TM

Development of Prototype

Occupational Information Network (O*NET)

Content Model

O*NET
The Occupational Information Network

Volume I: Report

Submitted by: Norman G. Peterson, *American Institutes for Research*
Michael D. Mumford, *American Institutes for Research*
Walter C. Borman, *Personnel Decisions Research Institutes, Inc.*
P. Richard Jeanneret, *Jeanneret & Associates, Inc.*
Edwin A. Fleishman, *Management Research Institute, Inc.*

Sponsored by: Utah Department of Workforce Services
Contract Number 94-542

September 1995

NOTICE

The American Institutes for Research, Washington, D.C., and its subcontractors Personnel Decisions Research Institutes, Inc., Management Research Institute, Inc., Jeanneret & Associates, Inc., Westat, Inc., and Policy Studies Associates, Inc., were awarded a contract by the Utah Department of Employment Security, on behalf of the U.S. Department of Labor (DOL), to develop an operational prototype for an occupational data collection, analysis, and dissemination system that will demonstrate the feasibility of and provide the foundation for creating an automated replacement for DOL's current Dictionary of Occupational Titles (DOT).

This report, submitted by The American Institutes for Research as a major deliverable under this contract, describes the types of occupational information that will be included in the prototype as well as the procedures used in their development. This "content model" will provide the framework for continued development of the DOT replacement system -- O*NET, The Occupational Information Network.

Because of the developmental nature of O*NET, the information presented in this report should be considered as "work in progress" and subject to revision and refinement as O*NET development continues.

Acknowledgements

A large number of able people assisted us by providing valuable, insightful comments on earlier drafts of this report; most notably:

Mike Campion, *Purdue University*, Technical Review Committee
Donna Dye, *Department of Labor*, Project Officer
Marilyn Gowing, *Office of Personnel Management*, Technical Review Committee
Anita Lancaster, *Defense Manpower Data Center*, Technical Review Committee
Kenneth Pearlman, *AT&T*, Technical Review Committee
Marilyn Silver, *Aguirre International, Inc.*, Aguirre Project Director
Barbara Smith, *State of Utah Occupational Analysis Field Center*, Contract Monitor

Occupational Analysis field center staff also provided helpful feedback, both directly and indirectly, during development of the content for this report. George Wheaton, Ruth Childs, Neal Thurman, and Jean King, at *American Institutes for Research*, very capably conducted the final editorial and production effort.

Finally, we wish to thank all the chapter authors for their diligence and patience in carefully considering the comments from all quarters.

Norman G. Peterson, *American Institutes for Research*, Project Director

Development of Prototype Occupational Information System: Content Model

Table of Contents

VOLUME I: REPORT

SECTION III: EXPERIENCE REQUIREMENTS

SECTION IV: WORKER CHARACTERISTICS

SECTION V: OCCUPATION CHARACTERISTICS

SECTION VI: OCCUPATION-SPECIFIC REQUIREMENTS

Page

SECTION VII: CONCLUSIONS

VOLUME II: APPENDICES

Executive Summary

The world of work is changing. These changes in the nature of work have created a host of problems for government, industry, and workers. Government wonders what skills should be developed to ensure citizens access to the high wage jobs of the future. Employers need to know what skills must be developed to maintain a competitive edge. Workers wonder how they can find jobs in an ever more dynamic economy.

To address these and a number of other concerns, the U.S. Department of Labor (DOL) recently initiated a project intended to provide a comprehensive occupational information system that would help government, industry, and workers cope with these new challenges. The Secretary of Labor's Advisory Panel on the *Dictionary of Occupational Titles* (DOT; DOL, 1993) described its vision of the new, comprehensive occupational information system that would

> promote the effective education, training, counseling, and employment of the American work force . . . [provide] a database system that identifies, defines, classifies, and describes occupations in the economy in an accessible and flexible manner . . . [and] serve as a national benchmark that provides a common language for all users of occupational information. (p. 6)

Development of any occupational information system must begin with identification of the types of occupational information that will be collected to provide the framework of the system. In this report, we describe the development of such a content model, specifying the variables that will be considered in this new occupational information system. While the current DOT (DOL, 1991) is based on descriptions of the tasks workers perform, the new occupational information system will incorporate a comprehensive description of worker and job attributes. The new system will describe jobs at both cross-job and job-specific levels. At the cross-job level, jobs will be described in terms of (a) person requirements (e.g., skills and knowledges), (b) person characteristics (e.g., abilities and interests), (c) experience requirements (e.g., training and licensure), (d) job requirements (e.g., generalized work activities and organizational context), and (e) labor market characteristics (e.g., pay and openings). At the job-specific level, these cross-job variables can be used to organize job-specific descriptive data (e.g., tasks, occupation-specific skills) to create a common language framework.

In Chapters 3 to 13 of this report, the specific variables that might be used to describe jobs are presented. These variables are systematically taxonomized, based on the available psychological and job analytic literature. Nine questionnaires, developed to systematically measure the variables in these taxonomies, are presented in the appendices. These questionnaires will be used to accurately and cost-effectively collect occupational information from job incumbents and representatives for the organizations in which they work. After the system is created, the questionnaires will continue providing the necessary occupational data to allow the system to dynamically expand as new jobs are created.

In addition to describing the key components of the content model, the report addresses a number of other issues bearing on application of the content model. For example, procedures are presented which show how the cross-job variables have been used to organize job-specific descriptive data.

In the final chapter of this report, some general issues related to the form and substance of the content model are considered and the next steps needed to develop a working prototype of O*Net are indicated.

References

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington DC: Author.

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

Chapter 1
Introduction
Table of Contents

Chapter 1
Introduction

Michael D. Mumford
Norman G. Peterson
American Institutes for Research

The world of work is changing. These changes in the nature of work have been described by a number of commentators. Some scholars, Drucker (1994) and Reich (1992) for example, argue that the kind of jobs found in tomorrow's economy will be different from those that characterized American industry over the last half century. Other scholars note the changes occurring in employment patterns and wonder how people will adapt to the changing nature of employment opportunities. Still other scholars take the position that jobs as we know them may represent a dated view of work in the dynamic labor market of the twenty-first century.

These kinds of fundamental changes in the nature and conditions of employment pose a host of new questions. Workers wonder how they can find jobs that will capitalize on their prior training and experience. Employers wonder what skills they should seek to develop in their work force to maintain a competitive edge. Policymakers wonder what kinds of capacities must be developed in our children to promote access to high wage, high skill, and self-fulfilling jobs.

To answer these questions, one must be able to describe occupations. The intent of this report is to provide a framework for describing jobs as we move into the twenty-first century. The report begins by examining the forces which gave rise to the need for a new descriptive system. In Chapter 2, we provide an overview of the proposed system and a justification for the general types of descriptors being employed. In the later chapters we examine in some detail the specific variables being included in each part of the descriptive model, drawing from prior research and extant theory to justify inclusion of these variables in a comprehensive Occupational Information Network (O*NET).

Background Considerations

The Dictionary of Occupational Titles. The present effort does not represent the first attempt to create a comprehensive system for describing occupations. Beginning in the 1930s, the United States Department of Labor initiated an ongoing effort intended to provide a comprehensive description of all occupations in the labor force. The result of this work is the current version of the *Dictionary of Occupational Titles* (DOT; U.S. Department of Labor, 1991) which provides descriptive information for more than 10,000 distinct occupations.

A variety of procedures has been used over the last fifty years to obtain the occupation descriptions needed for the DOT. Although procedures have changed with time, the most common approach relies on the skills of job analysts. Essentially, one or two job analysts will interview and observe incumbents at one or more sites. This information, primarily qualitative in nature, is then used by the analysts to identify the tasks and duties performed on the job. The task data and other available qualitative information are then used to draw inferences about the levels of job demands and required vocational preparation.

In providing a comprehensive description of the tasks performed in multiple occupations, the DOT provides the kind of basic descriptive data needed to answer a number of questions about occupations. For example, the Social Security Administration uses information contained in the DOT to help case workers assess disabilities. The Immigration and Naturalization Service uses DOT information to make decisions about visas and immigration.

Use of the DOT, however, has not been limited to the kind of policy questions mentioned above. One of the more important uses of the DOT is person-job matching. More specifically, counselors use the descriptive information contained in the DOT and available information about an individual's work history to draw conclusions about the kinds of occupations for which that individual will be particularly well suited. Industry, on the other hand, uses the descriptive data provided by the DOT when developing position descriptions, making transfer decisions, and establishing wage and salary rates.

The APDOT Report. The Advisory Panel for the *Dictionary of Occupational Titles* (APDOT), commissioned by the Secretary of Labor, was specifically tasked with identifying the limitations of the *Dictionary of Occupational Titles* and specifying the requirements for a new, comprehensive occupational information system. Although the APDOT report (U.S. Department of Labor, 1993) acknowledges the value of the information contained in the current version of the DOT, it concludes that a number of issues not dealt with by the current DOT need to be addressed in a truly comprehensive occupational information system.

The report notes that the framework underlying the current version of the DOT was more appropriate for describing occupations in mass production industries than in the emerging labor force of the twenty-first century. More specifically, occupations are described in terms of the tasks being performed by people employed in a given occupation. Typically, these tasks, and the information derived from them, are identified through job analysts' observations of incumbents. No one would debate the need to describe the tasks performed in specific occupations. However, this focus on job tasks, and the procedures used to collect this descriptive information, lead to a number of problems.

One problem is that the DOT is based on analysts' descriptions of job tasks. These tasks have been defined in different ways, at different levels of generality. Because description is primarily based on occupation-specific information, it becomes difficult to organize the resulting information and make cross-job comparisons. Furthermore, because of differences in the nature and level of available task data, it becomes difficult to demonstrate the comparability of inferences being drawn from the data concerning other attributes, such as the level of job demands or required vocational preparation. As Campbell (1993) points out, it is open to question whether this kind of occupation-specific descriptive information can be used to classify jobs and draw conclusions about similarities and differences in performance requirements.

A second problem is related to the first by virtue of the fact that the DOT is fundamentally based on one kind of descriptive information — the tasks workers perform on their jobs. Although task information is an essential component of any truly comprehensive occupational information system, many other types of information that might be used to describe occupations are not currently included in the DOT. For example, information bearing on the interests, knowledges, skills, and abilities needed to perform job tasks is not directly collected. Such information may be crucial to answer questions inherent in person-job matching, training, skill transfer, and wage and salary administration (Harvey, 1990; McCormick, 1976, 1979). Not only does the current DOT fail to capture crucial information about person requirements, but it also largely fails to generate information about the nature and conditions of task performance. The DOT does provide information about work conditions, including noise, temperature, and work schedule. However, it does not contain more complex types of descriptive information, such as level of job stress, exposure to hazards, organizational influences, or the conditions of task performance.

A third problem is the time and expense involved in updating descriptive information. An adequate analysis of tasks requires a substantial investment of time. It is difficult to obtain information about occupations quickly and to update this information when changes are introduced in technology and patterns of employment. One consequence of the difficulties inherent in collecting occupation-specific information using the current procedures is that a substantial portion of the information contained in the DOT at any given time is dated. This problem will become even more pronounced if rapid changes occur in the labor force.

These deficiencies in the available descriptive information make it difficult to apply the DOT to answer a number of questions about occupations. The problem is compounded by another characteristic of the DOT: information is presented as a set of discrete, qualitative descriptions. While such a format is useful for a dictionary, it makes it difficult to link the DOT with other databases, and limits the kinds of analyses that might be conducted. For example, the current DOT would not permit rapid assessment of the skills required within a job family, nor would it permit an analysis of how skill levels are related to pay rates in different job families. Those questions can only be answered by linking information contained in the DOT to other occupational databases.

The preceding observations give rise to a set of general conclusions echoed in the APDOT report. Based on the many varied applications of the current DOT, there is compelling need for a comprehensive occupational information system. It is open to question whether the DOT, in its present form, provides the kind of integrated framework and comprehensive descriptive system needed to address the current needs of government, industry, and workers. Like most first-generation systems, it suffers from a number of problems. Additional problems occur because the procedures used to format and report data limit the value of the DOT's descriptive information. Other problems arise from deficiencies in the particular kind of descriptive information being collected. Still others stem from the procedures used to collect information for the DOT.

APDOT Recommendations. The APDOT not only considered the limitations of the DOT but also formulated a set of recommendations for a new, more comprehensive, occupational information system. Those recommendations began with a Statement of Purpose. According to the APDOT report, a viable new occupational information system should

> promote the effective education, training, counseling, and employment of the American work force. The DOT should be restructured to accomplish its purpose by providing a database system that identifies, defines, classifies, and describes occupations in the economy in an accessible and flexible manner. Moreover, the DOT should serve as a national benchmark that provides a common language for all users of occupational information. (p. 6)

This general Statement of Purpose is noteworthy because it implies a number of requirements for a viable new occupational information system. Broadly speaking, these requirements may be subsumed under three general rubrics: *content*, *structure*, and *data collection*. In the ensuing discussion, we will attempt to sketch out the central requirements in these three areas with specific reference to their implications for a truly comprehensive occupational information system.

<u>Content of the O*NET</u>. Earlier we noted that the current DOT focuses on describing the specific tasks performed in an occupation. As a consequence, the DOT represents an occupation-specific descriptive system where each occupation is treated as a unique, qualitatively different entity. The occupation-specific focus makes it difficult to conduct cross-occupation comparisons and formulate general classifications of occupation. Because of its focus on occupation-specific information, the current DOT cannot provide a common framework for describing occupations.

One major implication of these observations is that any new occupational information system cannot be limited to occupation-specific information. Instead, information must be collected that allows occupation to be described in terms of more general, cross-job descriptors. Use of these cross-occupation descriptors will permit information about specific occupations to be organized in ways that facilitate communication and enhance integration of descriptive information into broader structures.

A second implication has to do with the kinds of cross-occupation descriptive information that should be collected. As noted above, the new O*NET is intended to promote person-job matching, training, and counseling. These applications require two different kinds of cross-occupation descriptors. First, descriptors detailing the kind of work being done and the conditions under which this work is being performed are needed to describe the nature of requisite work activities. Second, it is necessary to consider the requirements these activities impose on the people doing the work. Thus a complex, multivariate, descriptive system is required that considers a variety of attributes of both the occupation and the worker.

A third implication for the content of the new system stems from the intended applications of the information. Many of the intended applications focus on the capacities the individual has developed as a function of experience. Therefore, cross-occupation descriptors should consider both attributes arising from experience, such as skills and expertise (Chi & Glaser, 1988; Halpern, 1994), and more basic attributes of the individual, such as abilities, interests, and personality characteristics (Dawis, 1990; Snow & Lohman, 1984; Tyler, 1965), that influence the development of more general performance capacities.

Structure of the O*NET. Recommendations made in the APDOT report have important implications for the structure of the new system. Clearly, a comprehensive occupational information system should be able to answer a wide variety of queries, ranging from person-job matching to the assessment of disabilities. The capacity to respond to the needs of many different users imposes a number of structural requirements on the descriptive system.

First, different kinds of applications will require analyses at different levels of specificity. Thus, for some purposes, the concern at hand may be the specific skills involved in a single occupation. Other purposes, however, such as job matching and retraining, may require the examination of skills at a broader cross-occupation level. This need for analyses at different levels of specificity implies that descriptors should be hierarchically arranged.

A second requisite structural characteristic is that the occupational information system be accessible to people who have different backgrounds and who want to address different kinds of issues. Further, a truly useful system would help integrate these different uses. For example, person-job matching might be explicitly linked to training recommendations bearing on the training or development of requisite skills. If the occupational information system is to integrate responses to diverse queries, two requirements must be met. First, descriptors must be phrased so that they are readily understandable by users with different backgrounds and different concerns. Second, the descriptors must provide a common language that will permit users with different backgrounds and concerns to integrate and interrelate their efforts.

<u>Procedures used to collect requisite descriptive information</u>. This is the third set of recommendations found in the APDOT report. If the O*NET is to be of real lasting value, the resulting descriptive information must provide for accurate and valid descriptions of work characteristics and worker attributes. Accordingly, procedures must be developed that permit effective measurement of a variety of different variables in a number of different work environments.

Of course, any given attribute of occupations or the workers employed in those jobs might be measured in a number of different ways. For example, skills might be measured through self-assessments, observations of performance on relevant tasks, or through direct measures of the relevant skills. It is highly likely that different kinds of measures may be required to obtain valid and reliable assessments of different kinds of attributes.

However, in selecting a measurement format, the reliability and validity of the resulting descriptive information are not the only concerns. A viable occupational information system must also remain current. There is a clear-cut implication here when one expects rapid changes in both occupations and the nature of work. A measurement system is required that allows for rapid, cost-effective data collection.

To complicate matters further, in a rapidly changing workforce, a truly viable occupational information system cannot rigidly focus on only well known, existing occupations. Instead, it must be capable of identifying real occupations as they emerge in the workforce. The need for a system capable of identifying new, emerging occupations implies that descriptions of work and worker characteristics cannot be rigidly referenced to existing occupation titles.

Rather, descriptive information must be collected at a position level in such a way that aggregation across positions will identify emerging occupations and occupational families.

Taxonomic Issues. The APDOT report establishes a set of criteria for evaluating any new occupational information system. Ideally, a new occupational information system would provide meaningful information about occupation in such a way that it permits users to address the many questions posed by the APDOT report. How might one go about developing a system that will allow users to address these many issues? The answer, as mentioned earlier, lies in developing a common descriptive language.

The call for a common descriptive language, however, has a major implication. A viable common language must provide for accurate, comprehensive descriptions of relevant variables in a variety of domains, such as generalized work activities, work context, and characteristics of workers. Thus, a taxonomic system of descriptors must be devised that provides for valid and comprehensive description of both work and the worker.

A meaningful taxonomy essentially is a classification system. The purpose of classification is to provide a set of categories or constructs that allows us to summarize information about a set of objects by assigning objects to a smaller number of categories (Fleishman & Quaintance, 1984). Because people work in a variety of different positions and these positions might be described in a number of different ways, the development of a taxonomy is an essential step in the development of an occupational information system based on a common descriptive language.

Development of any taxonomy involves three major steps (Fleishman & Mumford 1991; Owens & Schoenfeldt, 1979). First, the domain of objects to be described must be defined. Second, a set of descriptors must be developed that allows us to assess the similarities and differences among all objects lying in this domain. Third, a set of rules must be developed that allows us to group objects together on the basis of this descriptive information.

But a number of different classification systems are possible differing in the domains of objects they examine, in the descriptors used to assess those objects, and in the decision used to group objects. Such competing classification systems pose another problem. Specifically, how does one determine whether one classification is superior to another? Traditionally, the answer has been that the most useful is chosen. Recently however, Fleishman and Mumford (1991) proposed a broader set of criteria (based on construct validity) for evaluating different classification systems (Cronbach, 1971; Landy, 1986; Messick, 1989, 1994).

Within this construct validation framework, the question at hand is whether the classification will lead to more meaningful inferences about the likely behavior or characteristics of objects than the inferences provided by competing classification methods. Evidence for the meaningfulness of the inferences being derived from a classification might be obtained from many sources. However, Fleishman and Mumford (1991) make a distinction between two basic types of validity evidence — internal and external validity.

