column of Table 18 marked Difference A/Difference B. In 121 of the 164 cases the ratio of the Difference A to Difference B fell within the range from 1.25 to 0.75. Of the other 43 cases 15 were professional, 16 were craft, and 6 were operative occupations. It might also be noted that there were over 30 cases for which the ratio of the differences was greater than 1.00, while the ratio of the growth rates was less than 1.00, or vice versa. For these cases the 1960 employment estimate was larger for the method having the smaller growth rate and enough so to yield a larger estimate of incremental need.

What overall conclusion concerning the two methods can be made? In view of the relative simplicity of Method A it seems to have done very well in comparison to Method B. Almost all the results were in the same direction. The large majority of the calculated trends were very close, as were the majority of the growth rates and levels of incremental needs. The occupations for which the greatest number of poor results were found were in the professional and craft groups.

The choice of method would seem to depend on the amount of time and resources available as well as on the degree of accuracy required. The results seem to indicate that calculation of Method B trends for a condensed area matrix comprised of only major occupational totals would not

give a particularly good clue to the direction of error involved in individual occupations since these varied a great deal. In view of the fact that the largest variation between Method A and Method B trends were found in the professional and craft groups for which the greatest original Iowa Census I-O information was available, a matrix limited to the occupations contained in the Census might be a reasonable compromise between complete reliance on Method A and the development of a full 165 x n matrix (where n equals the number of industries to be included).

Changes in the Distribution of Occupational Employment

Turning again to the results obtained by Method B and comparing these to the 1960 occupational distribution of employment, one finds that because of the large decrease in the share of employment made up of farmers and farm workers, the shares of all other occupations except laborers will increase.

Expressing the eight nonfarm occupations as a ratio to total nonfarm employment requirements one finds that the professional, clerical and service occupations will increase their shares while the management, sales, craft, operative and labor occupations will decrease. These results are displayed in Table 22.

Growth Occupations

Finally, Table 23 identifies what may be referred to as growth occupations. The latter are defined as those occupations whose trend is equal to or greater than the overall trend for nonfarm occupations, 1.39. Nearly 75% of the professional occupations included in the study satisfy this

Table 22. Occupational distribution of Iowa employment, 1960 and 1975

	1960 total employment	1975 total employment	1960 nonfarm employment	1975 nonfarm employment
Professional	.0930	.1216	.1238	.1416
Management	.0765	.0804	.1018	.0937
Clerical	.1187	.1431	.1580	.1666
Sales	.0701	.0745	.0933	.0868
Craft	.1119	.1267	.1490	.1476
Operative	.1390	.1504	.1850	.1751
Service	.1021	.1301	.1359	.1516
Labor	.0400	.0318	.0532	.0370
Farm	.2487	.1415	-	-
Total	1.0000	1.0000	1.0000	1.0000

criteria, as do over 70% of the service occupations. While the occupations in the table refer to Method B results, it might be noted that each of these occupations also had trends of 1.39 or above for Method A. In addition, other natural scientists, millwrights, patternmakers, inspectors, log and lumber, and asbestos and insulation workers had trends of 1.39 or greater for Method A. Of the 79 growth occupations 13 had trends of greater than 2.00 for Method B. The 13 are marked with a check in Table 23. These occupations also had trends of greater than 2.00 for Method A. Aeronautical, industrial and metallurgical engineers also had trends of greater than 2.00 but for Method A only, as did chemists, cashiers and counter workers.

According to Method B, the fastest growing occupations in order of their trend are mathematicians, biological scientist, college teachers,

Table 23. Growth occupations

Professional, technical & kindred
- Engineers, aeronautical
- Engineers, chemical
- Engineers, civil
- Engineers, electrical
- Engineers, industrial
- Engineers, mechanical
- Engineers, metallurgical
- Engineers, mining
- Engineers, other technical √
- Chemists
- Agricultural scientists
- Biological scientists √
- Geologists & geophysicists √
- Mathematicians √
- Physicists √
- Draftsmen
- Surveyors
- Radio operators
- Technicians, other √
- Nurses, professional
- Pharmacists
- Physicians
- Psychologists √
- Technicians, medical & dental √
- Chiropractors & therapists
- Teachers, secondary
- Teachers, other
- Teachers, college √
- Economists
- Statisticians & actuaries
- Social scientists, other √
- Accountants & auditors
- Artists, athletes, entertainers & authors
- Designers, except design draftsmen
- Lawyers & judges
- Librarians
- Personnel & labor relations workers
- Social & welfare workers
- Professional, NEC

Management
- Creditmen
- Officers, pilots, engineers, ship
- Purchasing agents

Clerical & kindred
- Stenographers, typists, secretaries
- Office machine operators √

Table 23. (Continued)

Bank tellers
Cashiers
Clerical & kindred, NEC
Craft
Cement & concrete finishers
Excavating, grading machine operators
Structural metalworkers
Foremen, NEC
Rollers & roll hands
Mechanics, except railroad & car shop
Photoengravers & lithographers √
Cranemen, derrickmen & hoistmen
Glaziers
Jewelers & watchmakers
Opticians & lens grinders
Inspectors, other
Upholsterers
Craft & kindred, NEC
Operatives & kindred workers
Assemblers A
Furnacemen, smeltermen, pourers
Welders & flame cutters
Attendants, auto parking
Service workers
Firemen, fire protection
Policemen, marshals, sheriffs
Bartenders
Cooks, except private household
Counter & fountain workers
Waiters & waitresses
Attendants, hospital & others √
Charwomen & cleaners
Nurses, practical
Service, NEC

office machine operators, physicists and medical and dental technicians. The list of fastest growing occupations differs for Method A. It excludes biological scientists and office machine operators but includes psychologists and counter and fountain workers.

It might be noted that the results reached were consistent with several

local studies of specific occupations. The latter employer surveys uncovered current and projected vacancies for radio-television servicemen, automobile mechanics, and lithographers. Stereotypers, on the other hand, were relatively free of current shortages (10, 22, 39, 43, 88).

Replacements

In addition to increments in occupational need created by changes in the size and structure of industries between 1960 and 1975, a considerable amount of openings will occur as people already in the labor force die and retire. Since persons planning educational programs must be aware of openings resulting from these sources as well as openings resulting from industrial change, estimates of replacement needs between 1960 and 1975 are reported in Table 17 for most of the occupations in that table.

The first step in developing 15 year estimates of replacement needs was to calculate annual separation rates for each of the occupations. Separation rates by age by sex from the U.S. Department of Labor's Working Life Tables (83, 84) were applied to occupational data by age by sex obtained from the Iowa Census (68, Table 123). The Census reports occupational data by age for the following age groups: 14-19, 20-24, 25-29, 30-34, 35-44, 45-54, 55-59, 60-64, and 65+. The annual separation rates from the Working Life Tables were therefore calculated for similar intervals. The gross number of separations calculated for females was adjusted for the likely reentry of 14-34 year olds into the labor force.[1] This net calculation of female separations was then added to male separations and expressed

[1]It was assumed that 60% of the females 14-34 years old who separated from the labor force would reenter during the period (3).

as a ratio to total 1960 employment in order to obtain annual separation rates. Note that calculations of separation rates in this manner take into account the different age distributions of occupations but not the specific characteristics of the occupations. A few studies have indicated, however, that the results obtained by this method are reasonably accurate (59).

Since Iowa age by occupation data was available for only 66 of the male and 35 of the female occupations included in this study, national annual separation rates by occupations had to be used for the remaining occupations (59, Appendix A).

The annual rates were then turned into estimates of 15 year rates by use of the following formula:

$$\text{15 year rate} = r\,\frac{(1-R^{15})}{1-R}$$

where r equals the annual separation rate, R^{15} equals $\frac{\text{1975 occupational employment}}{\text{1960 occupational employment}}$, and R equals the annual average ratio of change in employment. For a justification of this formula see Technical Manpower in New York State (34). Multiplication of these rates by 1960 employment resulted in the estimates of deaths and replacements reported in Table 17. The rates vary considerably but most are in the neighborhood of from 25 to 30% of 1960 employment. Also because the trend of employment between 1960 and 1975 varies among occupations, the relative shares of openings due to industrial change and to deaths and retirements differ from occupation to occupation. Most of the separation figures are about 25 to 30% of the openings due to industrial change, but there are also many cases in which separations are over 100% of the latter.

SUPPLY

The Model

Since data on job openings due to industrial growth and to deaths and retirements are difficult to assess without at least some rough indication of the number of persons available for employment, the experience of the male labor force between 1950 and 1960 was examined for the nine major occupations.[1] The method used was based on the work of Abram J. Jaffee and R. O. Carleton as developed in their book, Occupational Mobility in the United States, 1930-1960 (23).

Examination of the movement of males into and out of the labor force as well as among occupations during the decade from 1950 to 1960 enabled projections of the male labor force by occupation to be made for 1970. The rates of change by occupation from 1960 to 1970 were then examined to obtain an indication of the occupational structure of the total labor force in 1975.

The model used to project the male labor force from 1960 to 1970 was as follows:

$$O_2 = O_1 - D + NE - R \pm NM$$

where O_2 and O_1 are the numbers observed in a given occupation and age cohort at the beginning and end of the decade, D is intercensal deaths among the occupational cohort, NE is intercensal new entries, R is retirements, and NM is net mobility. The magnitude of each component for each occupation and age cohort was estimated for the decade from 1950 to 1960 and used to project the occupational structure of the labor force to 1975.

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[1] Farm laborers and farm management were also studied separately.

Census Survival Rates

Since census data was used in the model, one of the first things which had to be estimated was census survival rates for males from 1950 to 1960. These were calculated as the number in the age cohort at the end of the decade divided by the number in the age cohort ten years younger at the beginning of the decade. For example, the census survival rate for males whose age changed from 15 to 19 to 25 to 29 during the decade was computed as:

$$\frac{\text{Males 25 to 29 in 1960}}{\text{Males 15 to 19 in 1950}}$$

Deaths estimated in this way are net deaths, i.e. gross deaths plus or minus gains or losses due to migration, underenumeration and misreporting of age. It should also be noted that the application of the same survival rates to all occupations for a specified cohort implies the assumption that occupational survival differentials are negligible.

The survival rates for 1950 to 1960 were calculated for age groups for which survival rates from 1960 to 1970 could be most easily estimated. Since the latter depend on population projections to 1970 the age groups into which the population projections were readily separable determined the age groups used for the survival rates. The survival rates for 1950 to 1960 and 1960 to 1970 are reported by age cohort in Table 24. The sources for the calculations were the 1950 Census for Iowa, the 1960 Census for Iowa and the population estimates of the Bureau of the Census.[1] (65, Table 51, 68, Table 94, 79, Table 6, Series II-B)

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[1]The Series II-B estimates assume a moderate increase from present levels in national fertility and that migration rates will change from recent levels so as to result in no net migration among States in 50 years.

Table 24. Census survival rates for Iowa

Age of cohort at beginning of decade	1950 to 1960	1960 to 1970
4 to 7	.9333	.9165
8 to 11	.7129	.7503
12 to 14	.7051	.7381
15 to 19	.8103	.8516
20 to 24	.8762	.8995
25 to 34	.8951	.9320
35 to 44	.9299	.9667
45 to 54	.8717	.7611
55 to 64	.7569	.7344
65 and over	.3781	.3707

Labor Force Participation Rates by Age by Occupation[1]

Another set of figures which had to be estimated were labor force participation rates by age by occupation for each year between and including 1950 to 1960. While rates for all ages were needed for 1950 and 1960, intercensal year rates were needed only for those age groups subject to new entries or retirements.