Internal validity. One kind of validity evidence, internal validity, pertains to the procedures used in the development of the classification system. Essentially, this kind of evidence examines whether the operational steps used in development of the taxonomy would lead one to expect that the system would result in meaningful inferences. For example, one might ask whether the descriptors in use represent variables likely to reliably differentiate objects within the domain. A more important issue, of course, is whether the descriptors appear to provide a comprehensive description of key differences among objects or provide meaningful information about characteristics of these objects — in the case at hand, occupations.

External validity. External validation strategies represent a distinct set of inferential tests. Explicit hypotheses are drawn about the implications of assignment to a category and, as the number, breadth, and depth of the confirmed inferences increase, evidence accrues for the meaningfulness of the classification (Cronbach, 1971; James, Muliak & Brett, 1984; Landy, 1986). This evidence is most compelling when it is possible to construct and establish meaningful theoretical relationships.

The external validity of a classification represents the strongest evidence for the meaningfulness of a taxonomic system. However, as Fleishman & Mumford (1991) point out, one is unlikely to obtain adequate external validity evidence, and develop a classification that allows one to draw the practical inferences of interest, unless one has first constructed a system that displays adequate internal validity. Thus, the procedures used in developing the content model, or the descriptors used to summarize information about occupations, lay the groundwork for subsequent assessment of the external validity of the occupational information system.

Content Model Requirements

As discussed above, recommendations contained in the APDOT report have a number of important implications for the procedures used to develop the new, comprehensive, O*NET. Some of the more important ones will shape the substance and structure of the content model that lies at the heart of the descriptive system. Below, we state some of the general requirements for the content model. We discuss its formal development in Chapters 2 through 14.

Identifying the Domain of Interest. As we indicated earlier, the first step is to define the domain of objects to be described by this system. At a superficial level, one might say the domain is obvious — our concern is describing occupations. This definition of the domain, however, becomes inadequate when it is recognized that occupations themselves represent a classification we impose on work to summarize the activities of people at work. Further, occupations might be defined at many different levels. For example, the job family, nursing, might subsume a variety of occupations, such as nurse anesthesiologist. Thus, we arrive at a fundamental question. Will the classification system be used to describe individual positions, occupations, the activities of individual persons at work, the activities of groups of persons at work, or the activities occurring in groups of occupations? Selection of positions as the domain of objects to be described and classified best promotes flexibility in the occupational information system and insures that the system is robust with respect to changes in labor market characteristics. In our usage, *positions* refer to the work activities performed by an individual as a function of his/her role in the organization.

Choosing Sets of Descriptors. If the domain of objects to be described and classified is occupations, or activities performed by individuals at work, then the next question is how to describe the activities occurring in these occupations. This question is important because the descriptors selected will, to a large extent, determine the kind of classification that can be constructed and the kind of inferences that can be drawn.

There is no one set of descriptors that provides an absolute, fully comprehensive description of people's activities in an occupation. Occupations have been described in terms of several different types of variables including: ability requirements (Fleishman, 1982; Fleishman & Reilly, 1994), tasks (McCormick, 1979), and work characteristics (Harvey, 1990). Different types of descriptors, of course, result in differences in the kind of questions the classification system can be used to answer. For example, information about ability requirements is useful when addressing selection issues; task information is particularly useful for performance appraisal. Given the variety of questions the occupational information system will be asked to address, it seems clear that multiple types of descriptive information must be collected.

The APDOT report and consideration of likely uses to which the information system would be put suggest certain requisite characteristics for the descriptors. First, they must be cross-occupation descriptors in the sense that they must be capable of being applied to people working in a variety of occupations. Second, they must be capable of organizing and integrating more occupation-specific types of information applying to limited subsets of positions. Third, the descriptors must consider both the characteristics of the work and the characteristics of the persons doing the work. Fourth, and finally, because many of the questions likely to be addressed through the occupational information system bear on the characteristics a person must develop to perform the work required by an occupation, some attention must be given to descriptor domains such as skills, knowledges, and training, reflecting developed performance capacities of the worker.

It is clear that multiple types of descriptors must be developed to ensure a comprehensive description of occupation and to enable the resulting occupational information system to address a variety of questions. However, the quality of the descriptive information obtained from each type of descriptor will exert an equally important influence on the kinds of inferences that can be drawn concerning people's work and the kinds of questions that can be answered by the O*NET. Therefore, the procedures used to develop each type of descriptor become of paramount concern.

When selecting potential descriptors, our ultimate concern is whether these variables will provide a meaningful description of the similarities and differences among occupations. Thus, the first step in developing a set of descriptors within a given area (e.g., work context, worker skills) is to provide evidence that the key variables have been identified. Specification of these variables might occur in one of two ways. Either available theory might be used to specify relevant variables, or, alternatively, prior empirical findings might be used. Both approaches provide some initial evidence that the right variables have been identified within an area. Which approach is taken, however, will necessarily vary by area as a function of the available research literature.

Although prior theoretical and empirical research provides the best basis for identifying relevant descriptors within an area, a viable set of descriptors must meet a number of other criteria. First, to promote flexible application of the system and ensure comprehensive coverage of the relevant area, the variables should be placed in a broader theoretical framework that enables them to be hierarchically organized. Second, each of the proposed variables should be measurable using one or more measurement techniques (e.g., incumbent ratings, analyst observations, interviews, or formal assessments). Third, these variables should be of demonstrated relevance in addressing the kinds of questions asked of, or inferences likely to be drawn from, the occupational information system.

These criteria for selection of descriptors may seem surprising. Parsimony is not explicitly stated as a criterion, although parsimony has been built into the system by arranging variables in a hierarchical fashion. Similarly, issues bearing on the relationship of variables across descriptor types are not addressed, although it is recognized that the empirical relationships observed among variables in different areas might provide evidence of construct validity. For example, one would expect skills to display strong relationships with both knowledges and requirements for certain kinds of generalized work activities (Anderson, 1993; Kanfer & Ackerman, 1989). Finally, although potential inferences must be considered, selection of variables is not explicitly linked to any single potential application of the information system.

The reason for selecting descriptors in the manner described above is that such an approach is consistent with the broader construct validation framework being applied in developing the content model. Essentially, the key issue in developing a content model within this construct validation framework is that the descriptors can be justified on the basis of available theory and research. Analysis of the available literature within a descriptor domain helps ensure comprehensiveness and identification of crucial influences on individuals' work activities and performance. This literature-based, theoretical framework provides requisite internal validity evidence. Also, the hypotheses implied by the theoretical framework, particularly cross-domain relationships, provide a basis for subsequent efforts to obtain further internal validity evidence and to establish the external validity of the classification system. Finally, by developing independent taxonomies for each domain specified in the content model, it becomes possible for different users to apply different parts of the content model to address different kinds of questions. Thus, the development of internally consistent models within domains should allow users to apply different windows in studying the world of work, looking at skills as a unique set of variables, apart from abilities

In the following chapters we describe the particular variables examined in each descriptor area and justify their selection within the construct validation framework sketched above. In each chapter either an empirical or a theoretical justification will be provided for the descriptors included in the taxonomy. Additionally, an approach to measuring these descriptors will be proposed, which will provide reliable and valid descriptive information that can be obtained using relatively low-cost information gathering techniques. Finally, some potential uses of each taxonomy will be discussed.

Before proceeding to the descriptor sets formulated in each area, however, we examine the major areas for which descriptor sets were developed. This overview, presented in Chapter 2, considers structural characteristics of the content model, including its use in organizing occupation-specific information, along with the kinds of questions that might be addressed by an occupational information system based on such a content model. In the final chapter of this report we consider the implications of a field test where this model was applied in describing a set of occupations and discuss the implications of these field test results for application of the measures derived from the content model.

References

Anderson, J.R. (1993). Problem solving and learning. *American Psychologist, 48*, 35-44.

Campbell, J.R. (1993). *Classifying jobs.* Paper prepared for the United States Department of Labor, Washington, DC.

Chi, M.T.H., & Glaser, R. (1988). *The nature of expertise.* Hillsdale, NJ: Erlbaum.

Cronbach, L.J. (1971). Test validity. In R.L. Thorndike (Ed.) *Educational measurements* (pp 216-312). Washington, DC: American Council on Education.

Dawis, R.V. (1990). Vocational interests, values, and preferences. In M.D. Dunnette & L.M. Hough (Eds.) *Handbook of industrial and organizational psychology: Volume two* (pp. 833-872). Palo Alto, CA: Consulting Psychologists Press.

Drucker, P. (1994). *Jobs and employment in a global economy.* Boston, MA: Atlantic Monthly.

Fleishman, E.A. (1982). Systems for describing human tasks. *American Psychologist, 37*, 1-14.

Fleishman, E.A., & Mumford, M.D. (1991). Evaluating classifications of job behavior: A constant validation of the ability requirements scales. *Personnel Psychology, 43*, 523-576.

Fleishman, E.A., & Reilly, M. (1994). *Handbook of human abilities.* Palo Alto, CA: Consulting Psychologists Press.

Fleishman, E.A., & Quaintance, M.K. (1984). *Taxonomies of human performance: The description of human tasks.* Orlando, FL: Academic Press.

Halpern, D. (1994). *A national assessment of critical thinking skills in adults: Taking steps towards the goal.* Washington, DC: National Center for Educational Statistics.

Harvey, R.T. (1990). Job analysis. In M.D. Dunnette & L.M. Hough (Eds.) *Handbook of industrial and organizational psychology: Volume two* (pp. 71-164). Palo Alto, CA: Consulting Psychologists Press.

James. L.R., Muliak, S.J., & Brett, J.M. (1984). *Causal analysis.* Sherwood Oaks, CA: Sage.

Kanfer, R., & Ackerman, P.L. (1989). Motivation and cognitive abilities: An integrative-aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology, 74*, 657-690.

Landy, F.J. (1986). Stamp collecting versus science; Validation as hypothesis testing. *American Psychologist, 41*, 1183-1192.

McCormick, E.J. (1976). Job and task analysis. In M.D. Dunnette (Ed.), *Handbook of industrial and organizational psychology* (pp. 651-698). Chicago, IL: Rand-McNally.

McCormick, E.J. (1979). *Job analysis: Methods and applications.* New York: Amacom.

Messick, S. (1989). Validity. In R.L. Linn (Ed.) *Educational measurement* (pp. 13-105). New York: MacMillan.

Messick, S. (1994). *Validation designs for a new generation of tests.* Paper presented at the Bowling Green Conference on Alternatives to Traditional Tests, Toledo, OH.

Owens, V.A,. & Schoenfeldt, L.F. (1979). Toward a classification of persons. *Journal of Applied Psychology, 64*, 569-607.

Reich, R. (1992). *The work of nations: Preparing ourselves for 21st century capitalism.* New York: Vintage Books.

Snow, R.E., & Lohman, D.R. (1984). Toward a theory of cognitive aptitude for learning from instruction. *Journal of Educational Psychology, 76*, 337-346.

Tyler, L.E. (1965). *The psychology of human differences.* Englewood Cliffs, NJ: Prentice-Hall.

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington DC: Author.

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

Chapter 2
Content Model
Table of Contents

Figures

Chapter 2
Content Model

Michael D. Mumford
Norman G. Peterson
American Institutes for Research

In this second chapter of the report, we propose a general structural model that is intended to capture the major kinds of attributes that might be of interest to people when using the O*NET. The model builds upon and extends the sound foundation provided by the APDOT content model (U.S. Department of Labor, 1993). This extension of the APDOT model was developed with two other considerations in mind. First, it was intended to provide a reasonably comprehensive model capturing the major kinds of cross-occupation descriptors. Second, it was developed with the express intent of providing a general descriptive system that might be used to organize more specific information pertaining to particular sets of positions.

In the first major section of this chapter we examine the major types of variables needed in the model. In the second major section we consider the model's key structural characteristics in terms of potential applications of the model in organizing more specific types of descriptive information. In the final main section of this chapter we consider certain general issues bearing on assessment of the different kinds of variables included in the content model.

Content Model

Any attempt to develop a viable occupational information system must begin by identifying cross-occupation descriptors. The APDOT report provides one model that might be used to identify the kinds of variables that should be included in the content model. Figure 2-1 presents the APDOT variables as they relate to the occupational information system.

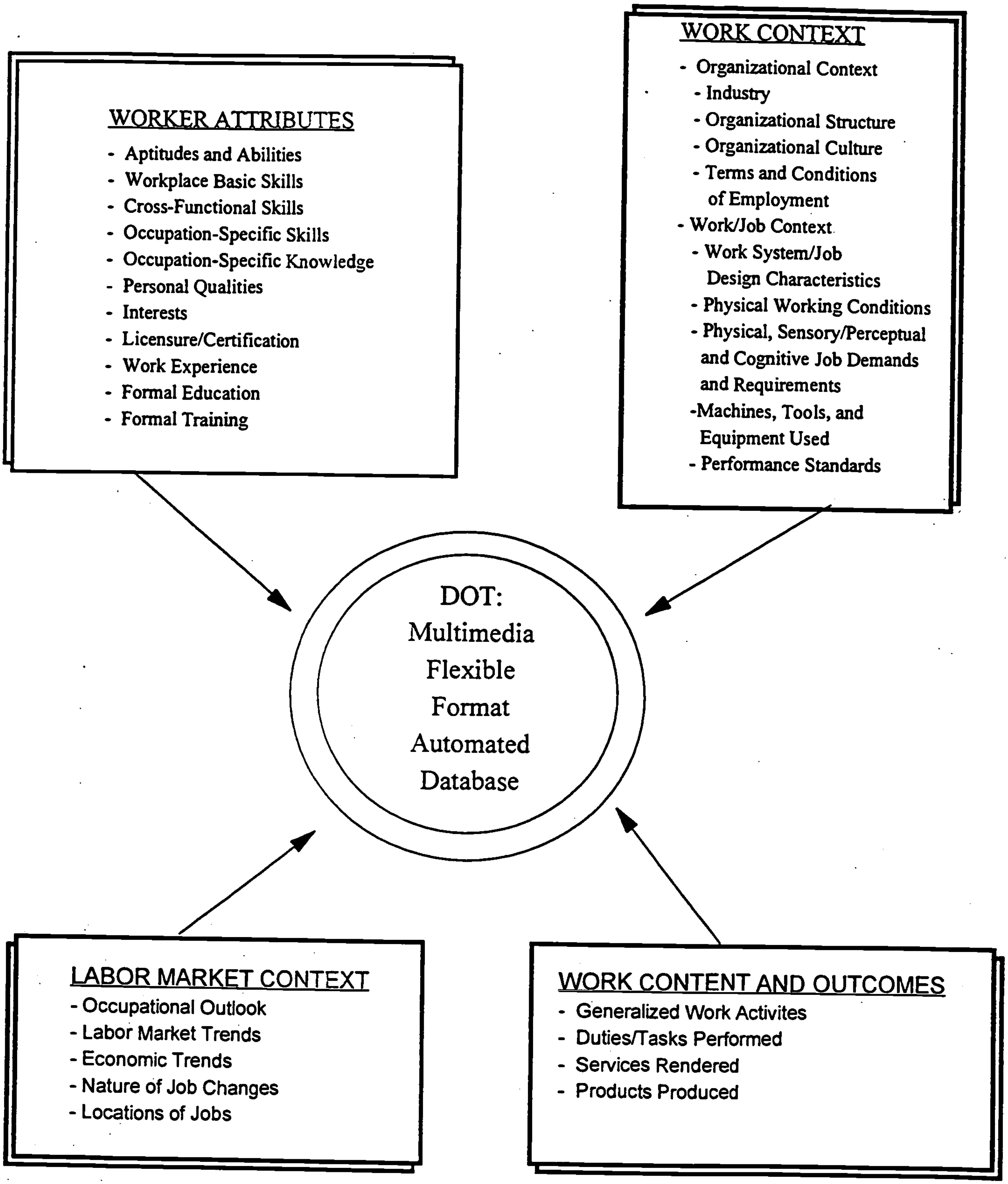


Figure 2-1
APDOT Content Model

The APDOT model represents a relatively parsimonious system for describing the kinds of variables that might be included in a comprehensive occupational information system. In this model (see Figure 2-1), four basic types of variables are proposed: 1) worker attributes, 2) work context, 3) labor market context, and 4) work content and outcomes. Within each of these four broad categories, more specific kinds of variables are specified. For example, the work content category includes tasks and duties, as well as generalized work activities, while worker attributes include both cross-functional and occupation-specific skills.

The APDOT model incorporates a number of variables. Broadly speaking, two types of variables are proposed — one set bearing on attributes of the work to be done, and one set bearing on attributes people must possess to do this work. This is an important distinction, AND one that must be retained in any model.

The APDOT model does not consider two other distinctions. One of these, noted by Campbell (1993), concerns the difference between occupation-specific and cross-occupation descriptors. The APDOT model does not make this distinction, combining, for example, cross-functional and occupation-specific skills into one category, worker attributes. Occupation-specific variables, however, represent a distinct category of attributes which, due to their specificity, do not permit comparison of jobs or, for that matter, the development of more general, cross-occupation descriptive systems.

A second distinction that might be made among these variables concerns their manipulability. Some variables, abilities and work styles, for example, cannot be readily changed. Other variables, such as skills, knowledges, generalized work activities, and work context, can be changed as a result of worker or organizational actions. Because many interventions and policies (e.g., training and certification; the skills boards) expressly focus on these more malleable aspects of people's work, it seems important to include this distinction in a more comprehensive content model. The term *requirements* is used to refer to attributes amenable to directed change, while the term *characteristics* refers to attributes that cannot readily be changed by the individual or the organization.