While total male civilian labor force participation rates and unemployment rates are available by single years of age from 14 to 24, they are available for only five year intervals starting with age 25-29. In addition, data on the employed labor force by age by occupation are available for the following age intervals: 14 and 15, 16 and 17, 18 and 19, 20 to 24, 25 to 29, 30 to 34, 35 to 44, 45 to 54, 55 to 59, 60 to 64, and 65

[1]Unless otherwise noted the data were obtained from the 1950 Census of Iowa and the 1960 Census of Iowa (65, 68).

and over. The age data by occupation were used to obtain labor force participation rates by age by occupation for single years of age from 14 to 24 and by five year intervals thereafter. For example, first approximation to these rates for 14 year old professionals were calculated in the following manner:

$$\frac{\text{Employed professionals 14 and 15} \times \frac{\text{Total employed 14 year olds}}{\text{Total employed 14 and 15 year olds}} \times \frac{1}{\text{Employment rate for 14 year old professionals}}}{\text{Total number of 14 year olds}}$$

Thus the 14 year old's share of professional 14 and 15 year old employment was assumed to be proportional to its overall share of 14 and 15 year old employment. The estimate of employed professionals was then multiplied by 1/employment rate for 14 year old professionals to obtain an estimate of the 14 year old professional labor force. The latter when divided by the total number of 14 year olds provided an estimate of the labor force participation rate for professional 14 year olds. This was done for each of the occupations included in the study to provide a complete set of labor force participation rates for 14 year olds. Similar computations were performed for 15, 16, 17, 18, 19, 20, 21, 22, 23 and 24 year olds as well as for the age groups 25 to 29, 30 to 34 and so on.

The employment rates by age by occupation used in the above computations were calculated in the following manner:

$$\text{Employment rate for age X for occupation Y} = \frac{\text{Total employment rate for age X}}{\text{Total employment rate for all ages}} \times \text{Employment rate for all ages for occupation Y}$$

The labor force participation rates by age by occupation calculated in the above manner were then prorated to equal the total civilian labor force participation rates by age as reported in the Census.

While rates for 1950 and 1960 were all that were necessary for some age groups, for each single year of age between 14 and 24 it was necessary to calculate labor force participation rates by occupation for each of the intercensal years. This was done by assuming a linear trend over the decade. The difference between the 1960 and 1950 rate for a given age and occupation was thus divided by 10 and added in successive steps to the 1950 rate.

Since labor force participation rates were available only for five year intervals starting with ages 25 to 29, the rates examined for retirement estimates were much more restricted. Here it was feasible to develop rates only for 1950, 1955 and 1960.[1] This was done for those 50 to 54 years old as well as those 55-59, 60-64, 65-69, 70-74 and over 75.

New Entries

New entries for a single year age cohort in a specified year were estimated as the difference between the occupational distribution of the cohort in the specified year (observed) and its estimated occupational distribution at the same time one year earlier (expected). Mortality, of course, must be allowed for. It was possible, however, to use the size of the cohort in 1950 throughout. Thus estimates were obtained of new entries under the assumption that no deaths occurred to the cohort during the decade

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[1]This is so because as the age of the 50 to 54 year old cohort in 1950 changed to 51 to 55 in 1951, there would be no rates to measure their activity with in 1951.

and the sum of all these estimates was then survived at once with the ten-year census survival rates.

The method is best illustrated by an example. The cohort which was 8 years old in 1950 turned 14 in 1956, 15 in 1957, 16 in 1958, 17 in 1959 and 18 in 1960. New entries from the 8 year old cohort in 1950 were estimated by the difference between the observed labor force which was 14 in 1956, 15 in 1957 and so forth and the expected labor force in these years. The observed ages 14 to 18 in 1956 to 1960 were obtained as the product of the total population age 8 in 1950 and the participation rates of ages 14, 15, 16, 17 and 18 in 1956, 1957, 1958, 1959 and 1960 respectively. These are the numbers which would have been observed had there been no deaths to the cohort since the 1950 Census. The observed were then assumed to be the expected one year older and one year later. For example, the observed age 16 in 1958 were taken to be the expected age 17 in 1959 since this is the number which would be observed if there were no further entries during the year, i.e., it is the number expected. New entries from the male cohort age 8 in 1950 as it changed from age 16 to 17 were then calculated as the difference between the observed age 17 in 1959 and the observed age 16 in 1958. The exception to this was for the 14 year olds since the observed at age 14 are assumed to be all new entries at age 14.

The calculated new entries for the male cohort age 8 in 1950 are recorded in Table 25. Since there were certain occupations for which new entries were estimated to be negative in 1960 it was necessary to make some adjustment. It was assumed that while the volume of net mobility (2,251, the sum of the plus and minus figures) was correct, the number of new entrants into sales and farm labor were zero rather than minus. Thus

Table 25. New entries from cohort age 8 in 1950

	New entries 14 in 1956= observed 14 in 1956	New entries 15 in 1957= observed 15 in 1957- observed 14 in 1956	New entries 16 in 1958= observed 16 in 1958- observed 15 in 1957	New entries 17 in 1959= observed 17 in 1959- observed 16 in 1958	Unadjusted new entries 18 in 1960= observed 18 in 1960- observed 17 in 1959	Adjusted new entries[a] 18 in 1960
Professional	30	9	19	18	464	210
Management	19	4	8	6	102	46
Clerical	166	53	137	92	564	255
Sales	963	192	218	396	-908	-
Craft	147	244	-	94	1,150	520
Operative	524	168	436	279	2,352	1,064
Service	496	134	282	253	106	60
Labor	718	262	532	383	39	18
Farm management	144	47	88	99	173	78
Farm labor	2,613	474	877	819	-1,791	-
Total					2,251	2,251

[a]The positive values in the previous column were multiplied by $\frac{2,251}{4,950}$.

the sum of the positive estimates, 4,950, which was swollen by the negative new entry figures, 2,699, had to be reduced by this amount.

Similar calculations were undertaken for all single age cohorts who became 14 to 24 during the decade. Thus the calculations began with the 4 year olds in 1950 who turned 14 in 1960 and continued through to the 23 year olds in 1950 who became 24 years old in 1951. It was assumed that no new entries occurred after each cohort had reached age 24. The estimates of new entries during the decade from each cohort were then summed and were combined for those 4-7, 8-11, and 12-14 in 1950.

It should be noted that the while the total new entries estimated in this manner is unaffected by net mobility, for individual occupations the estimate of new entries will be a net estimate in the respect that it signifies the gain through gross new entries plus or minus the gain or loss through net mobility as well as minus the loss through gross withdrawals.

Retirements

Computations for retirements were the same as for new entries except that the observed were subtracted from the expected rather than vice versa. Estimates of retirements were made for the cohort age 45 to 49 in 1950 as its average age changed from 50 to 54 in 1955 to 55 to 59 in 1960. The observed were equal to the product of the number age 45 to 49 in 1950 times the labor force participation rates of 55 to 59 year olds in 1960. The expected in 1960 were equal to the observed in 1955 where the latter were calculated as the product of the number age 45 to 49 in 1950 times the labor force participation rates of those 50 to 54 in 1955.

Similar calculations were made for those 50 to 54, 55 to 59, 60 to 64, 65 to 69, 70 to 74 and 75+ in 1950. The results were then summed for each cohort and combined for those 45 to 54, 55 to 64, and 65 and over.

Adjustments for negative retirement figures were similar to those made for negative new entries. Likewise it should be noted that the estimate of retirements is a net figure equal to gross retirements minus whatever gross new entries or re-entries may have occurred.

Net Mobility

In order to estimate net mobility by age by occupation for the decade from 1950 to 1960 it was necessary (1) to survive O_1, the number observed at the beginning of the decade to the end of the decade via the application of the census survival rates so as to estimate the number of deaths, (2) to survive new entries and retirements in the same manner and (3) to adjust the estimated number of deaths to allow for differential survival experience between the total male population and those participating in the labor force.

The figures for those 12 to 14 years old in 1950 provide an example of the procedure for cohorts who supplied new entries during the decade from 1950 to 1960. The overall model is:

$$O_2 = O_1 - D + NE - R \pm NM$$

while net mobility is calculated as

$$NM = O_2 - O_1 + D - NE + R$$

for those under 45 retirements drop out of the equation and

$$NM = O_2 - (O_1 + NE - D)$$

For those 12 to 14, the quantity in parentheses was calculated by summing

by occupation the observed in 1950 and the new entries during the decade and applying to these figures the appropriate census survival rate.[1] The results of these calculations appear in Table 26 in the column marked Expected 1960. The expected in 1960 is thus equal to the sum of the survivors of the observed in 1950 plus the survived new entrants. These expected figures had to be adjusted, however, to make the total of the expected equal to the total of the observed in 1960. The difference between the two as originally calculated can be attributed to differences in the survival experience of those in and out of the labor force. This difference was adjusted by prorating it among the several occupations according to their size. The results are reported in the column of Table 26 marked Expected adjusted (E_A). Net mobility was then calculated as the difference between those observed in 1960, O_2, and the expected adjusted, E_A, in 1960.

Similar computations were calculated for those 4 to 7, 8 to 11, 15 to 19, and 20 to 24 in 1950. For those 4 to 7 and 8 to 11 in 1950 the observed in 1960 were taken to be zero. Thus only new entries had to be survived and adjusted.

For those 25 to 34 and 35 to 44 in 1950 neither new entries nor retirements were estimated so the expected in 1960 were equal to the survived O_1 from 1950.

Finally for those 45 to 54, 55 to 64 and 65 and over in 1950, the expected were equal to the survived of those observed in 1950 minus those who retired during the decade, i.e. $(O_1 - R)$ x Census Survival rate. The expected were adjusted to make their total equal to the total of the

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[1] See Table 24.

Table 26. Net mobility of males age 12 to 14 in 1950

	(1) O_1 1950	(2) Unsurvived new entries 1950 to 1960	(3) Expected 1960 = [(1) + (2)] x Census Survival Rate	(4) O_2 1960	(5) E_A Expected adjusted[a]	(6) NM Net mobility (4) - (5)
Professional	18	2,646	1,878	3,513	1,845	1,668
Management	20	872	629	1,329	618	711
Clerical	93	3,052	2,218	3,005	2,180	825
Sales	1,013	4,106	3,609	2,289	2,546	-1,257
Craft	52	6,414	4,559	6,296	4,480	1,816
Operative	286	10,670	7,725	10,263	7,591	2,672
Service	367	3,179	2,500	1,869	2,457	-588
Labor	353	5,267	3,963	3,467	3,894	-427
Farm management	77	2,386	1,737	3,422	1,707	1,715
Farm labor	2,939	12,196	10,672	3,353	10,488	-7,135
Total			39,490	38,806	38,806	0

[a]Calculated by multiplying expected figures by 38,806/39,490.

observed in 1960, O_2. And the differences between the O_2 and expected adjusted, E_A, were taken as the estimates of net mobility.

It must be pointed out that net mobility calculated in this manner for the cohorts still experiencing new entries during the decade is really only a residual. Net mobility was estimated by the difference between adjusted expected and observed at the end of the decade. Actually, however, it was estimated as the second difference between expected and observed since new entries were also estimated, prior to net mobility, as the difference between observed and expected.

Intercensal Deaths

An estimate of intercensal deaths which referred only to the observed at the beginning of the decade and which at the same time took into account the adjustment made because of the survival differential, was obtained by raising or lowering each O_1 by the factor used to adjust the expected at the end of the decade (observed at the end of the decade divided by expected at the end of decade) and then multiplying by the appropriate census survival rate, thereby obtaining the survivors of O_1. Deaths were then estimated as those who did not survive. Estimates of survived new entries and retirements were obtained in a similar manner.