These two additional distinctions gave rise to the extended content model presented in Figure 2-2. This model covers virtually all of the various types of variables included in the initial APDOT model. However, it differs from that model because it considers, in addition to the

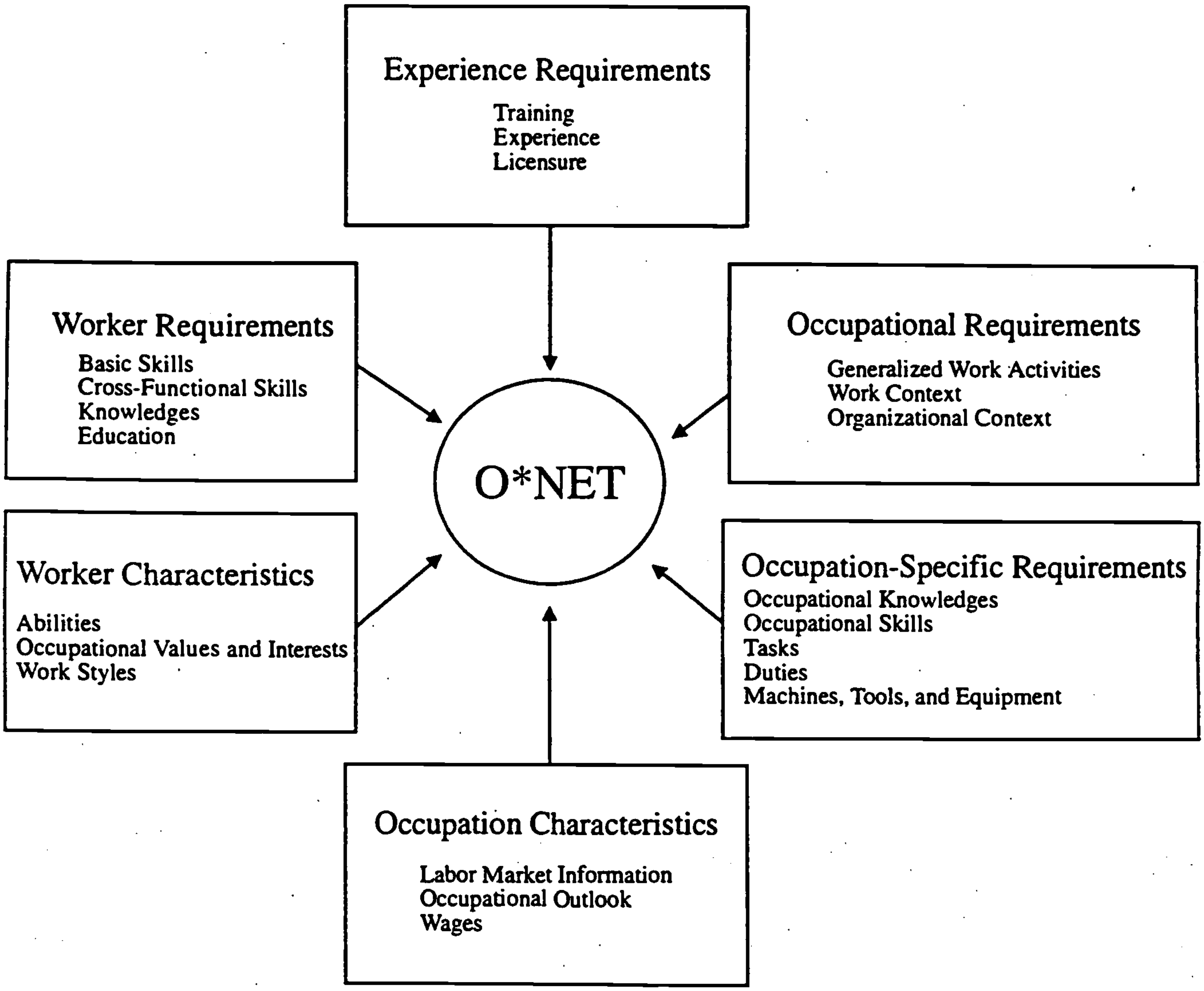


Figure 2-2
*O*NET Content Model*

distinction between worker attributes and job attributes, the distinction between cross-occupation and occupation-specific descriptors, as well as the distinction between malleable requirements and less malleable characteristics of the work and the worker.

The broad types of variables included in this model clearly display some systematic relationships to each other. People's work activities and tasks are influenced by industry on broader characteristics of the occupation. Worker requirements, such as skills, and occupation requirements, such as generalized work activities, will influence experience requirements, such as training, work experience, and licensure. Figure 2-3 illustrates how the various variables included in the content model might relate to each other. It should be noted, however, that these relationships only represent an initial, hypothesized structure, one likely to change, which only specifies a few major relationships.

In the following sections of this chapter, we examine the major types of variables included in this extended content model. We begin by examining worker characteristics and worker requirements. Next we consider experience requirements, occupation requirements, and occupation characteristics. Throughout, we will focus on the major types of cross-occupation descriptors included in the content model. Occupation-specific descriptors, such as tasks and tools, will be considered in a separate chapter, where procedures for collecting these more specific descriptors are discussed within the broader, cross-occupation taxonomic structure.

Worker Characteristics

Enduring characteristics of a person influence the capacities that they can develop as a function of experience, as well as their willingness to engage in certain types of activities (Fleishman, 1982; Snow, 1986). This point has long been recognized by counselors, who commonly use information about a person's characteristics as a basis for placing people in jobs (Dawis, 1990; Holland, 1973). Along similar lines, information about worker characteristics is commonly used to select people for jobs (Guion, 1966; Schmidt, Hunter & Pearlman, 1981). As might be expected based on these observations, information about requisite worker characteristics often provides a basis for describing and comparing occupations.

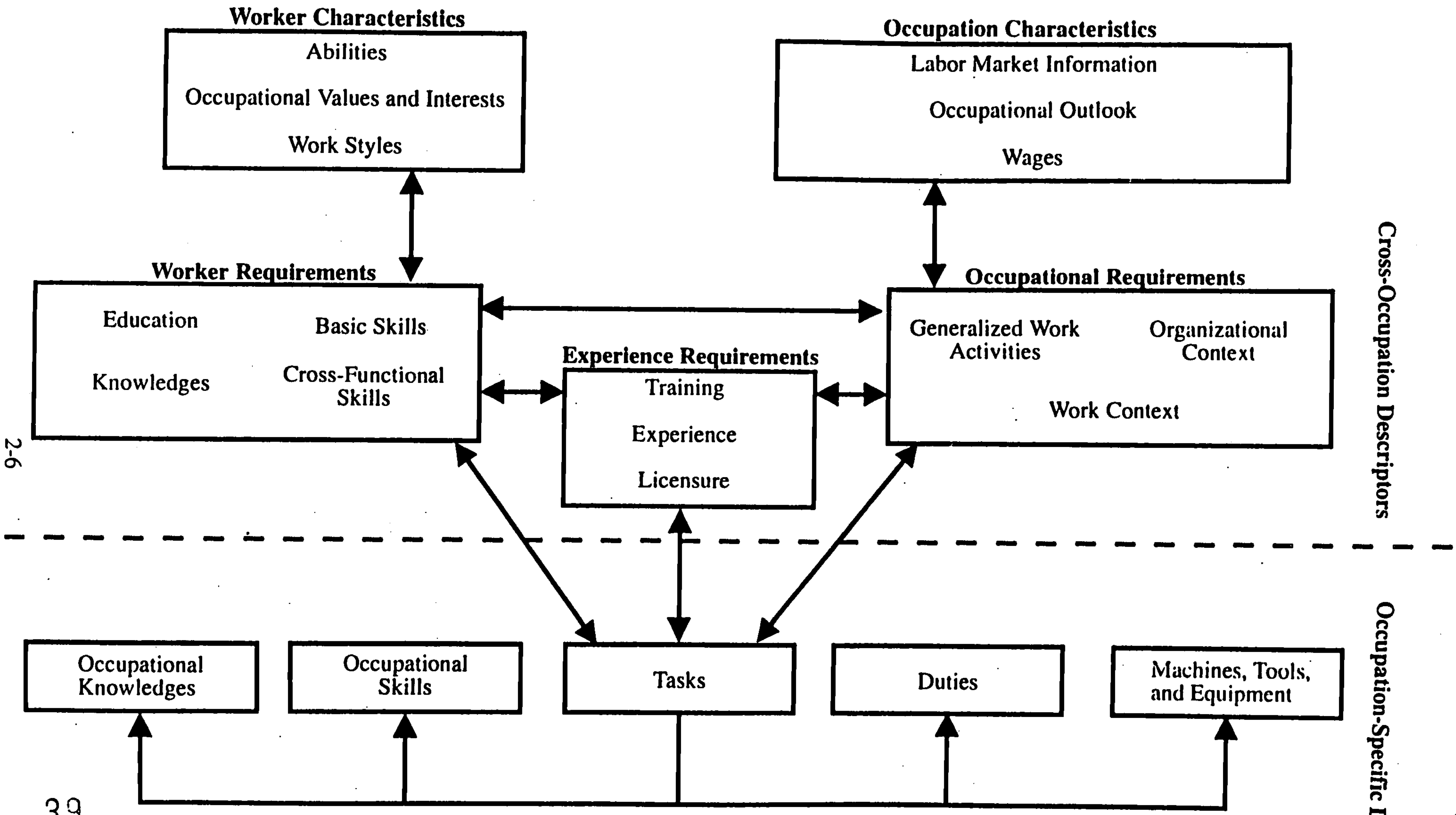


Figure 2-3

Hypothesized Relationships among Content Model Components

Since the 1920s, one of the most common techniques for describing and comparing jobs in terms of relatively enduring characteristics of the person has involved comparing jobs in terms of requisite abilities. Initially, these ability comparisons involved little more than comparisons of incumbents' mean scores on ability tests (Thorndike & Hagen, 1959). More recent efforts, however, have focused on describing occupations in terms of their ability requirements *per se* (Fleishman & Quaintance, 1984; Lopez, 1988).

Perhaps the best developed system along these lines may be found in Fleishman's ability requirements approach (Fleishman & Mumford, 1988, 1991). Within this approach, occupations are described in terms of the basic abilities required for successful task performance. Initially, factor analytic techniques were used to identify the abilities that could account for task performance within certain broad, cross-occupation performance domains, such as cognitive, psychomotor, physical, and sensory performance. Subsequently, behaviorally anchored rating scales were developed that would allow incumbents, supervisors, or job analysts to identify requisite abilities. These evaluations of performance requirements in terms of abilities have, in fact, provided a valid system for identifying requisite abilities and classifying occupations in terms of their ability requirements.

Although few people would dispute the need to describe occupations in terms of their ability requirements, abilities represent only one type of enduring attribute of the individual that would influence the capacity or motivation to perform various work activities. Recent studies by Sackett, Zedeck, and Folgi (1988) draw a distinction between typical and maximal performance, noting that the attributes conditioning maximal performance may not be identical to the attributes conditioning typical day-to-day performance. Usually, abilities are viewed as the enduring characteristics of individuals that determine maximal performance, while personality or work style variables, including motivation, integrity, and other characteristics such as openness or mastery motives, are held to influence typical task performance. The evidence compiled by Dweck (1986), Hogan (1990), and Schmeck (1988) indicates that these kinds of characteristics can have a marked influence on how people adapt to new tasks, while also influencing the development and maintenance of skilled performance in various domains.

Although there is reason to suspect that these stylistic variables may represent an important influence on people's day-to-day work performance, these variables have not traditionally been used for describing jobs in terms of requisite person characteristics. In part, this viewpoint derives from the position that non-normative, clinical syndromes do not provide an appropriate basis for describing occupations. This point is difficult to dispute. However, it may well prove possible to describe occupations in terms of more general, non-clinical attributes, such as achievement motives, self-discipline, and integrity, that influence how people typically approach work related tasks. In fact, Guion and his colleagues (Guion, 1994, personal communication) have shown that job activities can be described using these kinds of non-clinical personality attributes when attributes have been selected expressly to capture key aspects of typical, day-to-day, performance. Given this evidence, and the need for a truly comprehensive descriptive system that considers influences on both maximal and typical performance, it seems necessary to consider information about personality, particularly personality constructs bearing on work style, in the content model.

In addition to abilities and work styles, a third issue relevant to worker characteristics should be considered in the development of the content model. It is not enough for people to be able to do the work, they must also be willing to do the work. Worker characteristics bearing on the willingness to invest in a certain type of work are commonly subsumed under the rubric of interests. As might be expected, based on these observations, interests are commonly used as a basis for considering any person-job matching.

A variety of taxonomies for describing interests has been proposed over the years (Campbell, 1971; Holland, 1973; Strong, 1943). Further, interests have shown some value as a basis for describing the similarities and differences among occupations (Borgen, 1988). On the other hand, the unique value of interests as a basis for describing occupations is often limited because they focus primarily on personality patterns. This kind of system for describing interests is nicely illustrated in the work of Holland (1973). An alternative approach for describing the occupations involved in various jobs may be found in the work of Dawis (1990). Dawis' (1990) approach attempts to describe interests in terms of preferences for certain types of occupational reinforcers. This kind of occupation-based approach to the definition of interests is particularly attractive, in part because it clearly distinguishes interests from personality and in part because it references the definition of interests against occupation relevant attributes. However, a truly comprehensive system might consider both approaches.

Worker Requirements

Worker characteristics, such as abilities, work styles, and interests are important not only because they influence how people approach work tasks, but also because of evidence which indicates that these variables influence the development of work relevant skills (Ackerman, 1987; Fleishman & Hempel, 1955; Snow, 1986).

Worker requirements, broadly speaking, refer to developed attributes of the individual that might influence performance across a range of work activities. People acquire a variety of attributes that influence performance as a function of education and experience (Anderson, 1993). One effect of education and experience is that people acquire knowledge or an organized set of facts and principles pertaining to the characteristics of objects lying in some domain. Prior studies of expert-novice differences (Chi, Bassock, Lewis, Reimann, & Glaser, 1989; Chi & Glaser, 1985; Feltovich, Spiro, & Coulson, 1993) indicate that expert performers in domains ranging from medicine to foreign affairs typically differ from novices in that they have a more extensive set of concepts available, organized on the basis of underlying principles, which facilitate recall, recognition, and problem solving. Although knowledge appears to develop as a function of domain specific, episodic experiences (Medin, 1984), the organization of experience in terms of the principles applying in a domain suggests that a general, cross-occupation framework for describing requisite knowledge might be developed by identifying interrelated bodies of principles.

In addition to knowledge, experience in working within a domain also provides people with a set of procedures for working with knowledge (Anderson, 1993; Campbell, McCloy, Oppler, & Sager, 1992). These procedures for working with available knowledge are commonly what is being referred to when people apply the term *skills*. Skills, however, might be conceived of in two different ways. First, when people use the term *basic skills*, they are commonly referring to procedures, such as reading, which would facilitate the acquisition of new knowledge. In contrast to basic skills, cross-functional skills refer to procedures that extend across general domains of work activities. Thus, one might speak of problem solving and social skills. These cross-functional skills, of course, develop as a function of experience, although their development may also be influenced by more basic skills and by relevant worker characteristics, such as abilities (Snow & Lohman, 1984).

Although requisite knowledge and skills have been used to describe occupations (Mitchell, Ruck, & Driskell, 1988), the description of requisite knowledge and skills is commonly phrased in terms of a specific occupation or set of positions. As a result, the kind of descriptive information provided by these procedures is of limited value in formulating a general cross-occupation descriptive system. Recent work by Mumford, Fleishman, and their colleagues (Mumford & Baughman, in press; Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991), however, suggests that it might be possible to identify cross-occupation knowledges and skills by identifying general bodies of principles and the procedures which influence performance across domains of activities that extend across occupations.

Worker requirements, such as knowledge, basic skills, and cross-functional skills develop in part as a function of experience in performing a certain set of tasks. However, educational background also seems to represent a significant influence on the development of these general knowledges and skills (Snow & Swanson, 1992; Ward, Byrnes, & Oventon, 1990). Recognition of the relationship between education and the acquisition of general knowledge and relevant basic skills (Halpern, 1994) has led many investigators to use educational experience as a proxy for information bearing on general knowledges and skills. Because educational experiences represent a developed capacity of the individual influencing the acquisition of knowledge and basic skills, requisite educational background may also represent another characteristic of the person that must be used to describe cross-occupation differences in terms of relevant worker requirements.

Experience Requirements

Like education, training and licensure represent experiences that are a property of an individual. In contrast to education, however, which is expressly intended to provide general knowledge and basic or cross-functional skills, training and licensure are variables that are explicitly linked to the nature of certain kinds of work activities. Training and licensure, of course, may be specific to the tasks being performed in a particular position (Goldstein, 1990). However, training and licensure may also apply to tasks occurring in a number of positions. For example, a training program may seek to develop general leadership or problem solving skills. When training and licensure are intended to extend across a specific set of position activities, these kinds of experiences may provide still another potentially useful type of cross-occupation descriptor. In fact, prior training and licensure are often used as a basis for personnel selection, counseling, and job matching.

Training and licensure requirements have been used to describe occupation requirements using a number of different approaches. For example, people have been asked which specific types of training they have completed or what licenses they possess. However, Ash (1988) notes that many of these variables lack sufficient generality to be useful as cross-occupation descriptors. One common approach used to address this issue is to ask when and where training or a license was acquired. Another approach suggested by Peterson (1992) is to examine the amount of training required or when this capacity was acquired. This latter approach, in fact, might prove particularly useful in assessing training and licensure requirements if it is linked to a broader taxonomy of requisite knowledges and skills that might potentially be developed in training.

Occupational Requirements

As noted above, person requirements, such as knowledges and skills, as well as training and licensure, are in part a function of a person's experiences. In the description of people's work activities, these experiences are commonly framed in terms of the requirements of the job or the set of positions under consideration. Although these work requirements might be assessed in terms of a number of different descriptors — for example, tools used, products and services provided, or functional duties — the most common procedure used to describe work requirements is through definition of the tasks performed in the occupation (McCormick, 1976, 1979). A task is commonly defined as a specific activity performed on some object to meet some functional occupation requirement.

With regard to development of a comprehensive occupation description, the identification of requisite tasks represents an essential step. On the other hand, however, well-developed task statements are usually specific to a particular occupation or set of occupations (Harvey, 1990). As a result, task statements may be of limited value in describing the kind of cross-occupation similarities and differences that must be captured by the envisioned occupational information system. Thus, a viable system may require a somewhat broader approach to describing occupation activities.

One approach that might be used to address this specificity problem is suggested by the work of McCormick (McCormick 1976, 1979), Cunningham (Cunningham, Boese, Neeb, & Pass, 1983) and Harvey (1990). Essentially, this approach attempts to identify generalized work activities or dimensions that summarize the specific kinds of tasks occurring in multiple occupations. For example, one might speak of the descriptor *controlling machines or processes*, which might subsume a number of tasks occurring in specific occupations, such as driving heavy machinery, or working on a manufacturing production line.

In fact, prior factor analyses of task inventories suggest that it is indeed possible to identify general dimensions of work activities that summarize more specific tasks occurring in a variety of occupations (McCormick, Jeanneret, & Mecham, 1972; Campbell, McHenry, & Wise, 1990). Thus, it might be possible to formulate a taxonomy of generalized work activities by examining the results obtained in these factor analytic efforts in relation to a general theory of work performance. This taxonomy of generalized work activities might not only provide a viable cross-occupation framework for the description of differences in requisite work tasks, but the resulting dimensional structure might also provide a basis for generating more specific descriptive information concerning the tasks, tools, and duties which apply in a particular occupation or set of occupations.

In describing work activities, however, it may not be sufficient to describe the general kinds of activities occurring in an occupation. The rating of a task and its implications for task performance are not simply a function of the kinds of activities that must be performed but also of the conditions under which these activities must be performed (Fleishman & Quaintance, 1984). For example, performance of a task in a noisy environment may impose rather different requirements on the worker than performing the same task in a quiet environment. This, in turn, implies that a comprehensive description of people's work activities may require attending to the conditions under which various generalized work activities must be performed (Howell, 1990).

Jeanneret, in his work on the Position Analysis Questionnaire, has begun to develop a taxonomy of the kind of work context, or environmental influences, that might affect the execution of various work activities (Jeanneret, McCormick, & Mecham, 1977). As an example, this system examines variables such as noise, temperature, shift, and physical risk, all clearly environmental variables that might influence the nature of and requirements for effective performance of certain work activities. Although most initial efforts examining work context influences on performance have primarily focused on the physical variables that influence certain kinds of work activities, it should prove possible to extend this approach to capture attributes of the social environment that also influence the nature and conditions under which people perform requisite work activities. A comprehensive taxonomy examining both the physical and social variables that shape the context in which various kinds of tasks are performed will provide essential information needed to describe both the nature of people's work activities and the conditions under which they are employed. Thus, this kind of work context information may well constitute an essential component of a truly comprehensive occupational information system.

The physical and social variables that influence how people go about performing certain kinds of work activities are not the only kinds of contextual variables that influence people's work activities. Work activities occur within a broader organizational structure, and there is substantial reason to suspect that attributes of the organizational context or structure, such as leadership, structure, role requirements, and the autonomy that is granted employees, also influence how people go about doing their work (Ilgen & Hollenbeck, 1990; Ulrich, & Wieland, 1981). Accordingly, there would seem to be a need to consider the effects of organizational structure and context in a truly comprehensive occupational information system.

A variety of conceptual models has been used to identify relevant organizational variables and how these variables act to influence performance across different positions in an organization. Although a variety of models might be used to identify relevant organizational variables, perhaps the most widely accepted theoretical framework may be found in the various models of organizational behavior that view organizations as complex systems (Katz & Kahn, 1978). Within a systems framework the organization is viewed as an adaptive entity composed of multiple sub-systems trying to maintain an efficient, successful production process within a dynamic internal and external environment. This kind of framework for understanding organizations is particularly attractive, in part because it explicitly seeks to understand how organizations maintain high performance in the face of a dynamic competitive environment. More directly, however, organizational systems theory has proven useful in identifying the kinds of variables that influence people's work activities and motivation, including organizational goals and values, role requirements, task characteristics, and leadership styles (Bass, 1994; Campion & Thayer, 1985; Hackman & Lawler, 1971; Katz & Kahn, 1978).

Occupation Characteristics

One important point stressed by organizational systems theory is that organizations operate within, and must adapt to, a broader economic and social system. Thus, a comprehensive occupational information system must go beyond the description of work activities, work context, and organizational context to consider the broader economic environment in which this work occurs. These economic descriptors, from the point of view of an occupational information system, might be subsumed under the rubric of labor market characteristics. The general category of labor market conditions would consider broader economic variables, such as industry, employment opportunities, job scarcity, and pay.

Information bearing on these and a number of other economic variables that might be used to describe occupations is collected through the ongoing efforts of various federal agencies, including the Department of Commerce, the Department of Education, and the Bureau of Labor Statistics. These existing databases might, therefore, be reviewed to identify the kinds of information that should be considered in a comprehensive occupational information system. These aggregate economic variables might then be systematically related to the various kinds of variables subsumed under the rubrics of occupation requirements and worker requirements to provide a truly comprehensive description of the world of work.

Model Structure

The foregoing discussion has primarily focused on the general types of cross-occupation descriptors that would be included in a new occupational information system. This discussion of the major types of cross-occupation descriptors, however, has not considered a variety of issues bearing on how these variables would be structured to promote different kinds of applications, such as the acquisition and organization of job-specific descriptors. Thus, in the following discussion, we will consider these structural issues within the context of the general structural model presented above.

To begin, it is important to recognize that the foregoing description of the content model has only focused on general categories or types of variables. Thus, we have provided relatively little information bearing on the specific nature of the variables included in each of these general domains. This information will be the primary focus of many of the following chapters. At this point, however, there is a need to consider certain general issues bearing on the structure of these variables.

Within a given domain — skills and interests, for example — a variety of theories has been proposed to account for the key descriptors in the domain. Thus, in identifying the particular variables or the taxonomy to be applied within a domain, it is necessary to begin with a review of the pertinent theoretical work and empirical findings (Fleishman, & Mumford, 1991). This review is intended to identify those specific variables that have the strongest basis in the literature and might provide the most useful information for a comprehensive occupational information system.

Although it is necessary to arrive at a final taxonomy describing the key variables needed in each general domain specified by the content model, this effort is likely to be complicated by a characteristic of nearly all taxonomic systems. More specifically, definition of relevant variables might occur at many levels. For example, in the area of abilities, some investigators apply a broad one-factor or general intelligence model (Spearman, 1931), while other investigators propose more narrow taxonomic systems encompassing a number of discrete abilities (Guilford & Hoepfner, 1967; Thurstone, 1938). These differences in the level of description bring to the fore a new question. Exactly what level of description should be applied in an occupational information system?

A potential solution to this problem is suggested by the work of Vernon (1950). More specifically, there are studies of abilities that indicate that these different levels of description do not necessarily represent competing taxonomic systems. Instead, broad general taxonomies often subsume more narrow taxonomies in a hierarchical structure of the sort illustrated in Figure 2-4. Accordingly, in developing taxonomies within each area specified in the content model, an attempt was made to specify higher and lower level organizations of the relevant variables.

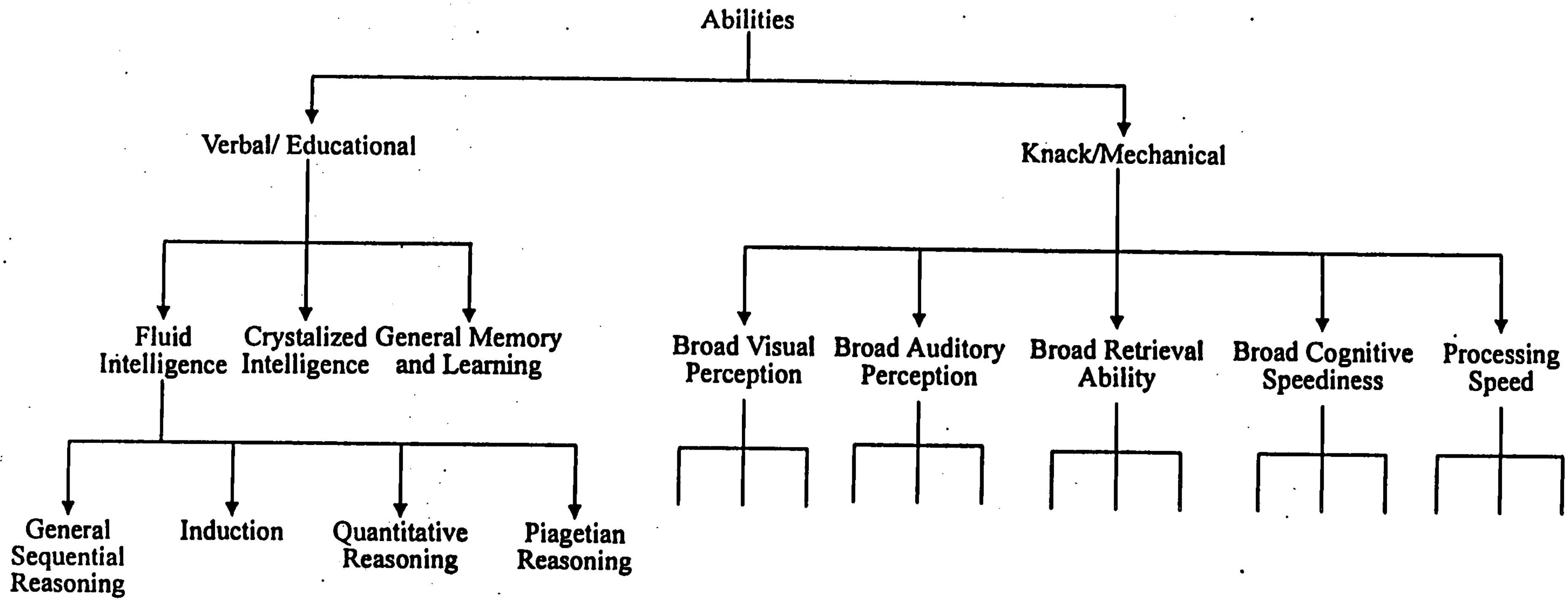


Figure 2-4
Hierarchical Arrangement of Abilities

This hierarchical arrangement of variables within a given domain of the content model might prove useful in addressing four issues. First, this organization permits the integration of multiple taxonomic systems employing different levels of description, thereby resulting in a more comprehensive descriptive system. Second, because relationships among variables at different levels of description are specified, a stronger foundation is available for drawing inferences about the construct validity of the resulting descriptive information. Third, arrangement of the variables in a hierarchical fashion permits users to apply a taxonomy at the level of description most appropriate for the questions they are asking. Fourth, and finally, it becomes possible to extend the initial taxonomies to capture more detailed descriptive information for certain variables of special interest in addressing certain more limited questions. This flexibility in the level of description should, in turn, provide an occupational information system that can readily be extended to address new types of questions.

The hierarchical organization of the cross-occupation descriptors included in the taxonomy also is of some importance in extending this descriptive system to capture occupation-specific information. Although cross-occupation descriptors provide a necessary foundation for the development of a general occupational information system, occupation-specific descriptions will still be required to address certain questions such as training program design and the certification of requisite occupation-specific skills (McCage, 1993).

Within the kind of hierarchical structure described above, occupation-specific descriptors might be identified and organized in terms of the broader, cross-occupation descriptors. Thus, occupation-specific skills might be organized within the framework of a broader set of cross-functional skills, while tasks might be organized in terms of generalized work activities. Not only would this approach provide a systematic framework for the organization of occupation-specific descriptors such as tasks, tools, duties, occupation-specific skills, and occupation-specific knowledges, but it also might provide a more efficient set of procedures for the identification of occupation-specific descriptors.

Traditionally, job description primarily consists of inductive rating beginning with specific descriptors applied to a particular occupation or set of occupations. More general cross-occupation descriptors are empirically identified by determining the commonalities that occur across occupations. Like other inductive procedures, this approach is slow, requiring the progressive accumulation of data, and suffers from problems associated with the comparability of the data being collected. Further, the lack of an *a priori* framework for collecting data makes it substantially more difficult to obtain the requisite descriptive information in a timely, low cost fashion.

In contrast, one might attempt to identify occupation-specific information deductively, using a valid set of cross-occupation descriptors as a basis for generating more specific descriptive information. In fact, this approach has been applied in a recent series of studies by Mumford and his colleagues (e.g., Clifton, Connelly, Reiter-Palmon, & Mumford, 1991). In these studies, an attempt was made to identify the tasks performed by sales personnel, senior managers, and stockbrokers through a series of subject matter expert meetings. In contrast to the procedures commonly used in the identification of job tasks, panel members were asked to generate task statements for certain generalized work activities drawn from prior factoring of the Position Analysis Questionnaire. It was found that, given this *a priori* framework, panel members could generate task statements far more rapidly than is typically the case, with higher agreement among panels concerning the tasks involved in their occupations. Further, this task information could be used to identify tools and equipment needed, as well as functional duties involving multiple tasks performed to provide some product or service.

If this kind of hierarchically-based, deductive procedure could be extended to the definition of occupation-specific skills and knowledges, it might provide a more cost efficient procedure for the identification of requisite occupation-specific information. When the efficiencies inherent in this deductive procedure are considered in light of the ability of this kind of procedure to organize occupational information in terms of a broader cross-occupation framework, they provide a compelling argument for application of this approach in the development of a comprehensive occupational information system.

Measurement

Assuming one can develop a set of taxonomies describing the descriptors included in the various domains being examined by this content model, a new question arises. How might we go about measuring jobs in terms of their status on these descriptors? A variety of techniques might be used to describe occupations or sets of occupations with respect to their status on the variables included in the content model. One might, for example, develop objective formal tests intended to assess incumbents' expression of certain characteristics. Alternatively, one might ask job analysts to observe performance in an occupation or set of occupations and then rate the extent to which each variable appears to be required for effective job performance.

The selection of a technique for measuring these variables is necessarily conditional upon a host of considerations. However, certain structural issues bearing on implementation of the content model provide some guidelines concerning the measurement of pertinent variables. To begin, standardized tests intended to assess performance or generalized work activities, knowledges, and skills are simply too expensive to develop, and too time consuming for participating organizations, to be feasible at this juncture. Accordingly, some variation on the information gathering procedures commonly used in job analysis studies must be applied in assessing the variables included in the content model.

Developing and administering paper-and-pencil questionnaires is relatively inexpensive. This is especially true when the questionnaires administered to subject matter experts examine the same general set of cross-occupation descriptors regardless of the occupation at hand. More specifically, only one questionnaire needs to be developed to describe a variety of occupations. If more detailed occupation-specific information needs to be collected, this may be done over time and for select occupations, thereby further reducing the costs of occupation analysis efforts.

Alternatively, data might be collected using a number of more advanced techniques, such as a computer-assisted telephone interview, computer administration of the questionnaire using a diskette mail-out or INTERNET, and fax back. Clearly, many of these alternatives to the traditional paper-and-pencil questionnaire depend on access to certain technologies. Thus, it appears that a traditional paper-and-pencil approach, perhaps coupled with follow-up telephone calls, would provide the most general approach for collecting requisite descriptive information. Nonetheless, as recommended by the APDOT report, there still is a need to investigate the relative merits of these and other potential alternatives to the traditional paper-and-pencil questionnaire.

For the time being, initial data collection is likely to depend on paper-and-pencil questionnaires, supplemented by alternative techniques, and there is a need to consider who will be asked to complete these questionnaires. Three types of respondents are available who have an adequate background to complete job analysis questionnaires: incumbents, supervisors, and job analysts.

Often the information obtained from job analysts is given somewhat greater weight in job analysis efforts. This preference for analysts' judgments is, in part, based on two considerations. First, analysts are commonly held to be more objective about occupation requirements. Second, analysts are held to have a broader background for evaluating occupation requirements. Third, one might argue that analysts are better able to cope with the language involved in most paper-and-pencil job analysis questionnaires.

On the other hand, however, it should be recognized that analysts cannot make ratings on many descriptors without a substantial amount of observation and a number of incumbent interviews. Further, for some potentially useful descriptors, work styles or organizational context, it may not be possible for analysts to respond to these questions without prolonged observation. Thus, analyst-based measures may be too expensive for rating use.

Further, it should be recognized that the bulk of the available empirical evidence does not support the proposition that analysts provide uniquely accurate information. In one study along these lines, Fleishman and Mumford (1988) examined the degree of agreement among ability requirement ratings obtained from incumbents, supervisors, and job analysts. They found that, at least in these relatively high ability populations, all three types of raters yielded virtually identical descriptions of ability requirements.

These results are by no means unique. In another study, Peterson, Owens-Kuntz, Hoffman, Arabian, and Whetzel (1990), had soldiers, their supervisors, and job analysts assess knowledge, skill, ability and work style requirements of a sample of Army jobs. They found that these judges displayed substantial agreement with respect to occupation requirements.

When one considers these findings with respect to the expense entailed in gathering analysts' judgments, they clearly argue for the use of an alternative approach. More specifically, because comparable descriptive data can be obtained from incumbents and supervisors, and these data can be gathered without incurring the costs associated with analyst observation, it appears that incumbents and supervisors should be used in lieu of analysts. However, to make this approach feasible, it is essential that simple, easily understood operational definitions be formulated for each descriptor which can be responded to by incumbents or supervisors with a sixth grade reading level.

With regard to the choice between incumbents and supervisors as potential raters, one further comment seems in order. Eventually, a viable occupational information system must be able to identify new occupations as they emerge. Thus, it is desirable to minimize the amount of *a priori* structure imposed on the data collection. As a result, it seems that incumbents rather than supervisors should be preferred as a source of descriptive information. It is of note, however, that a relatively large number of incumbents, 20 or more, may be required to obtain adequate job descriptions at the occupation level. Further, in some cases, such as the organizational context variables where incumbents lack adequate exposure, it may be necessary to obtain information from relevant managerial personnel.

If it is granted that incumbents, people who actually are working in an occupation, provide an appropriate population for providing descriptive information, then a new question arises. What scales or response formats will be used to provide this descriptive information? Any answer to this question is necessarily dependent on the particular type of variable under consideration. Thus, the specific measurement scales under consideration can only be addressed in the context of the taxonomy developed for a particular set of cross-occupation descriptors.

Bearing this necessary caveat in mind, it still is possible to draw some general conclusions about requisite scales, at least in certain areas. When one is considering attributes of the worker, including abilities, interests, and work styles, as well as knowledges and skills, a number of different scale formats may be applied. Fleishman's (1982) ability requirement ratings, for example, are based on behaviorally anchored scales examining the level of the ability required for task performance. Other investigators ask incumbents to rate the importance of a characteristic to overall task performance. Beyond level and importance, a number of other scales might be proposed, such as the importance of the characteristic in accounting for performance differences or the application of this characteristic under emergency or stressful conditions (Sackett, 1993, personal communication).

Typically, these different scales for acquiring information about worker characteristics display sizable correlations, indicating some redundancy in the information being provided. However, as McCormick (1964) points out, the use of multiple scales appears to result in more reliable evaluations, perhaps because they induce somewhat more careful evaluations on the part of incumbents. Further, different scales may provide somewhat different types of descriptive information. In the case of office clerks, for example, writing may be an important determinant of performance, but a high level of writing skill may not be required in comparison to other occupations. Thus, there would seem to be some merit in describing variables in terms of multiple scales.

Broadly speaking, two types of scales appear to provide the kinds of information needed in an occupational information system. These scales are a level scale reflecting the complexity of the demands made on an attribute, and an importance scale reflecting the impact of this variable on performance. With regard to this general conclusion, however, two further comments are necessary. First, depending on the type of variable at hand, different kinds of anchors may be required for different level scales. For example, general anchors may be appropriate for abilities, while occupation-relevant level anchors may be more appropriate for cross-functional skills, which are referenced against the work domain. Second, additional scales may be required for certain types of variables. In the case of knowledges and skills, which represent developed attributes, it would be useful to have information bearing on when or where a given knowledge or skill was acquired.

It is somewhat more difficult to draw general conclusions about the kinds of scales that should be applied when describing occupation requirements, such as generalized work activities, work context, and organizational context, because specific types of variables imply rather different questions and rating scales. A similar situation exists for training, licensure, and education, where different variables dictate different types of questions.

In most cases, however, information pertinent to these variables comes in two basic forms. First, one might ask people to describe the occurrence of an activity or an event. Second, one might formulate questions examining the frequency with which an event occurs. Third, questions might be formulated examining reactions to an event or the outcomes of an action. In the case of generalized work activities and work context, frequency and occurrence questions provide an especially appropriate descriptive strategy — one commonly used in describing work requirements (McCormick, 1976, 1979). However, a broader range of scale types is likely to be required in the training, licensure, and education areas, as well as the organizational context area.

Conclusions

In the following chapters of this report we will examine the variables identified for each of the cross-occupation descriptors included in the content model. We will also consider the specific types of questions and measures that will be used to describe people's positions using these variables. Before turning to the specific variables and measures proposed for each area of the content model, however, it would seem appropriate to consider a broader issue. Will the kind of content model described above provide the kind of occupational information system called for in the APDOT report?