The data for each of the 10 age cohorts studied were then arranged in terms of the original model so that their experience from 1950 to 1960 could be easily examined and expressed as rates. The data for those age 12-14 in 1950 are presented in Table 27. Here O_2 is seen to be O_1 - D + Survived NE $\pm$ Net Mobility.

Table 27. Components of occupational change for males 12 to 14 in 1950

	O_2 =	O_1 -	D +	NE +	NM
	Observed in 1960	Observed in 1950	Deaths	Survived new entries	Net mobility
Professional	3,513	18	6	1,833	1,668
Management	1,329	20	6	604	711
Clerical	3,005	93	29	2,115	825
Sales	2,289	1,013	311	2,845	-1,257
Craft	6,296	52	16	4,444	1,816
Operative	10,263	286	88	7,393	2,672
Service	1,869	367	113	2,203	-588
Labor	3,467	353	108	3,650	-427
Farm management	3,422	77	24	1,653	1,715
Farm labor	3,353	2,939	903	8,451	-7,135
Total	38,806	5,218	1,604	35,191	0

Rates Used for Projections

For the projections to 1970, O_1 in 1960 was taken as given while deaths, new entries, retirements and net mobility were estimated based on the experience from 1950 to 1960. Rates of change for these components were calculated and applied to the observed in 1960. The rates used are explained below.

Deaths

Deaths were estimated by the census survival rates calculated for the decade from 1960 to 1970 and reported in Table 24.

New entries

New entry rates were calculated as the ratio of the survived intercensal new entries in each occupation to the total survivors of those not in the working force at the beginning of the decade. These rates thus express the proportion of all those exposed to the probability of entering who actually did enter. For example, the total survivors of males 12 to 14 in 1950, 42,954, were the number of males 22 to 24 in 1960. When the number of those observed in the labor force in 1950 was survived, ($O_1 - D = 3,614$) and subtracted from this figure the total survivors of those not in the labor force at the beginning of the decade, 39,340, were obtained. New entries rates between 1950 and 1960 for the cohort age 12 to 14 in 1950 were then obtained by expressing each of the new entry figures by occupation as a ratio to 39,340.

Retirements

Retirement rates for each cohort were computed as the number of survived and retired in an occupation out of all those of that cohort in the occupation at the beginning of the decade who survived to the end. (Thus the denominator for each rate was different as well as the numerator.)

Net mobility

While the net mobility rates were such that there would never be more out mobility from an occupation than there were in the occupation at the beginning of the period nor would there be extremely large in-mobility, net in-mobility was not necessarily equal to net out-mobility and therefore had to be adjusted.

The net out-mobility rates for an occupation were taken as the ratio

of those who moved out of an occupation to the expected adjusted in that occupation at the end of the decade since the latter indicate the number which would be observed if there was no net mobility.

The net in-mobility rates, on the other hand, were taken as the ratio of those who did move into an occupation to the sum of all those who were in all the occupations having out-mobility and who survived to the end of the decade since the latter provide the source of net in-mobility. An example of how net mobility rates were calculated for males age 12 to 14 in 1950 is illustrated in Table 28. The expected adjusted and net mobility figures are the same as in Table 26. The figures in the column marked "exposed to net mobility" are identical to expected adjusted for occupations having out-mobility and equal to the sum of expected adjusted of the occupations having net out-mobility for those having net in-mobility. The rates are then equal to net mobility divided by those exposed to net mobility.

Projections for Males Age 12 to 14 in 1960

An example will be used to illustrate the projections. For those age 12 to 14 in 1960, the census survival rate of .7381 was used to survive those observed at the beginning of the decade to the end of the decade. The new entry rates for those 12 to 14 in 1950 were applied to 53,048, the estimate of the survived of those not in the labor force at the beginning of decade, in order to obtain estimates of new entries by occupation. (For those cohorts exposed to retirements the number of survived retirements were estimated by the product of each occupational retirement rate and the number of estimated survivors in the occupation.) For 12 to 14 year olds in 1960, the expected in 1970 under the assumption of no net mobility was then the

Table 28. Net mobility rates for males age 12 to 14 in 1950

	E_A Expected adjusted	E_{NM} Exposed to net mobility	NM Net mobility	NM/E_{NM} Net mobility rate
Professional	1,845	20,385	1,668	.0818
Management	618	20,385	711	.0348
Clerical	2,180	20,385	825	.0404
Sales	3,546	3,546	-1,257	-.3514
Craft	4,480	20,385	1,816	.0890
Operative	7,591	20,385	2,672	.1310
Service	2,457	2,457	-588	-.2393
Labor	3,894	3,894	-427	-.1096
Farm management	1,707	20,385	1,715	.0841
Farm labor	10,488	10,488	-7,135	-.6803

sum of the survived 0_1 and survived NE. For out-mobility occupations those exposed to net mobility were equal to the expected in 1970. For in-mobility occupations the exposed to net mobility figure is the sum of the expected in the out-mobility occupations, 26, 182. The net mobility figures were then estimated as the product of those exposed to net mobility in the occupation times the mobility rate for that occupation. The out-mobility figures were adjusted slightly upward so that the volume of out-mobility was equal to that of in-mobility.

The estimates of the occupational structure of males 22 to 24 years old in 1970 was then equal to the sum of the survived 0_1 (0_1 - D) plus new entries plus net mobility. The relevant figures are recorded in Table 29.

Table 29. Projections to 1970 for males age 12 to 14 in 1960

	O_1 Observed in 1960	O_1-D Survived to 1970	NE New entries to 1970[a]	Exposed to net mobility[b]	Adjusted net mobility	O_2 Estimated for 1970
Professional	34	25	2,472	26,182	2,142	4,639
Management	15	11	817	26,182	911	1,739
Clerical	192	142	2,854	26,182	1,058	4,054
Sales	782	577	3,835	4,412	-1,646	2,766
Craft	190	140	5,994	26,182	2,330	8,464
Operative	609	450	9,968	26,182	3,430	13,848
Service	510	376	2,971	3,347	-797	2,550
Labor	865	638	4,923	5,561	-609	4,952
Farm management	169	125	2,228	26,182	2,202	4,555
Farm labor	1,988	1,468	11,395	12,863	-9,021	3,842
All occupations		3,952				
Total population		57,000				
Not in working force		53,048				

[a]New entries for 12 to 14 year olds times 53,048.