The content model sketched out above clearly considers virtually all of the areas held to be of some importance in the APDOT report. Moreover, it provides a way of organizing and interrelating these variables by distinguishing between cross-occupation and occupation-specific descriptors, as well as characteristics of the worker and characteristics of the work being done. This general structural framework allows us to organize the types of variables included in the APDOT report in such a way that the resulting occupational information system should be capable of answering a variety of questions posed by many different users.

For example, by establishing the relationship between generalized work activities and skills, this model would allow users to identify the kinds of skills they must acquire to be qualified for certain positions. Further, these skill requirements might be associated with recommendations about requisite training and education. Along somewhat different lines, the relationship between organizational context and generalized work activities might allow researchers to examine how organizational structure and culture influence the way people go about doing their work. Other examples of the kinds of questions that might be addressed through this content model could, of course, be cited. These illustrations, however, seem sufficient to make a more basic point. By establishing the relationships among these various categories of variables, the proposed content model will permit the development of an O*NET capable of addressing a variety of questions.

The content model, moreover, provides a basis for organizing occupation-specific information and organizing more specific descriptive information within a broader cross-job framework. Accordingly, this content model may well provide the kind of common language framework needed for a truly comprehensive occupational information system. In the following chapters we describe the kinds of variables that provide the basis for this common language.

References

Ackerman, P.L. (1987). Individual differences in skill learning: An integration of psychometric and information processing perspectives. *Psychological Bulletin, 102,* 3-27.

Anderson, J.R. (1993). Problem solving and learning. *American Psychologist, 48,* 35-44.

Ash, R.A. (1988). Job analysis in the world of work. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 3-13). New York: Wiley.

Bass, B.M. (1994). *Improving organizational effectiveness through transformational leadership.* Sherwood Oaks, CA: Sage.

Borgen, F.H. (1988). Occupational reinforcer patterns. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 902-915). New York: Wiley.

Campbell, D.T. (1971). *Handbook for the strong-vocational interest blank.* Palo Alto, CA: Stanford University Press.

Campbell, J.P. (1993). *Development of occupational/skill clusters: Issues and recommendations.* Paper prepared for the United States Department of Labor. Washington, DC.

Campbell, J.P., McCloy, R.A., Oppler, S.H., & Sager, C.E. (1992). A theory of performance. In N. Schmitt and W.C. Borman (Eds.), *Personnel selection in organizations* (pp. 35-70). San Francisco, CA: Josey-Bass.

Campbell, J.P., McHenry, J.J., & Wise, L.L. (1990). Modeling job performance in a population of jobs. *Personnel Psychology, 43,* 313-333.

Campion, M.A., & Thayer, P.W. (1985). Development and field evaluation of an interdisciplinary measure of job design. *Journal of Applied Psychology, 70,* 29-43.

Chi, M.T.H., Bassock, M., Lewis, M.W., Reimann, P., & Glaser, R. (1989). Self explanations: How students study and use examples in learning to solve problems. *Cognitive Science, 13,* 145-182.

Chi, M.T.H., & Glaser, R. (1985). *Problem solving ability* (Report No. LRDC-1985/6 for the Office of Naval Research, Washington, DC). Learning Research and Development Center, University of Pittsburgh, PA.

Clifton, T.C., Connelly, M.S., Reiter-Palmon, R., & Mumford, M.D. (1991). *Exploring the C Division regional sales manager position: Summary of subject matter expert meetings* (Report #91-6). Fairfax, VA: Center for Behavioral and Cognitive Studies.

Cunningham, J W., Boese, R.R., Neeb, R.W., & Pass, J.J. (1983). Systematically derived work dimensions: Factor analyses of the Occupational Analysis Inventory. *Journal of Applied Psychology, 68,* 232-252.

Dawis, R.V. (1990). Vocational interests, values, and preferences. In M.D. Dunnette and L.M. Hough (Eds.), *Handbook of industrial and organizational psychology: Vol. II* (pp. 833-872). Palo Alto, CA: Josey-Bass.

Dweck, C.S. (1986). Motivational processes affecting learning. *American Psychologist, 41,* 1040-1048.

Feltovich, P.T., Spiro, R.T., & Coulson, R.L. (1993). Learning, teaching, and testing for complex conceptual understanding. In N. Friedrickson, R.J. Mislevy, and I.I. Bejar (Eds.), *Test theory for a new kind of tests* (pp. 181-218). Hillsdale, NJ: Erlbaum.

Fleishman, E.A. (1982). Systems for describing human tasks. *American Psychologist, 37,* 821-834.

Fleishman, E. A., & Hempel, W. E. (1955). The relation between abilities and improvement with practice in a usual discrimination reaction time task. *Journal of Experimental Psychology, 44,* 301-312.

Fleishman, E.A., & Mumford, M.D. (1988). The ability requirements scales. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York: Wiley.

Fleishman, E.A., & Mumford, M.D. (1991). Evaluating classifications of job behavior: A construct validation of the ability requirements scales. *Personnel Psychology, 44,* 523-575.

Fleishman, E.A., & Quaintance, M.K. (1984). *Taxonomies of human performance: The psychology of human tasks.* Orlando, FL: Academic Press.

Goldstein, I.L. (1990). Training in work organizations. In M.D. Dunnette and L.M. Hough (Eds.), *Handbook of industrial and organizational psychology: Vol. II* (pp. 507-620). Palo Alto, CA: Consulting Psychologists Press.

Guilford, J P., & Hoepfner, R. (1967). *Structure of intellect factors and their tests.* Los Angeles, CA: Psychological Laboratory, University of Southern California.

Guion, N.M. (1966). *Personnel selection.* New York: McGraw-Hill.

Guion, N.M. (1994). Personal communication.

Hackman, J.R., & Lawler, E.E. (1971). Employee reactions to job characteristics. *Journal of Applied Psychology, 55,* 255-286.

Halpern, D. (1994). *A national assessment of critical thinking skills in adults: Taking steps towards the goal.* Washington, DC: National Center for Educational Statistics.

Harvey, R.J. (1990). Job Analysis. In M.D. Dunnette and L.M. Hough (Eds.), *Handbook of industrial and organizational psychology: Vol II* (pp. 71-164). Palo Alto, CA: Consulting Psychologists Press.

Hogan, R.T. (1990). Personality and personality measurement. In M. D. Dunnette and L. M. Hough (Eds.), *Handbook of industrial and organizational psychology: Vol. II* (pp. 873-919). Palo Alto, CA: Consulting Psychologists Press.

Holland, J.L. (1973). *Making vocational choices: A theory of careers.* Englewood Cliffs, NJ: Prentice-Hall.

Howell, W.C. (1990). Human factors in the work place. In M.D. Dunnette and L.M. Hough (Eds.), *Handbook of industrial and organizational psychology: Vol II* (pp. 209-270). Palo Alto, CA: Consulting Psychologists Press.

Ilgen, D.R., & Hollenbeck, J.R. (1990). The structure of work: Job design and roles. In M.D. Dunnette and L.M. Hough (Eds.), *Handbook of industrial and organizational psychology: Vol II* (pp/ 168-208). Palo Alto, CA: Consulting Psychologists Press.

Jeanneret, P.R., McCormick, E.J., & Mecham (1977). *Job analysis manual for the Position Analysis Questionnaire (PAQ).* West Lafayette, IN: University Book Store.

Katz, D., & Kahn, R. L. (1978). *The social psychology of organizations* (2nd ed.). New York: Wiley.

Lopez, F.M. (1988). Threshold trait analysis system. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 880-901). New York: Wiley.

McCage, R.D. (1993). *Observations regarding the development of occupational skills clusters.* Paper prepared for the United States Department of Labor. Washington, DC.

McCormick, E.J. (1964). *Development of a worker activity checklist for use in occupational analysis* (Report #62-77). Lackland AFB, TX: Air Force Human Resources Laboratory.

McCormick, E.J. (1976). Job Analysis. In M.D. Dunnette (Ed.) *Handbook of industrial and organizational psychology* (pp. 651-696). Chicago, IL: Rand-McNally.

McCormick, E.J. (1979). *Job analysis: Methods and applications.* New York: Amacom.

McCormick, E.J., Jeanneret, P. R., & Mecham, R. C. (1972). A study of job characteristics and job dimensions as based on the Position Analysis Questionnaire (PAQ). *Journal of Applied Psychology, 56,* 347-368.

Medin, D.L. (1984). Concepts and conceptual structure. *American Psychologist, 12,* 1469-1481.

Mitchell, J.L., Ruck, H.W., & Driskell, W.E. (1988). Task-based training program development. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 205-214). New York: Wiley.

Mumford, M.D., & Baughman, W.A. (in press). Process analytic models of creative capacities: Operations involved in the combination and reorganization process. *Creativity Research Journal.*

Mumford, M.D., Mobley, M.I., Uhlman, C.E., Reiter-Palmon, R., & Doares, L. M. (1991). Process analytic models of creative capacities. *Creativity Research Journal, 4,* 91-122.

Peterson, N.G. (1992). *Methodology report.* Washington, DC: American Institutes for Research.

Peterson, N.G., Owens-Kuntz, C., Hoffman, R.G., Arabian, J.M., & Whetzel, D.C. (1990). *Army synthetic validation project.* Alexandria, VA: U.S. Army Research Institute for the Behavioral Sciences.

Sackett, P.D. (1993). Personal communication.

Sackett, P.R., Zedeck, S., & Folgi, L. (1988). Relations between measures of typical and maximal performance. *Journal of Applied Psychology,* 73, 482-486.

Schmeck, R.R. (1988). Individual differences and learning strategies. In C.E. Weinstein, E.T. Goetz, and P.A. Alexander (Eds.), *Learning and study strategies: Issues in assessment, instruction, and evaluation* (pp. 171-191). New York: Academic Press.

Schmidt, F.L., Hunter, J.E., & Pearlman, K. (1981). Task differences as moderations of aptitude test validity in selection: A red herring. *Journal of Applied Psychology, 66*, 166-185.

Snow, R. E. (1986). Individual differences and the design of educational programs. *American Psychologist, 41*, 1029-1034.

Snow, R.E., & Lohman, D.F. (1984). Toward a theory of cognitive aptitude for learning from instruction. *Journal of Educational Psychology, 76*, 347-375.

Snow, R.E., & Swanson, J. (1992). Instructional psychology, aptitude, adaptation, and assessment. *Annual Review of Psychology, 43*, 583-626.

Spearman, C. (1931). *The abilities of man.* New York: McMillan.

Strong, E.K. (1943). *The vocational interest of men and women.* Palo Alto, CA: Stanford University Press.

Thorndike, R.L., & Hagen, E. (1959). *10,000 careers.* New York: Wiley.

Thurstone, L.L. (1938). Primary mental abilities. *Psychometric Monographs No. 1.* Chicago: University of Chicago Press.

Ulrich, K.V., & Wieland, J.C. (1981). *Organizational theory and design.* New York: Irwin.

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

Vernon, P.E. (1950). The validation of civil service selection and procedures. *Occupational Psychology*, 24, 75-95.

Ward, S.L., Byrnes, J.P., & Oventon, W.F. (1990). Organization of knowledges and conditional reasoning. *Journal of Educational Psychology, 82*, 832-837.

SECTION I

WORKER REQUIREMENTS

Section I
Worker Requirements

The content model presented in the preceding chapter indicates that jobs might be described in terms of a number of different kinds of cross-job descriptors. One might, for example, describe jobs in terms of worker characteristics or, alternatively, one might use the kind of variables subsumed under the general rubric of job requirements. In this section, however, we will focus on those descriptors subsumed under the rubric of worker requirements.

The term worker requirements is not merely a label for a hodgepodge of variables. Instead, the label refers to a specific set of worker-related variables that might be used to describe peoples' jobs. More specifically, worker requirements refer to developed attributes of the individual that might in some way contribute to performance across a variety of positions. Worker characteristics, in contrast to worker requirements, refer to more enduring attributes of the worker.

Worker requirements as a category might subsume a number of variables describing an individual. For example, knowledge, or expertise, clearly develops as a function of experience. Further, schooling, often intended to provide a certain body of knowledge, might also be viewed as a worker requirement. In addition to knowledge and education, people's experiences also provide them with a set of skills. Some skills, such as basic skills, might facilitate learning and the acquisition of knowledge in a variety of contexts. Other skills, such as certain cross-functional skills, may be more closely tied to the kind of work people do.

We will begin this section on worker requirements with a chapter (Chapter 3) that examines the various skills that might be used in a cross-job descriptive system. This chapter will begin by considering basic skills and then proceed to cross-functional skills. The second chapter in this section (Chapter 4) will examine knowledges and propose an initial taxonomy of occupational knowledges which includes both basic and cross-functional knowledges. In our third and final chapter in this section (Chapter 5) we will briefly consider educational requirements with specific reference to their implications for requisite knowledges and skills.

Chapter 3
Skills
Table of Contents

Tables

Figures

Appendices

Chapter 3
Skills

Michael D. Mumford
Norman G. Peterson
American Institutes for Research

Identification and assessment of the skills held to underlie job performance are of current interest in a variety of circles. One example of this interest in skill identification and development can be found in the work of the Secretary's Commission on Achieving Necessary Skills (SCANS). The skill boards established by the Departments of Education and Labor represent another recent example of concerns about the issues involved in skill identification and assessment.

In the scientific literature, this interest in work force skills represents a radical departure from earlier work in the areas of measurement and assessment. Classic texts in the field, such as Tyler's (1965) work on individual differences, or Cronbach's (1960) review of psychological testing, devote little if any attention to the topic of skills. In fact, to the extent that skills are considered, they are treated as special abilities.

In this chapter, we provide an initial framework for the systematic assessment of work place skills. We begin by considering the forces that underlie this new concern with skill identification and assessment. We then consider available evidence concerning the nature of skills. Finally, we consider the broader implications of the proposed taxonomies for a comprehensive occupational information system.

General Background

When one sees the emergence of a new interest in a certain kind of variable, such as skills, one must ask what social forces are giving rise to this concern with a particular aspect of individual performance. The current interest in skills can be traced to three general trends that confront industrial societies as we move into the next century. These trends include the rate of technological change, global competition, and worker mobility.

It is clear that the rate of technological change has been accelerating over the course of the last fifty years. This trend has become even more pronounced with the development of new information processing and communications technologies. For good or ill, this rapid explosion of information has placed a number of new pressures on society. One place where the effects of this rapid change is most apparent is in the area of education.

When things changed more slowly, it was possible for people to go to school for twelve to sixteen years and acquire a body of knowledge that would last them for the rest of their lives. Now, however, the knowledge acquired one year might be outdated the next year. This rapid dating poses a fundamental problem for educators and trainers. What can we provide to students or trainees that will make a lasting contribution? One answer to this question is that we might redesign our current approaches to education and training to facilitate the development of general skills that extend beyond domain-specific knowledge.

The need for a new educational framework is not the only outcome of changing technology. Technology is inherently democratic and the democracy of technology has created a new world of global industrial competition. This global competition has placed a premium on the availability of a skilled work force. More specifically, there is needed a work force that can rapidly master emerging new technologies. In fact, there is some reason to believe that in the future a competitive position in world markets will to a large extent primarily depend on these kinds of work force skills.

These changes in technology and the nature of industrial competition have, of course, placed a number of new pressures on industries. Organizations and jobs come and go more rapidly in a dynamic technologically-oriented environment. As a result, the employment patterns of the last century, when a person went to work for a large corporation and slowly ascended a well-structured career ladder, are fast disappearing. In its place what we find is a far more dynamic career pattern where people during their lifetimes will hold many different jobs with many different organizations. How are we to provide workers with a basis for adapting to such a dynamic environment? Again, the answer involves skills. In other words, we must provide workers with skills that will allow them to rapidly master a variety of new tasks.

Skills

When one considers these fundamental changes in society it is hardly surprising that many of our major institutions are trying to grapple with the problems involved in the identification, assessment, and development of skills. As is the case in many emergent areas, the skills literature is, at best, confused. At its worst, it has the feeling of a giant shell game. This point is nicely illustrated by considering the various definitions of skills commonly found in the literature. Some scholars define skills as task performance. Others define skills in terms of basic educational variables: the old "three Rs" of reading, writing, and 'rithmetic. Still others see skills as a set of rather broad new capacities, as illustrated in the literature on critical thinking skills (Halpern, 1994).

This definitional debate represents perhaps the most important problem in the skills literature. If we cannot define requisite skills, how are we to go about developing and assessing these skills? To solve this problem, one must begin by considering what we know about the nature of skilled performance.

Psychological and educational research has not traditionally spent much time examining the nature of skilled performance. Nonetheless, the few studies that have been conducted provide us with important clues concerning the nature of skills and skilled performance. These studies provide one potential framework for resolving the skill definition issue. Further, they provide some important clues as to how we might go about measuring and developing these skills.

Initial research into the nature of skilled performance was primarily empirical in nature. This research was, broadly speaking, concerned with identifying the variables that influenced the acquisition of skilled performance in narrowly defined task domains. For example, initial studies by Fleishman and his colleagues (Fleishman, 1982; Fleishman and Hempel, 1955) showed that abilities, such as verbal reasoning, represent important influences on the development of skilled performance. More recent work by Kanfer and Ackerman (1989) and Ackerman (1994) has shown that motivational and dispositional variables also influence the acquisition of skilled performance.

In contrast to this work on the differential variables influencing the acquisition of skilled performance, studies in the cognitive tradition have sought to use techniques such as protocol analysis and comparison of expert-novice differences to identify the characteristics of skilled performance (Anderson, 1993; Chi and Glaser, 1985; Ward, Byrnes, and Overton, 1990). Essentially, these studies indicate that skilled performance requires expertise, or a principle-based organization of relevant facts. In addition to knowledge or expertise, skilled performance also appears to require a set of procedures, processes, and strategies for acquiring and working with relevant knowledge (Anderson, 1993; Campbell, McCloy, Oppler, and Sager, 1992; Greeno and Simon, 1988; Sternberg, 1986; Sweller, 1989). Because these procedures for working with knowledge appear to generalize across domains, unlike knowledge *per se* which is somewhat domain specific, they may represent the key generalizable aspect of performance needed to define skills.

This observation is of some importance because it allows us to propose an initial, tentative definition of skills. Skills in this sense represent a set of general procedures that underlie the effective acquisition and application of knowledge in various domains of endeavor. This definition of skills has a number of noteworthy implications. First, skills are inherently tied to knowledge, practice, and expertise. One cannot apply skills, or for that matter acquire skills, without reference to some task or content domain. Second, skills can be viewed as general procedures required to perform multiple tasks lying in some broad domain such as problem solving or social interaction. Third, skills in this sense are not necessarily stable attributes of the individual. Instead, they are attributes of the individual that develop as a function of experience within a certain domain.

Given these observations, one cannot reasonably propose a single absolute taxonomy of skills. Instead, different skills will be called for and will develop in part as a function of experience in different kinds of task domains. Thus, skill definition must be domain referenced. This observation in turn poses a new question. How can one go about defining the domains of skilled performance?

The term *performance* is the key to answer this question and to define requisite skills. To identify skills within this framework, one must begin by specifying the major performance domains of interest. With regard to most current discussions of skills, three general performance domains are of concern (Kane & Meltzer, 1990).