[b]The out-mobility occupations were assumed to be the same as in 1950 to 1960.

Total Projections by Occupation for Males to 1970

Calculations such as those described above were performed for those 4 to 7, 8 to 11, 12 to 14, 15 to 19, 20 to 25, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 and over in 1960. The results were then summed by occupation to get an estimate of the overall occupational structure of the male labor force in 1970.

It might be noted that the out-mobility occupations were most often

sales, service, labor and farm labor for the younger age age groups, while labor, farm management and farm labor were most often out-mobility occupations for the older groups.

Total Projections by Occupation for Males to 1975

Half of the rates of change by occupation between 1960 and 1970 were applied to the 1970 projections in order to obtain an estimate of the occupational structure of the male labor force in 1975. The data for 1960,[1] the projections to 1970, the half decade rates of change and the estimates for 1975 are reported in Table 30. The total estimated in this manner, 759,010, was lower than the total reached when independently made labor force participation rate projections (24) were applied to the population data (79) used to calculate the census survival rates, 796,299. The 759,010 figure was thus prorated to equal 796,299.

Projections by Occupations for Females to 1975

Estimates of females by occupation to 1975 were calculated by means of the following formula:

$$\frac{\frac{\text{Females 1960}}{\text{Females 1950}}}{\frac{\text{Males 1960}}{\text{Males 1950}}} \times \frac{\text{Males 1975}}{\text{Males 1960}} = \frac{\text{Females 1975}}{\text{Females 1960}}$$

The relative difference between male and female rates of growth 1950 and 1960 were thus assumed to hold for 1960 to 1975. The rates of growth for females between 1960 and 1975 are recorded in Table 30 as are the

[1] These data are the numbers developed by application of labor force participation rates by age to occupation by age data contained in the Census.

Table 30. Occupational estimates of the male labor force, 1960, 1970, 1975 and females for 1975

	Males 1960	Males 1970	Half decade rates of change	Males 1975	Females 1975 / Females 1960	Females 1975	Total labor force, 1975
Professional	56,291	71,219	.1325	84,607	1.3720	61,573	146,180
Management	71,094	65,922	-.0363	66,642	1.0026	10,225	76,867
Clerical	38,103	41,608	.0459	45,649	1.6160	142,067	187,716
Sales	48,731	51,622	.0296	55,754	1.2115	33,447	89,201
Craft	119,016	128,205	.0386	139,677	1.1486	3,752	143,429
Operative	125,106	146,263	.0845	166,395	1.4320	47,273	213,668
Service	34,159	36,848	.0393	37,992	1.5665	123,020	161,012
Labor	45,249	43,899	-.0149	45,364	.8060	1,267	46,631
Farm management and labor	196,865	161,435	-.0899	154,219	.8821	13,789	168,008
Total	734,614	747,021		796,299		436,413	1,232,712

estimates of the female and total labor force by occupation for 1975. The female figures were prorated from the originally calculated level of 458,632 to agree with the 436,413 figure obtained from independent labor force and population estimates.

Adjustments for Unemployment and Dual Jobholding

It was desired to compare the occupational structure of the labor force as estimated above with the estimates of occupational employment requirements developed by use of the national industrial-occupational matrices for 1960 and 1975. Since the latter exclude the unemployed but include double jobholders the labor force projections developed in this chapter were adjusted to account for these two factors.

The sums of the male and female labor force by occupation were first multiplied by appropriate employment rates. The employment rates by occupation were estimated by taking the relationship between the given occupations' employment rate in 1960 and the overall rate in 1960 and multiplying this ratio by a rate of .975. The latter assumes that the unemployment rate in Iowa will be .025 in 1975. This rate was chosen for illustrative purposes since the rate for Iowa has typically been below that of the nation and has been below 3% since 1962 (82).

The employment rates by occupation are listed in Table 31. The product of these figures times the labor force estimates differed by only 19 from the assumed overall employment level. The individual figures were thus increased by 19. These figures are reported in Table 31 in the column marked Availables for employment, 1975. These figures were then adjusted for dual jobholding (18). Each employment figure was multiplied by its rate of

Table 31. Comparison of employment requirements to estimates of availables for employment

	Employment rates, 1975	Availables for employment 1975	Availables for jobs 1975	Employment requirements 1975	BLS matrix totals times Census rates of increase
Professional	.999	146,034	155,664	163,775	148,638
Management	.998	76,713	82,473	108,355	83,395
Clerical	.986	185,088	189,807	192,742	189,761
Sales	.988	88,131	93,361	100,417	91,956
Craft	.957	137,262	143,512	170,681	145,775
Operative	.945	201,916	209,187	202,588	206,076
Service	.976	157,148	165,885	175,306	159,546
Labor	.906	42,267	44,180	42,809	44,339
Farm management and labor	.996	167,336	220,164	190,593	234,726
Total	.975	1,201,894	1,304,322	1,347,266	1,304,322

doublejobholding to obtain an estimate of the number of persons employed in that occupation who held a second job. These figures were then summed and multiplied by the percent distribution by occupation of secondary jobholders to obtain an estimate of the number of secondary jobholders employed in each occupation. The totals of the employed by occupation plus the secondary jobholders by occupation are recorded in the column marked Availables for jobs, 1975.

Since the census count of farmers and farm workers in 1960 was so much below the count of the Department of Agriculture the availables for employment figure for agriculture was multiplied by the ratio of the 1960 agriculture figure used in the BLS area matrix to the 1960 agriculture figure obtained from the census, 1.3157. This brought the agriculture figure for 1975 to 220,164 and raised the overall availables for jobs total from 1,264,671 to 1,304,232.