First, one might speak of skills as developed capacities that facilitate learning or the more rapid acquisition of new knowledge. These learning-relevant skills are referred to as *basic skills*. Although basic skills are commonly held to facilitate learning, it is important to recognize that learning is not solely a property of the classroom. This observation was the basis for Jones' (1994) argument that many of the basic skills commonly examined in the educational literature may also be relevant to understanding learning and performance in the work force.

A second way one might conceive of skills is as developed capacities that facilitate performance in a variety of job settings. This definition of skills is what is commonly meant by the term *cross-functional skills*. The question that invariably arises, however, when one uses the term *cross-functional skills* is, exactly what are the kinds of developed capacities likely to contribute to performance and performance acquisition in a variety of job settings?

One potential answer to this question is suggested by the work of Fine (1988). Fine defines skills, such as synthesis, in terms of developed capacities that might facilitate performance in broad domains of activities that might occur on virtually any job. Thus, Fine (1988) proposes a taxonomy of the skills involved in working with data, people, and things. This broad definition of the likely types of cross-functional skills is consistent with observations about the nature of work.

Although many models of work place behavior are available, socio-technical systems theory represents the most widely accepted model (Katz & Kahn, 1978). Within this model, work is viewed as a process by which technology and people interact to transform raw materials into useful products. This transformation process not only requires ongoing problem solving, it also suggests that in solving significant problems in the organization's transformation process, virtually all jobs will require individuals to work with people, technology, and a broader organizational system, using available resources to complete the work. Thus, socio-technical systems theory suggests that there will be five general domains of cross-functional skills, specifically: 1) solving problems (problem solving skills), 2) working with technology (technical skills), 3) working with people (social skills), 4) working with resources (resource management skills), and 5) working with complex socio-technical systems (systems skills). Thus, in addition to data, people, and things, the socio-technical systems theory points to the need to attend to system and resource management skills. In fact, the literature on leadership performance provides some compelling evidence for the inclusion of these skills in an attempt to understand performance in the work place (Bass, 1994; Carrol & Gillen, 1987).

Of course, these cross-functional skills refer to broad domains of work activities. They do not, however, specifically address the specific kinds of procedures needed to perform the tasks occurring on a certain job. Thus, there is a need to consider a third type of skills, *occupation-specific skills*.

This third type of skill, occupation-specific skills, represents the procedures needed to acquire and perform various job tasks. Thus, occupation-specific skills are inherently tied to the specific activities being performed on a job or within a job family. Taken at face value, this statement might be held to imply that there is no systematic structure to occupation-specific skills. It should be recognized, however, that these skills might be viewed as instances of basic and cross-functional skills within the context of a particular job. Figure 3-1 depicts an example of this hierarchical arrangement of skills.

This figure describing the relationship between the basic and cross-functional skills and occupation-specific skills makes another noteworthy point. In formulating a system for identifying these skills, one cannot begin with the occupation-specific skills, in part because definition of these skills depends on broader skill structures and, in part because these skills must be defined with respect to occupation-specific tasks. Thus, in this chapter we focus on the definition of broader taxonomies of basic and cross-functional skills. We describe an approach to the identification of occupation-specific skills in Chapter 14.

Having identified these general domains or broad kinds of skills, the next question one must address concerns identification of the specific kinds of skills or procedures, processes, and activities that contribute to performance in each of those domains. In the case of basic skills, the educational studies examining the kind of procedures or activities involved in the acquisition of new knowledge might provide a basis for skill definition.

Although the educational research literature can be used to define basic skills, definition of the cross-functional skills underlying performance in general domains or job activities represents a somewhat more complex undertaking. In some cases — for example, problem

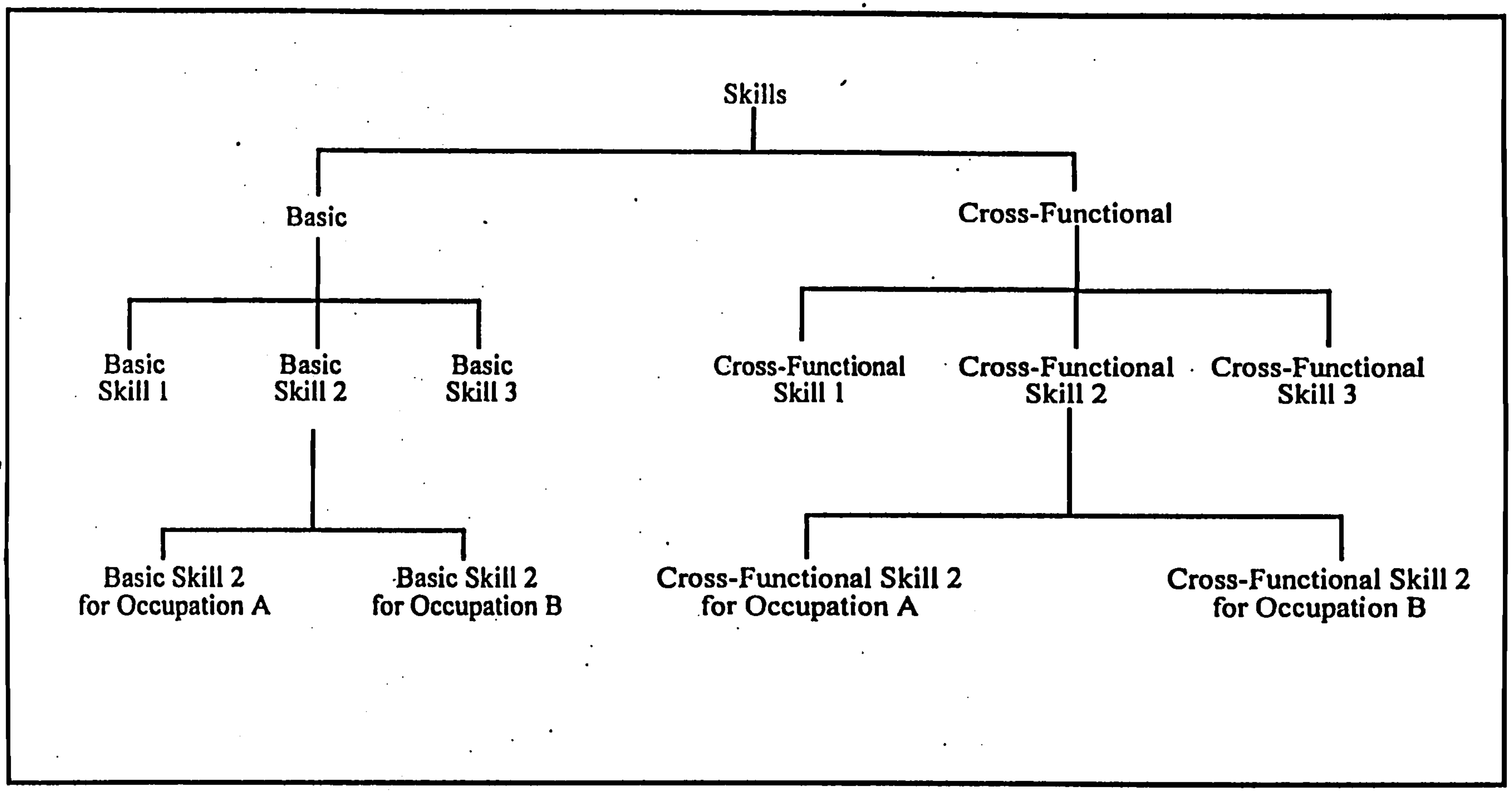


Figure 3-1
Model of Skill Relationships

solving and social skills — prior research examining the determinants of performance in these domains might provide a basis for identifying these skills. In other cases, however, such as technological skills, empirical evidence bearing on general procedural activities might provide a more appropriate basis for definition of the relevant skills.

In the following sections of this chapter, we focus on those skills that provide a general set of cross-job descriptors. We begin by presenting the taxonomy developed for basic skills. We then go on to consider the taxonomies developed for each of the five types of cross-functional skills. Finally, we consider some general issues bearing on the proposed skill taxonomies.

Basic Skills

Basic skills have been defined in a variety of ways. Perhaps the most common approach is to define basic skills with respect to the fundamentals that should be provided by any sound educational system (Cureton, 1951; Schmidt, Porter, Schwille, Floden, and Freeman, 1983). This view of basic skills is reflected in the classic definition of these skills as simply the old three Rs — reading, writing, and "rithmetic."

Basic skills, however, need not and perhaps should no, be defined solely in terms of classic educational content. Educational theory and educational practices are changing as a result of the pressures being placed on educational institutions to prepare students for a more complex work place (Linn, 1982; Snow and Swanson, 1992). Further, this content-based approach assumes that learning is simply a classroom activity. In the future, however, a substantial amount of learning may well occur outside the classroom. Thus, there is a need to approach the notion of basic skills from a broader substantive perspective (Jaeger, 1989; Jones, 1994).

Although a variety of approaches might be used to understand basic skills from a substantive perspective, a careful examination of discussions bearing on the nature of basic skills (Daly, 1994) suggests a somewhat different definition. More specifically, basic skills can be viewed as capacities developed over a relatively long period of time that promote or provide a foundation for learning other types of material. In this sense, basic skills, although often educationally-based, represent a key infrastructure needed for the ongoing development of cross-functional and occupation-specific skills as well as requisite knowledges.

When one looks at basic skills in light of these observations, it becomes apparent that they can be split into two broad categories. The first category really refers to content domains and represents background structures needed to work with and acquire more specific skills in a variety cf different domains. This general category includes skills such as reading and speaking used to acquire and convey a variety of types of information.

The second category of basic skills is less concerned with content and more concerned with process. These process skills represent learning-to-learn skills, or procedures that contribute to the more rapid acquisition of knowledge and skills across a variety of domains. Self-monitoring represents one of the skills included in this category (Brown and Camponie, 1986), as would critical thinking (Chaffee 1994; Halpern, 1994).

Content skills. We will begin our effort to develop a basic skills taxonomy by first considering the types of skills subsumed under the general content rubric. Clearly, a great deal of the information and learning material we are presented with in the course of our lives are provided by texts, reports, and other written materials. Accordingly, reading comprehension can be viewed as a basic skill. A variety of studies has examined the nature of reading (Beck and Carpenter, 1986; Friedricksen, 1982; Friedricksen, Warren, and Rosenberg, 1985; Just and Carpenter, 1980; Van Meter and Pressley, 1994). The findings of these studies indicate that reading comprehension is a complex process involving word recognition, vocabulary, comprehension monitoring, discourse analysis, and inference. Skilled readers seem to differ from poor readers in that they execute these processes more rapidly.

Not all information we acquire is necessarily in written form. In fact, much of the new information conveyed to us is in the form of oral communication. The importance of oral communication indicates that listening and questioning may represent another significant basic skill. In fact, Danneman and Carpenter (1986) have shown that good readers also tend to be good listeners, because listening, like reading, involves vocabulary, comprehension monitoring, and discourse analysis, as well as linguistic decoding skills. It is not, of course, sufficient just to listen; this information must be actively processed and feedback must be requested to clarify points of ambiguity. Thus, questioning, as a comprehension monitoring check, may be closely linked to listening. In fact, the available evidence indicates that questioning activities may represent an important influence on learning.

Reading and listening represent the two major ways information is conveyed to us. What is important to recognize here, however, is that this information will not be understood or grasped unless it can be framed within a broader set of concepts (Alexander and Judy, 1988; Stahl, Jacobson, David, & Davis, 1989). Thus, one set of basic skills involves the acquisition of procedural and declarative knowledge (Anderson, 1993) in those broad domains commonly used to structure our understanding of the physical and social world around us (Carey, 1986; Mayer, 1985; Resnick and Omanson, 1987). These observations point to the relationship between knowledge and basic skills. Knowledge of a domain, however, cannot be viewed as a basic skill, distinct from knowledge, unless the procedures being acquired in a domain promote learning in other domains. Because mathematics and science provide a set of unique procedures, such as hypothesis testing, that promote further learning, it appears that a grasp of the procedures involved in applying mathematical and scientific principles can also be viewed as basic skills.

Our foregoing observations bring us to our final set of content-oriented basic skills. In the learning process it is not enough simply to acquire and comprehend information. This information must be used for some practical purpose and conveyed to others. One way we convey learning to others is through written communications, involving the planning, generation, and revision of written material (Hayes and Flower, 1986; Needles and Knapp, 1994). The other way we convey our learning to others is through speaking which serves a variety of purposes, guided by both overall linguistic structure and the demands made by the context at hand (Daly, 1994; Knapp and Vangelisti, 1992; Rubin, 1985).

Process skills. Having identified the basic content skills, we will now consider those skills which facilitate the acquisition of content across domains. The acquisition and organization of information permeate the learning process. It is also true, however, that not all information we are provided with is equally valuable. Thus, to facilitate learning, people must learn to separate the wheat from the chaff. The capacity to identify important relevant information commonly is subsumed under the rubric of critical thinking skills, which includes argument analysis, hypothesis testing, and the application of logic in evaluating information (Chaffee, 1994; Halpern, 1994; Paul, 1990; Perkins, Jay, and Tishman, 1994).

Critical thinking is closely related to a second kind of general learning skill, referred to as active learning. A variety of studies has been conducted in recent years concerning the characteristics of good and poor students. Chi, Bassock, Lewis, Reimann, and Glaser (1989) contrasted good and poor learners with respect to knowledge structure development and found that good learners were more likely to try to actively work with information, searching for organizing principles and their implications. Along similar lines, Schmeck (1988) and Schmeck and Grove (1979) have provided evidence indicating that students who actively work with information, personally elaborating principles and applications, appear more likely to show gains in knowledge. Other work by Dweck (1986), and Snow and Swanson (1992) also points to the importance of these elaborative activities in learning.

Active learning might be viewed as a particular kind of learning strategy (Snow and Swanson, 1992). The term strategies, however, is more commonly used to refer to heuristics used to acquire and apply procedural and declarative knowledge. Means-ends analysis, therefore, represents one kind of learning strategy. Studies by Sweller (1989) and Van Meter, Yoki, and Pressley (1994a, 1994b) clearly indicate that some strategies provide a far more efficient base for the acquisition of knowledge than others. For example, role modeling examples appear to accelerate learning, as does the appropriate use of notes. Thus, an understanding of the learning strategies available, and practice in applying more effective strategies, may contribute to long-term continued skill acquisition in multiple domains.

The fourth process-oriented basic skill that has been shown to influence learning is monitoring (Brown and Camponie, 1986; Camponie and Brown, 1990). Monitoring represents an ongoing appraisal of the success of one's efforts, resulting in revisions in strategy or approach to the learning task when the desired results are not obtained. The evidence compiled by Brown and Camponie (1986) and Sternberg (1986) indicates that effective monitoring not only contributes to learning and performance on the task at hand, but may also promote transfer.

Taxonomy. With respect to performance in learning situations, these observations suggest that basic skills may be understood using the general structural model presented in Figure 3-2. Initially, in learning, people acquire information primarily using *Reading Comprehension* or *Active Listening* skills. This information may then be manipulated using certain general procedures such as those involved in *Mathematics* and *Science*. Finally, people must do something with this information. The *Writing* and *Speaking* activities involved in applying

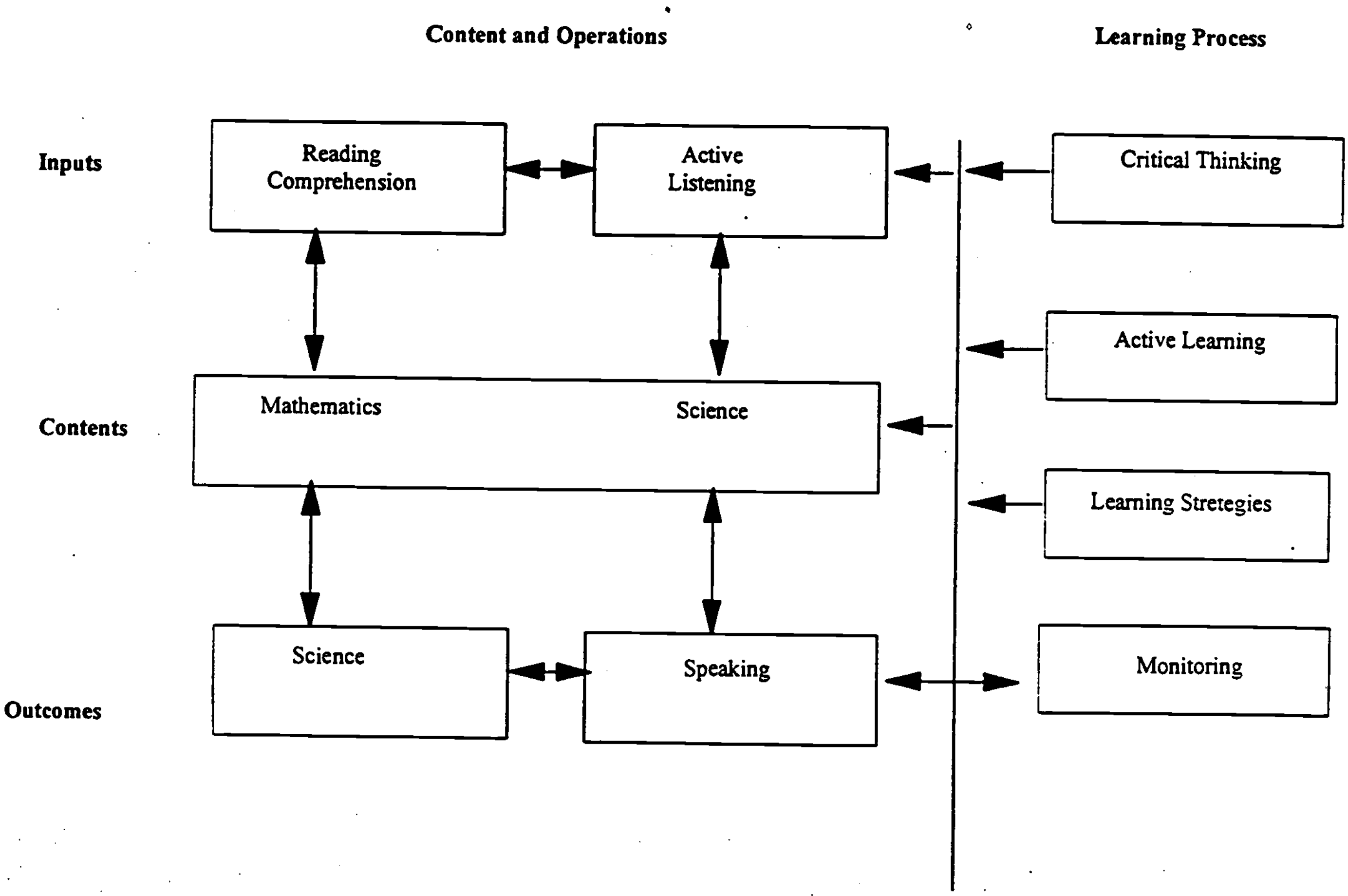


Figure 3-2
Model of Relationships among Basic Skills

information therefore represent our next set of basic skills.

The application of all these skills in the learning process will be influenced by four other kinds of basic skills which reflect learning-to-learn activities. These skills include *Critical Thinking, Active Learning,* use of *Learning Strategies,* and *Monitoring*. All of these learning-to-learn skills will affect application of the various content skills described above. Thus, critical thinking may contribute to listening and questioning as well as writing and the acquisition of scientific concepts. Figure 3-2 also illustrates how these learning process skills influence development and application of the content skills.

The question that arises at this point, of course, is whether these basic skills are indeed related to subsequent performance. The evidence compiled in a variety of test development studies (Guion, 1966; Jensen, 1980) indicates that measures of the various content skills will indeed predict performance. With regard to the learning-to-learn or learning process skills, the evidence is really not available to draw strong conclusions about whether they will predict job performance and skill acquisition on the job. A variety of studies, however, indicates that these skills will indeed contribute to learning in educational settings (Brown and Camponie, 1986; Greeno and Simon, 1988; Schmeck and Grove, 1979). Further, at least some evidence is available indicating that these learning-to-learn skills, like the various content skills, can be developed (Sweller, 1989; Van Meter, Yoki and Pressley, 1994a, 1994b). Thus, there is some reason to suspect that these attributes represent meaningful skill constructs.

Appendix 3-A provides a theoretical and operational definition for each of these basic skills. Appendix 3-A also provides some supporting citations for the skill definitions, a potential level scale, and the mapping of these skills onto the SCANS scales. Based on the results obtained in earlier studies (Fleishman and Mumford, 1991; Peterson, 1992), it can be expected that measures of these skills will yield interrater agreement coefficients in the .70s or .80s when ten to twenty incumbents are available.

It should be recognized, of course, that the number of variables included in this taxonomy is relatively large. Thus the question arises as to whether it might be possible to formulate a more parsimonious second-order taxonomy. Because most research in the basic skills area is primarily focussed on discrete variables rather than systems of variables, it is difficult to find relevant examples in the literature pertaining to the nature of the variables that would be

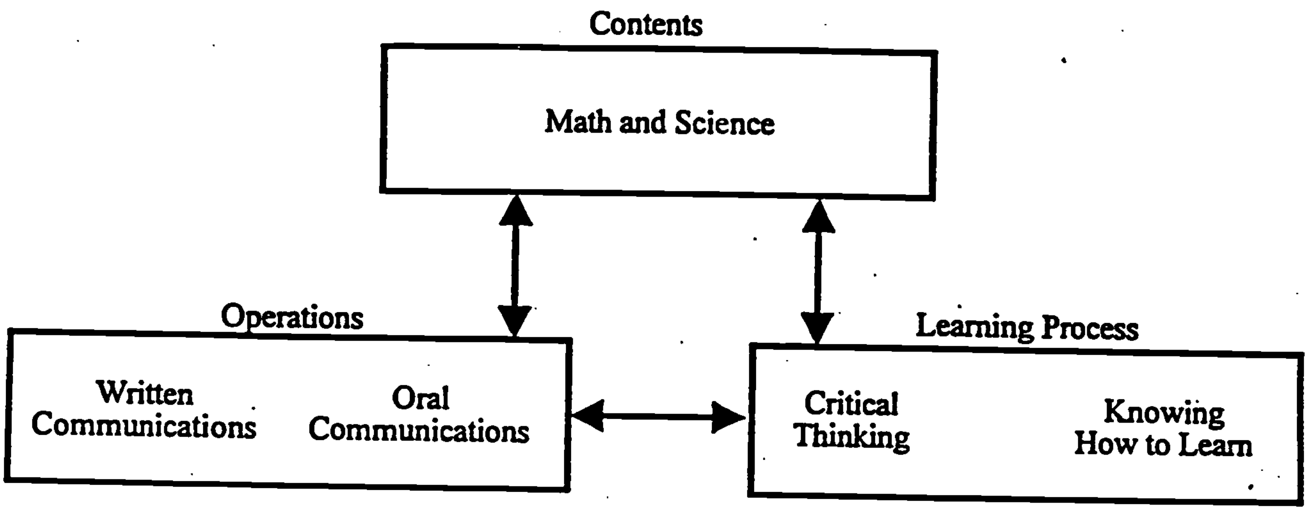


Figure 3-3
Model of Relationships among Higher Order Basic Skill Variables

Table 3-1
Description and Definition of Higher Order Basic Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Math and Science	Understands mathematical & scientific procedures & how these procedures might be applied in problem solving	Uses mathematics & scientific procedures to solve problems	Greeno (1985) Feltovich, Spiro, & Coulson (1993) Carlson (1993)	Mathematics Science Arithmetic	***High:*** Develops hardware for a new computer system. ***Medium:*** Conducts & analyzes product tests to insure that safety standards are met using a design provided by someone else. ***Low:*** Sets up & uses a test station to identify defects.
Critical Thinking	Recognizes & can analyze the strengths & weaknesses of arguments & propositions using logic to establish the validity of these propositions	Uses logic & analyses to identify the strengths & weaknesses in people's arguments	Halpern (1994) Perkins, Jay, & Tishman (1994)	None	***High:*** Writes a legal brief challenging a federal law. ***Medium:*** Identifies the unstated assumptions in a report. ***Low:*** Recognizes the pitch being made in a commercial.
Knowing How To Learn	Can identify & use strategies likely to facilitate learning including active elaboration & monitoring; can change strategies as indicated by performance & current status	Is actively involved in learning, identifying & applying different strategies that will accelerate learning	Greeno & Simon (1988) Brown & Camponie (1986) Snow & Swanson (1992)	Knowing How to Learn	***High:*** Identifies the activities needed to learn a new area of a profession. ***Medium:*** Identifies an alternative teaching style that might help trainees who are having problems. ***Low:*** Watches co-workers to find a quicker way of completing a task.
Written Communications	Can decode & comprehend written material & plan, generate, & revise written documents	Can understand written documents & communicates with others in writing	Hayes & Flower (1986) Friedricksen (1982) Needles & Knapp (1994)	Reading Writing	***High:*** Reads & revises the manuscript for a new book. ***Medium:*** Prepares a draft technical report. ***Low:*** Prepares & edits routine correspondence.
Oral Communications	Reviews, interprets, attends to verbal information & communicates with others in an appropriate fashion given the context at hand	Can effectively talk with others & quickly grasps what others are saying	Daly (1994) Beck & Carpenter (1986)	Speaking Listening	***High:*** Prepares speeches & presentations to be delivered to a number of different groups. ***Medium:*** Conducts a discussion with a work group to identify significant problems on their jobs. ***Low:*** Listens to instructions & adjusts activities as necessary.

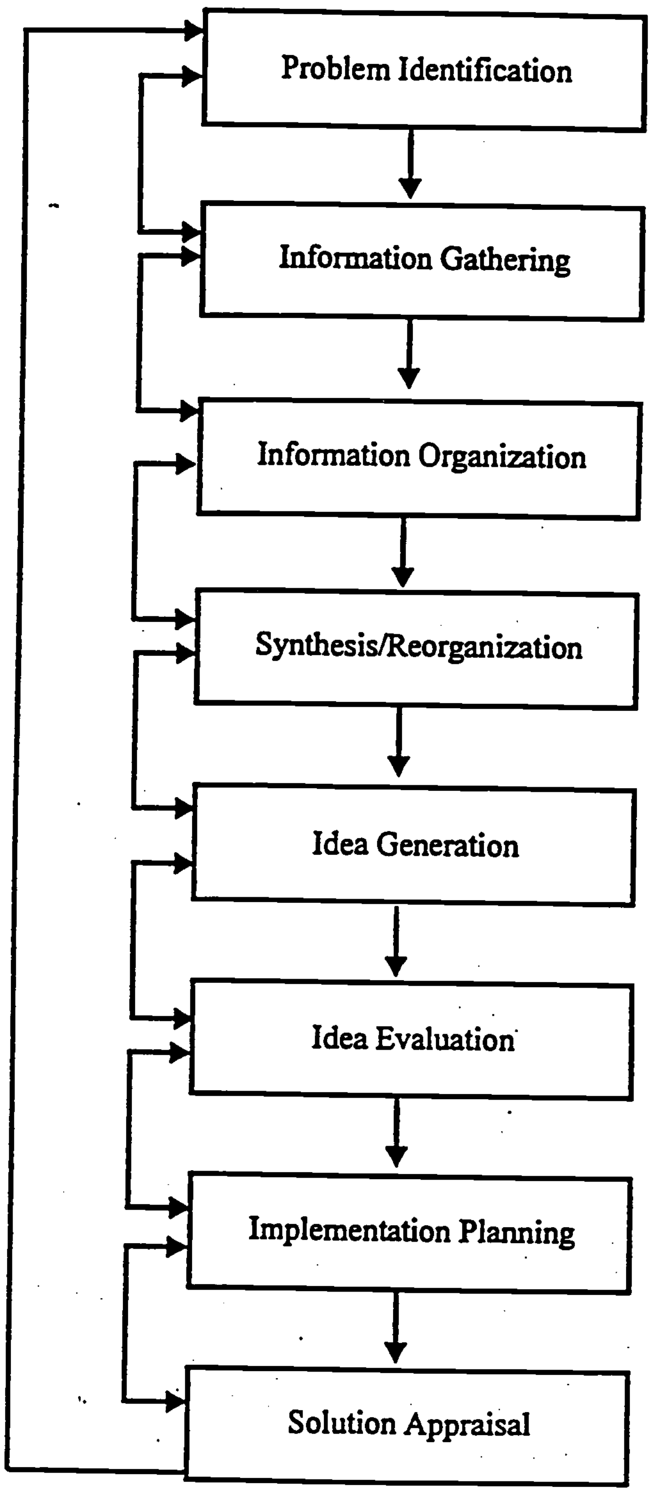


Figure 3-4
Model of Problem Solving Skills

included in this kind of taxonomy. On the other hand, the nature of the constructs at hand, and the structure of the first-order taxonomy, does suggest a potential higher order taxonomy.

As an example, reading and writing might be aggregated into a *Written Communications* dimension, while speaking and listening and questioning might be aggregated into an *Oral Communications* dimension. Math and science, because they involve related procedures, might be collapsed into a general *Math and Science* dimension. In the case of the learning process dimensions, *Critical Thinking* should probably be treated as a unique dimension. However, active learning, learning strategies, and monitoring might be combined into a general *Learning-To-Learn* dimension. Figure 3-3 illustrates the relationships among these second-order variables.

Table 3-1 provides the definitions and scales needed to assess these constructs. There is good reason to suspect that application of these higher order constructs will result in ratings of comparable reliability to those obtained from the first-order skills. Further, these higher order scales might prove equally useful in describing job requirements. By the same token, however, use of this second-order taxonomy will result in a significant departure from the literature in what is a rather sensitive area. Based on this consideration, it would seem that the first-order taxonomy should be applied.

Problem Solving Skills

The preceding section considered basic skills, or skills that facilitate learning. Skills contributing to learning, however, are not the only kinds of skills that might be used to describe the similarities and differences among jobs. Earlier, we noted that the general kinds of activities occurring on all jobs might also provide a basis for defining skills. In this section, we will consider these cross-functional skills, including problem solving skills, social skills, technological skills, systems skills, and resource management skills.

One kind of activity that occurs on virtually all jobs is problem solving. Problem solving is, of course, influenced by a host of variables. However, recent research indicates that certain general kinds of skills may play a role in virtually all problem solving efforts. We begin our discussion of cross-functional skills by examining the kinds of problem solving skills that might contribute to performance across a range of positions.

In recent years we have seen the emergence of a new interest in cognition generally. More specifically, however, a number of investigations have focussed on complex problem solving as a topic of interest in its own right (Carlson and Gorman, 1992; Wagner, 1991). Research on complex problem solving is, essentially, concerned with the cognitive capacities people apply as they attempt to solve novel, ill-defined problems in complex real-world settings (Fredericksen, 1984; Sternberg and Lubart, 1991).

Background. Broadly speaking, two general approaches have been used in studies of complex problem solving. The first approach derives from the literature on expertise and mental models (Anderson 1993; Chi, Bassock, Lewis, Reimann, and Glaser, 1989; Siegler and Richards, 1982; Snow and Lohman, 1989). These studies share in common an attempt to understand the nature of problem solving through identification of the kind of knowledge structures people bring to bear on the problem. Identification of differences in knowledge structures is typically accomplished through the comparison of experts and novices within a given domain. The findings obtained in these studies indicate that experts differ from novices in that they have a larger set of knowledge structures available, organized on the basis of underlying principles rather than superficial content similarities, that facilitate recognition and recall of relevant information. It appears, furthermore, that these principle-based knowledge structures emerge rather slowly and that as people move through different stages in the acquisition of expertise they are likely to make specific kinds of performance errors (Resnick, 1984).

This research on expert/novice differences has provided compelling evidence for the foundation of real-world problem solving in cognition. On the other hand, it should be clear that this research focuses more on knowledge *per se* than on the procedures by which this knowledge is applied in problem solving. It is, of course, these general procedures for working with information that are most relevant to the definition of cross-domain skills.

A variety of efforts has examined the kinds of procedures people typically apply in their attempts to solve complex problems. Typically, these studies fall under the rubric of process-based studies of problem solving. The intent of these studies is to identify the general kinds of procedures people apply as they work through complex problems (Davidson and Sternberg, 1984; Mumford, Mobley, Uhlman, Reiter-Palmon, and Doares, 1991; Sternberg and Lubart, 1991).

Although many of these studies examine the processes involved in problem solving within a particular domain (Pelligrino and Goldman, 1989), a number of more recent efforts have attempted to identify the kinds of procedures applied in solving problems in a variety of domains (Chaffee, 1994; Isaksen and Parnes, 1985; Merrifield, Guilford, Christensen, and Frick, 1962; Mumford, Mobley, Uhlman, Reiter-Palmon, and Doares, 1991; Sternberg, 1986). Sternberg (1986), for example, identified three basic processes that appear to be involved in most forms of problem solving: 1) information encoding, 2) specifics comparison, and 3) specifics combination. This taxonomy bears some similarity to the taxonomy identified by Bejar, Chaffin, and Embretson (1991), which also stresses the need for encoding, feature search, and feature mapping.

The taxonomies of Sternberg (1986) and Bejar, Chaffin, and Embretson (1991) really focus on how people go about solving well-defined reasoning problems. Other taxonomic efforts have addressed more complex, ill-defined problems of the sort encountered in the real world. Mumford, Mobley, Uhlman, Reiter-Palmon, and Doares (1991), for example, reviewed the process models used to account for creative problem solving. This review extended back to 1900 and included process models proposed by Dewey (1910), Wallas (1926), and Spearman (1927), as well as more recent models, such as those proposed by Isaksen and Parnes (1985), Sternberg (1986), and Silverman (1985).

Eight core processes appeared in most of these taxonomies. These processes included: 1) problem construction or problem identification, 2) information encoding, 3) category or feature search, 4) category or feature selection, 5) category combination and reorganization or synthesis, 6) idea evaluation, 7) implementation planning, and 8) solution monitoring. Runco (1991) proposed a similar taxonomy which calls for: 1) definition of the problem, 2) generation of alternative solutions, and 3) solution evaluation. Chaffee's (1994) taxonomy stresses the need for problem definition, alternative generation, and solution evaluation, but also calls for an implementation planning component.

Taxonomy. Based on these observations, one can define a relatively straightforward taxonomy describing the major types of procedures involved in solving complex "reasoned" problems. First, one must identify the nature of the problem and determine the basic approach that will be used in problem solving (Getzels & Csikszentmihalyi, 1976; Redmond, Mumford, and Teach, 1993; Runco, 1994). Following this initial hypothesis generation or *Problem Identification* effort (Hoover and Feldhusen, 1990), one must then gather information about the problem. This *Information Gathering* may involve the application of different strategies for identifying or tracking down relevant information (Perkins, 1992) and is similar to the information encoding construct proposed by Sternberg (1986). The next major category, *Information Organization,* represents the need to place information in context and use this reorganized synthesis as a basis for understanding the problem situation at hand. This process clearly subsumes Sternberg's (1986) selective comparison process. *Synthesis or Reorganization* represents the rearrangement of the information at hand to arrive at a new understanding of the problem situation (Finke, Ward and Smith, 1992; Mobley, Doares, and Mumford, 1992). *Idea Generation,* or the exploration of alternative approaches, is commonly held to flow from synthesis (Finke, Ward, and Smith, 1992). As Runco and Vega (1990) point out, however, idea generation is followed by *Idea Evaluation.* Once a workable idea has been identified, this will form the basis for *Implementation Planning* (Covington, 1987). This planning, however, may often be opportunistic, being guided by a broader vision of the end state desired in an evolving system (Hayes-Roth and Hayes-Roth, 1979; Krietler and Krietler, 1987). Finally, most models of problem solving assume that *Solution Appraisal* of the process and outcomes will follow, with individuals cycling back as needed to adjust or extend initial solutions. Figure 3-4 illustrates how these processing skills would operate in an integrated problem solving effort.

At this point, the question comes up as to whether evidence is available for the validity of these constructs. Studies by Hoover and Feldhusen (1990), Krietler and Krietler (1987), Okuda, Runco, and Berger (1991), and Smilansky (1984) indicate that measures can be developed to assess all of these skills and that measures of these skills do make a unique contribution to problem solving above and beyond the variance attributable to general intelligence. Moreover, at least some evidence has been obtained (Baer, 1988; Swanson, 1990; Ward, Byrnes and Overton, 1990) indicating that effective application of these skills is influenced by appropriate developmental experience and that such developmental experience extends to performance on transfer tasks. Thus, there is indeed some reason to suspect that these problem solving processes represent a unique and potentially developable set of skills.

Other evidence indicates that measures of these skills are effective predictors of performance on relevant problem solving tasks and on jobs that require problem solving. Owens (1969), for example, constructed a measure of synthesis or reorganizational skills by asking engineers to combine certain parts and principles to generate a workable new machine. It was found that scores from this test correlated (r=.40) with patent awards and supervisory ratings obtained more than five years later. Along similar lines, studies by Getzels & Csikszentmihalyi (1976) and Redmond, Mumford, and Teach (1993) indicate that problem identification or problem construction skills tend to be effective predictors of creativity in the arts and advertising, yielding correlations in the .30s and .40s with subsequent performance.

Aside from the traditional test validation paradigm, a number of other procedures have been used to establish the relationship between these skills and problem solving performance. Studies by Simon and his colleagues (Kilkarni and Simon 1990; Qin and Simon, 1990) have shown that information search or information gathering strategies may play an important role in scientific discoveries. Other studies by Carroll and Gillen (1987) indicate that careful evaluation of ideas and effective planning contribute to leader performance and overall organizational effectiveness.

Taken as a whole, there is reason to believe that this taxonomy of problem solving skills may capture a key aspect of skilled performance. Further, these skills may prove of great importance in a rapidly changing world that stresses the need for innovation and the analysis of information. Appendix 3-B, therefore, presents a proposed set of scales and scale definitions that might be used to measure these problem solving skills. That appendix also presents some supporting citations, and maps these problem solving skills onto the SCANS scales.