Comparison to Employment Requirements

The results indicate that based on the population projections for Iowa (79), the labor force participation projections for Iowa (24), assuming a 2.5% unemployment rate and the dual jobholding experience of the 1960's (18) the number of availables for jobs will fall approximately 43,000 short of the number previously projected as required. In addition no estimate was made of the migration of jobholders out of the state to work which accounted for about 6,000 persons in 1960.

There are numerous ways in which the approximately 3.7% shortage of availables could be made up. Movement of people into the state to live and/or to work could be encouraged and in particular movement of young people

out of the state could be discouraged. The low census survival rates for young people reported in Table 24 reflect the extent to which they now leave Iowa. Furthermore, labor force participation rates do respond to economic opportunities and these may increase. Finally, rates of dual jobholding could increase to supply some of the deficiency.

Also of interest is the degree to which those available for jobs match the occupational structure of those required for jobs. The availables fall short of the required in all occupations except for operative, labor and farm. The shortages are particularly large for management and craft occupations, as well as for service and professionals.

Similar results were obtained when the percentage rate of increase between the occupational projections based on census data to 1960 census estimates of employment adjusted for dual jobholding were applied to the 1960 occupational employment totals used in the 1960 BLS area matrix. These figures were constrained to equal 1,304,322 and are reported in the last column of Table 31. With these figures the shortage of professionals, sales, and service occupations is increased while the excess of operatives is decreased.

These projections are based on the experience from 1950 to 1960. Unfortunately several years have passed since 1960 and the experience during these years could not be taken into account since no current occupational data by states is available. Since labor force participation rates are adaptive to changing employment requirements (14) it is only reasonable to expect that some of the shortages and surpluses uncovered by these projections will have been responded to by the population. Likewise the beginning of the Area Vocational School system in Iowa should have increased

the sensitivity of labor force participation to changes in the size and structure of Iowa's industries. Nevertheless the projections do direct attention to the occupations which may be most out of balance. Shortages of management and craft personnel, in addition to professionals seem particularly likely.

Educational Attainment

Gilpatrick makes the point that our labor force has proved itself amazingly adaptive (14, p. 93), while Mangum and Nemore point out that the "provision of better education and broader skills is a more than adequate substitute for detailed projections of the supply of narrowly defined skills." (29, p. 12) With this in mind, the adequacy of the educational attainment of the labor force of Iowa projected to 1975 was compared to the educational levels implied by the employment requirements projected to 1975 to get a rough idea of how well the former is suited to the latter.

Projections of the educational attainment of the civilian labor force 25 years and over to 1975 are available for the United States (82). These were extended to include 14 to 24 year olds for a local study conducted by the New York State Department of Labor (3). The latter reports estimates of the educational attainment of the New York labor force for 1975 based on the 1960 relationship between New York and the United States in terms of educational attainment. The figures for New York for those 14 to 24 and for the United States for those over 24 were put on a percentage basis in order to develop estimates for Iowa.

The educational attainment of Iowa's population as reported in the 1960 census was then put on a percentage basis and the ratio between Iowa's

percent distribution and that of New York for males and females from 14 to 24 and of the United States for those 25 to 44 and 45 and over were computed (3).

These ratios were then multiplied by the New York and United States projections of the distribution of educational attainment of the labor force for 1975 to obtain a projection of the percentage distribution of educational attainment for Iowa's labor force for 1975.

Thus for example, the proportion of females in the labor force age 25 to 44 with college educations was estimated as:

$$\begin{array}{l}\text{proportion of females in labor force age 25 to 44 with college educations for Iowa, 1975}\end{array} = \frac{\begin{array}{l}\text{proportion of females in population, 25 to 44, with college, Iowa 1960}\end{array}}{\begin{array}{l}\text{proportion of females in population 25 to 44 with college, U.S., 1960}\end{array}} \times \begin{array}{l}\text{proportion of females in labor force 25 to 44 with college for U.S., 1975}\end{array}$$

For males 14 to 24, however, the proportion with college educations were estimated as:

$$\begin{array}{l}\text{proportion of males in labor force age 14 to 24 with college, Iowa, 1975}\end{array} = \frac{\begin{array}{l}\text{proportion of males in population 14 to 24 with college, Iowa, 1960}\end{array}}{\begin{array}{l}\text{proportion of males in population 14 to 24 with college, New York, 1960}\end{array}} \times \begin{array}{l}\text{proportion of males in labor force 14 to 24 with college, New York, 1975}\end{array}$$

The proportion of males in the labor force 14 to 24 with college for New York, however were based on U.S. figures for 1975 corrected by the ratio between the educational attainment of New York's population and that of the U.S. so, in effect the New York figures cancel out and the entire

distribution for Iowa's labor force for 1975 is based on the relationship between Iowa's population and that of the U.S. in 1960.

The projections for Iowa's labor force for 1975 are reported in Table 32. The great majority of the labor force will have at least a high school education. Only 9.44% will have no high school at all.

Table 32. Educational attainment of Iowa's labor force, 1975

	Total	Elementary school	High School		College	
			1 to 3 years	4 years	1 to 3 years	4 or more years
Males						
14 to 24	186,998	15,334	39,457	82,278	39,457	10,472
25 to 44	466,074	39,616	54,065	246,554	49,403	76,436
45 and over	143,227	38,098	25,924	49,843	13,893	15,469
Females						
14 to 24	124,933	5,622	23,737	60,093	30,359	5,122
25 to 44	220,884	12,590	24,518	125,904	31,366	26,506
45 and over	90,596	5,164	15,945	49,194	11,777	8,516
Total	1,232,712	116,424	183,646	613,866	176,255	142,521
Percentage totals	100.00	9.44	14.90	49.80	14.30	11.56
Percent with given level of education or more		100.00	90.56	75.66	25.86	11.56

The projections of employment requirements for 1975 were also put on a percentage basis in terms of educational attainment. This was done by utilizing the projections of the percent distribution of employed workers according to educational attainment by major occupation group for the

United States. The data are for those 14 years and over and represent 1965 to 1975 averages (3, Table 33). The results when the U.S. figures were applied to Iowa's projected employment requirements are reported in Table 33.

Table 33. Employment requirements in terms of educational attainment, 1975

			High School		College	
	Total	Elementary school	1 to 3 years	4 years	1 to 3 years	4 or more years
Professional	163,775	2,784	5,077	32,591	25,222	98,101
Management	108,355	13,653	13,003	41,282	18,529	21,888
Clerical and sales	293,159	20,228	44,853	159,772	49,837	18,469
Craft	170,681	42,500	39,086	71,173	13,996	3,926
Operative	202,588	61,789	57,535	73,337	8,104	1,823
Service	175,306	43,301	61,181	57,676	11,220	1,928
Labor	42,809	16,439	13,228	10,745	2,012	385
Farm[a]	190,593	99,680	36,594	43,456	7,814	3,049
Total	1,347,266	300,374	270,557	490,032	136,734	149,569
Percentage totals	100.00	22.30	20.08	36.37	10.15	11.10
Percent required with given level of education or more		100.00	77.70	57.62	21.25	11.10

[a]The figures of the Department of Agriculture which formed the basis for this projection are higher than census labor force participation rates indicate. Adjusting this figure to account for this difference would have very little effect on the results.

The results indicate that the general level of education of Iowans' will be adequate to satisfy the needs of industry. The percent of the population having a high school education, 1 to 3 years of college or 4 or more years of college will be greater than the percent of jobs requiring the latter. This is more clearly illustrated when educational attainment and requirements are expressed in a cumulative way as is done in Tables 32 and 33. While 57.62% of jobs will require at least a high school education, 75.66% of the population should have such education. Likewise 25.86% of the population should have completed some college, while this is required for only 21.25% of the jobs. The figures for those with 4 or more years of college are quite close, 11.56% for the labor force compared to 11.10% of the jobs.

The fact that the educational attainment of the labor force should equal or surpass that required for jobs is an encouraging finding. It indicates that Iowa's population will be more easily able to respond to changes in the types of jobs available. It also means that the imbalances that are found will be at specific rather than general skill levels.

SUMMARY AND CONCLUSIONS

The discussion in the first chapter indicated that employment projections can be approached from two sides. On the one hand the needs of industry in terms of persons to fill jobs can be estimated. Since these are usually based on time series of employment rather than true estimates of demand they are often labelled "employment requirements". On the other hand, projections of persons available to fill these jobs can be independently made. These projections consider attrition patterns, mobility and so forth. Although projections of the former type were the main focus of this study, projections of the latter type were also included.

In order to use the national information contained in Tomorrow's Manpower Needs a matrix of 165 occupations and 64 industries was developed. It was necessary to allocate the data on occupation and/or industry not reported into the area matrix. This was done on the basis of age and sex. It was also necessary to develop additional column matrices to account for all of the 64 industries and to estimate occupation by industry data for a large number of the 165 occupations.

The industry totals were then adjusted to agree with BLS time series totals for 1960 where the latter were corrected to include the self-employed, unpaid family workers, domestics and government employees by function. Adjusting the matrix in this way resulted in new occupational totals. The change for most occupations was in the direction indicated by the employer record check on the national Census.

Regression estimates linking Iowa to U.S. national industrial employment were then used to project employment requirements for wage and salary

workers to 1975. The lack of time series data for a large number of the 64 industries required a simple relationship between U.S. and Iowa employment in these industries for 1960 and 1975 to be drawn. The private wage and salary estimates were then corrected to reflect total employment.

The 1960 and 1975 employment levels by industry were then turned into occupation by industry figures through application of U.S. occupational employment patterns for these years. Division of the 1975 matrix by the 1960 matrix each based on U.S. patterns yielded occupation by industry trend figures which could then be applied to each cell of the 1960 area matrix. Projections of occupational requirements in total and by industry were thus obtained.

The results reached by this method were compared to those reached by a considerably simpler method in which only a single trend factor for each occupation was computed. The results reached by the two methods were quite close for a large number of occupations. Almost all the trend figures were in the same direction and in most cases differed by .10 or less. For the major occupation groups, the largest difference was found for professionals. Method A's trend value was 106% of Method B's indicating that even although Iowa has more professionals than national employment patterns would indicate (see Table 19) they are more concentrated in industries having smaller trend values than these same national patterns would indicate.

The fact that the industrial data for a great many of the occupations were estimated from national patterns probably contributed to the closeness of many of the trends calculated. Approximately two-thirds of the occupations for which the trend values differed by .20 or more were occupations for which data was either reported separately or in small groupings in the

original Iowa Census I-O table. This indicates that development of an area matrix limited to occupations contained in the original census might be a reasonable compromise between the two methods used here.

Considering the occupational structure of employment requirements as a whole, it was found that the professional, clerical and service occupations would increase their share of employment requirements relative to the other nonfarm occupations. Several growth occupations were identified particularly in the professional and craft groups. Estimates of replacement needs by occupation were also included.

In order to have some basis to compare availables with employment requirements, cohort analysis was used to examine the experience of the male labor force between 1950 and 1960. Simple assumptions were then made to project the total labor force by occupation to 1975. When the latter projections were adjusted for unemployment and dual jobholding rather large shortages of management and craft personnel as well as professional and service employees were noted. On the other hand, surpluses of labor, farm and operative personnel were revealed.

When the labor force was compared to job requirements in terms of educational attainment, however, it was seen that the general level of education of the labor force was more than adequate to satisfy the educational requirements of projected jobs. This speaks well of the ability of Iowa's labor force to adapt itself to changing employment requirements.

This study can be brought to a close with a repetition of the often voiced request for better local data. The lack of any current occupational data severely limited the usefulness of the availables projections while more detailed occupation by industry data and even industry data itself would have improved the projections of employment requirements.

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