Prior research by Mumford and his colleagues (Reiter-Palmon, Uhlman, Clifton, Connelly, DeFlippo, and Mumford, 1990; Mumford, Threlfall, Costanza, Baughman, and Smart, 1992) indicates that importance scales intended to assess these and other related constructs yield interrater agreement coefficients in the .70s or .80s using the Shrout and Fleiss (1979) procedures with 20 to 30 judges. Other findings obtained in these studies indicate that the perceived importance of these attributes may be related to performance in sales positions. Thus, there is some reason to suspect that incumbents can provide viable ratings of those skills at a relatively low cost.

Although the theoretical and job analysis literature has, for the most part, focused on rather narrowly defined sets of problem solving skills, the work of Chaffee (1994) and Runco (1991) provides a framework for constructing a somewhat more parsimonious taxonomy of problem solving skills. This taxonomy would include four basic skills: *Problem Identification*, *Knowledge Acquisition*, *Solution Generation*, and *Solution Evaluation*. *Problem Identification* would be defined in much the same way as earlier, representing initial definition of a problem to be solved. *Knowledge Acquisition* represents the second step in an integrated problem solving effort where information is both acquired and structured to form an understanding of the key elements of the problem situation. *Idea Generation*, our next major component in this second-order taxonomy, could subsume synthesis or reorganization as well as alternative generation. Thus, this construct would involve creating an understanding of the problem situation and generating solution alternatives based on this understanding. The final construct in this second-order taxonomy would be *Solution Evaluation*, which would involve evaluating ideas, planning implementation, and monitoring the implementation. Figure 3-5 illustrates how those higher order skills would operate together in an integrated problem solving effort.

Table 3-2 provides a technical and operational definition for each of these second order constructs. Table 3-2 also provides anchors for each construct, and supporting citations, and a mapping of the constructs onto the SCANS skills.

The advantages of this higher order taxonomy are, in a sense, obvious. If this taxonomy were used, it would take less time to collect the requisite descriptive information. On the other hand, these second order constructs do not have as strong a foundation in the literature. Based on these observations, and the importance of problem solving skills in the emerging work place, the lower order taxonomy should be used in O*NET.

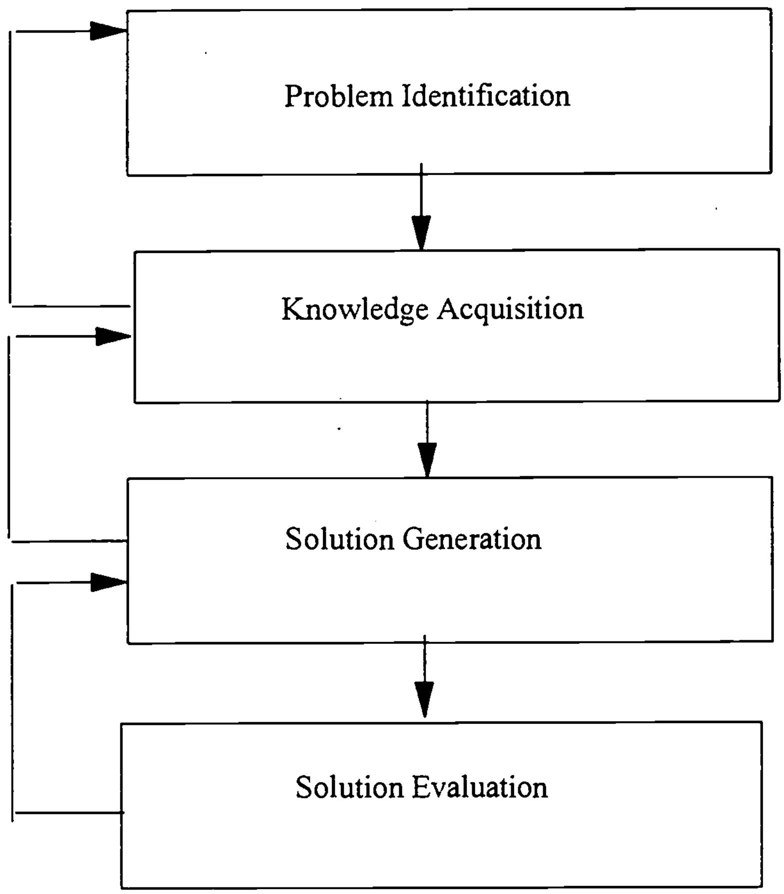


Figure 3-5
Model of Higher Order Problem Solving Skills

Table 3-2

Description and Definition of Higher Order Problem Solving Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Problem Identification	Reflects the restructuring of an ill-defined situation such that the basic nature of the problem & requisite problem solving strategies are identified	Identifying the nature of problems	Getzels & Csikszentmihalyi (1976) Redmone, Mumford, & Teach (1993) Hoover & Feldhusen (1990)	Problem solving Creative Reasoning Decision making	***High:*** Generates new hypothesis about chemical reactions ***Medium:*** Suggests why two groups are in conflict ***Low:*** Asks questions about why a procedure should be used
Knowledge Acquisition	Searches for key diagnostic information needed to address a problem & organizes this information using appropriate concepts	Knows how to find & organize information	Davidson & Sternberg (1984) Perkins (1992) Qin & Simon (1990)	Problem solving Creative Reasoning	***High:*** Identifies & categorizes resources needed for retooling a manufacturing plant ***Medium:*** Prepares annotated outline for a major technical report ***Low:*** Makes a personal filing system
Idea Generation	Uses available information to create an understanding of the problem & identify potential approaches & features of viable solutions	Generates a number of potential problem solutions	Finke, Wand, & Smith (1992) Guilford (1950) Runco (1991) Mobley, Doares, & Mumford (1992)	Creative Problem solving	***High:*** Restructures a corporation to meet changing markets ***Medium:*** Identifies two or three potential solutions to a construction problem ***Low:*** Rearranges filing system to make it easier to get needed material
Idea Evaluation	Evaluates whether a proposed solution will work within the setting at hand & formulates & implements plans to bring about a solution	Evaluates whether ideas will work & creates plans for implementing an idea	Mumford, Zaccaro, Harding, & Fleishman (in press) Carroll & Gillen (1987) Covington (1987)	Problem solving Decision making Reasoning Creative	***High:*** Determines whether a bill should be brought to Congress ***Medium:*** Determines what kind of computer equipment should be purchased ***Low:*** Determines whether a task can be completely by the end of the day

Social Skills

Virtually all jobs require people to work with others. In fact, some investigators (Hackman and Morris, 1975; Steiner, 1972) would define work in terms of requisite patterns of social interaction. Although social interchange has always been a significant component of work (Katz and Kahn, 1978), it is likely that these interactive components of work will become ever more important as organizations stress teamwork and customer service in an attempt to enhance productivity and improve customer satisfaction.

Given these observations, there is indeed some reason to believe that social skills will represent an important, if not crucial, component of cross functional skills. Relatively few taxonomies of social skills have appeared in the general literature. In part, the dearth of relevant taxonomies may be traced to the continuing debate over the distinction between social intelligence and general intelligence (Cronbach, 1960; Keating, 1978; Thorndike and Stein, 1937). More specifically, some argue, there is no effective distinction between intelligence as it is manifest in social behavior and general intelligence.

Background. There is reason to believe that social skills are indeed related to, and perhaps dependent on, general intelligence. However, there also is reason to believe that social skills might represent a distinct set of constructs. Social skills are influenced by general intelligence. On the other hand, experience in various social situations may also contribute to the development of these skills (Cantor and Kihlstrom, 1984, 1987; Ford and Tisek, 1983).

Over the years, the few available attempts to construct taxonomies of social skills have tended to focus on aspects of social intelligence. Moss, Hunt, Omwake, and Woodward (1955), for example, have proposed a six-variable taxonomy which includes: 1) judgment in social situations, 2) memory for names and faces, 3) recognition of facial expressions, 4) observation of human behavior, 5) knowledge of social information, and 6) recognition of the mental state of the speaker. Other work by Marlowe (1986) has examined the factors emerging from social intelligence tests. In this study, five factors were identified, including: 1) pro-social attitude, 2) social skills, 3) empathy skills, 4) emotional, and 5) social anxiety. In still another effort concerned with defining the key aspects of social intelligence, Zaccaro, Gilbert, Thor, and Mumford (1991) proposed two key variables. One, social perceptiveness, was concerned with the acquisition and interpretation of social information. The other was behavioral flexibility or the capacity to adjust social behavior in relation to the demands imposed by the situation.

In contrast to these studies, all focusing on social intelligence, other researchers have employed a more pragmatic approach. In this performance-based approach to identification of social skills, an attempt is made to identify variables that influence how well people perform tasks that call for social interaction. One illustration of this approach may be found in the recent work of Gilbert and Fleishman (1992). In this study, the available literature bearing on performance in social situations was used to construct a taxonomy of social skills. This review led to the identification of 16 social skill variables, including: 1) agreeableness, 2) behavior flexibility, 3) coordination, 4) dependability, 5) assertiveness, 6) negotiation, 7) persuasion, 8) sociability, 9) social conformity, 10) social sensitivity, 11) self-control, 12) social confidence, 13) achievement striving, 14) openness to experience, 15) self-sufficiency, and 16) coaching. This study also provided evidence indicating that these constructs can be reliably evaluated by incumbents using importance and level scales. The resulting interrater agreement coefficients are in the .80s, while it was found that judges could identify job behaviors that reflected manifestations of these skills. Further, the resulting descriptive information apparently evidences some construct validity in the sense that it captures expected differences among different types of jobs.

On the other hand, it should be recognized that the Gilbert and Fleishman (1992) taxonomy is an unusual one in the sense that personality variables likely to facilitate interpersonal interactions were expressly included in the development of the taxonomy. When one focusses on the components of this taxonomy directly relevant to social skills, a somewhat simpler taxonomic system emerges which includes: 1) behavioral flexibility, 2) coordination, 3) negotiation, 4) persuasion, 5) social sensitivity, 6) coaching, and 7) assertiveness.

This reduced taxonomy is noteworthy in part because it displays substantial similarity to a taxonomy of social skills proposed by Peterson (1992). Peterson's (1992) taxonomy includes six variables: 1) participates as a member of a team, 2) teaches others, 3) serves clients/customers, 4) exercises leadership, 5) negotiates to arrive at a decision, and 6) works with cultural diversity. Of course, the teaches, negotiates, participates as a member of a team, and exercises leadership dimensions of Peterson's (1992) taxonomy are similar to the coaching, negotiation, coordination, and assertiveness dimensions of Gilbert and Fleishman

(1992). It should also be noted that Peterson's (1992) cultural diversity construct could effectively be subsumed by Gilbert and Fleishman's dimensions of social sensitivity and behavioral flexibility. Service orientation, however, is a distinct construct not captured in the Fleishman and Gilbert (1992) taxonomy.

Taxonomy. When one considers the work of Peterson (1992) and Gilbert and Fleishman (1992), it becomes apparent that eight lower order variables might account for the major social performance skills found in the literature. This taxonomy of lower order dimensions would include: 1) *Behavioral Flexibility*, 2) *Coordination*, 3) *Negotiation*, 4) *Persuasion*, 5) *Social Sensitivity* or *Social Perceptiveness*, 6) *Instructing*, 7) *Assertiveness*, and 8) *Service Orientation*. It is of note here that *Assertiveness* or *Social Engagement* may be viewed as the inverse of shyness, a variable which has been shown to lead to poor performance in many social situations (Caspi, Bem and Elder, 1989), just as dominance, a synonym for assertiveness, has been shown to contribute to leader emergence and performance (Lord, Devader, and Alliger, 1986).

With regard to this taxonomy, it should be recognized that certain variables might be viewed as dispositional constructs which influence how people interact with others. Behavioral flexibility and assertiveness, for example, are often viewed as dispositional or personality constructs (Borman, 1991). If these variables are more appropriately viewed as dispositional constructs, then a somewhat simpler taxonomy of social skills might be proposed which includes: 1) coordination, 2) negotiation, 3) persuasion, 4) coaching, 5) service orientation, and 6) social perceptiveness.

This taxonomy is attractive, at least in the sense that it seems to summarize the work of prior efforts using a performance-based approach. Three other pieces of evidence, however, point to the meaningfulness of this taxonomy. First, because this taxonomy includes dimensions concerned with response coordination and social perceptiveness, it is consistent with the available work on social intelligence (Ford and Tisak, 1983; Marlowe, 1986; Zaccaro, Gilbert, Thor, and Mumford, 1991). Second, this taxonomy displays some convergence with team performance requirements. For example, Fleishman and Zaccaro (1992) note that team performance involves five higher order variables, including orientation functions (for example, information exchange), resource distribution, and time and response coordination. Clearly, skills such as coordination, negotiation, persuasion, and social perceptiveness would contribute to the effective execution of all these functions. Along similar lines, recent work by Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995) points to the importance of skills such as coordination, social perceptiveness, and cooperation or service orientation. All represent key skills contributing to effective team performance. Third, and finally, these social skill variables appear capable of being organized in terms of a stimulus, operations, response model. Thus they can be conceived of as operating as an integrated set of performance relevant skills within the social domain.

Figure 3-6 illustrates the relationships among these social skill variables. The available evidence (Ford and Tisak, 1983; Gilbert, 1994) indicates that it may be possible to construct behaviorally based, typical performance measures of those skills. However, it remains open to question whether maximal performance measures can be developed that are distinct from intelligence. Further, the results obtained by Bray, Campbell, and Grant (1974), as well as Howard and Bray's (1988) findings, indicate that these skills may indeed develop as a function of experience. These findings, and the evidence obtained for the reliability and validity of measures of these skills, in various job analysis efforts, provide some justification for measuring these skills in the occupational classification prototype. Table 3-3, therefore, provides technical and operational definitions for each of these skills. This table also presents the mapping of these skills onto the SCANS scale, and provides potential level anchors for each social skills scale.

The number of skills included in this taxonomy, although small given the complex nature of the domain, is still sufficient to bring into question the feasibility of applying this taxonomy. Thus, the question arises as to whether a simpler higher order taxonomy might be developed using these constructs. Some rules about how one might develop this kind of higher order taxonomy may be found in the structure of the first-order taxonomy and the earlier work of Zaccaro, Gilbert, Thor, and Mumford (1991).

Zaccaro, Gilbert, Thor, and Mumford (1991) note that social perceptiveness or the capacity to acquire and understand social information provides a basis for all forms of complex social interaction. Thus, in keeping with the lower order taxonomy described above, *Social Perceptiveness* can be viewed as our first higher order skill. Zaccaro, Gilbert, Thor, and

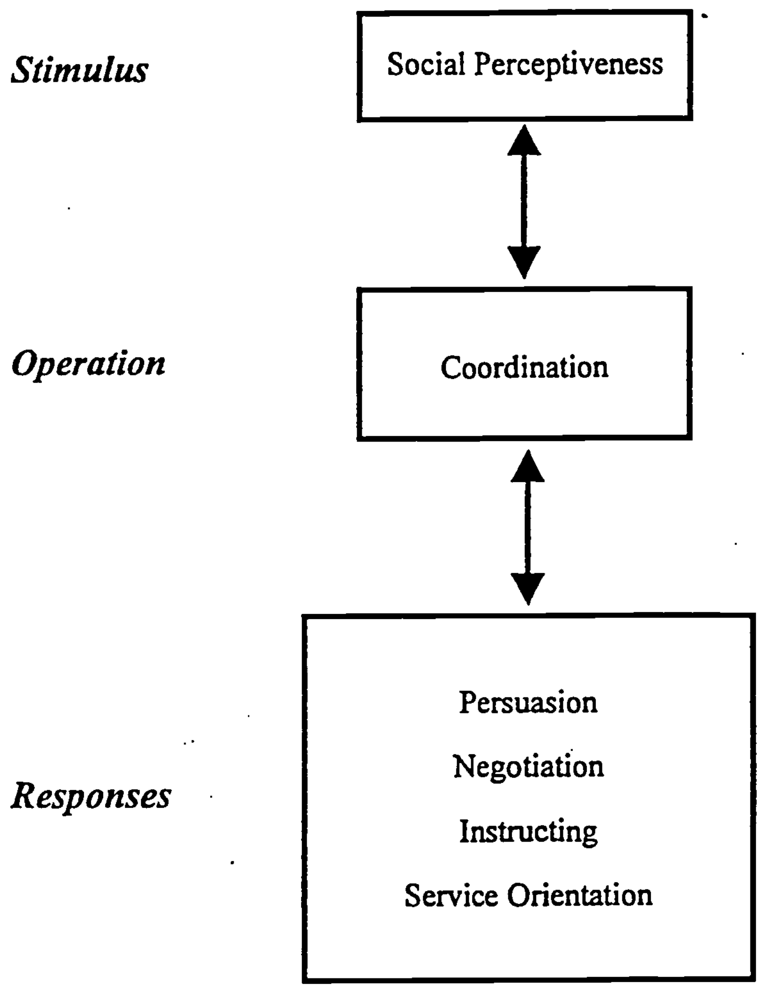


Figure 3-6
Description of Relationships among Social Skill Constructs

Table 3-3
Description and Definition of Social Skills

Construct Name	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Social Perceptiveness	Can accurately diagnose and appraise social situations attending to others' reactions within the broader context of ongoing social interchange	Being aware of others' reactions and understanding why they react the way they do	Gilbert & Fleishman (1992) Zaccaro, Gilbert, Thor, & Mumford (1991)	Participates as member of a team Leadership	***High:*** Counseling depressive patients during a crisis period. ***Medium:*** Being aware how a co-worker's promotion would affect a work group. ***Low:*** Noticing that customers are angry because they have been waiting too long.
Coordination	Is able to structure and adjust activities in accordance with the needs of others anticipating their actions and the demands placed on them	Adjusting actions in relation to others' actions	Gilbert & Fleishman (1992) Peterson (1992)	Participates as member of a team	***High:*** Working as director of a consulting project calling for interaction with multiple subcontractors. ***Medium:*** Working with others to put a new roof on a house. ***Low:*** Scheduling appointments for a medical clinic.
Persuasion	Can present information in such a way as to influence others attitudes and behavior	Persuading others to approach things differently	Gilbert & Fleishman (1992)	None	***High:*** Changing the opinion of the jury in a complex legal case. ***Medium:*** Convincing a supervisor to purchase a new copy machine. ***Low:*** Soliciting donations for a charity.
Negotiation	Can bargain as a representative of others or can bargain for one's self in situations calling for a transaction	Bringing others together and trying to reconcile differences	Peterson (1992) Gilbert & Fleishman (1992)	Negotiates to arrive at a decision	***High:*** Working as an ambassador in negotiating a new treaty. ***Medium:*** Contracting with a wholesaler to sell items at a given cost. ***Low:*** Presenting justification to manager for altering work schedule.
Instructing	Can develop the skills of others attending to their needs and current level of mastery	Teaching others how to do something	Peterson (1992) Gilbert & Fleishman (1992)	Teaches others	***High:*** Demonstrating surgical procedures to interns in a teaching hospital. ***Medium:*** Instructing a co-worker in how to operate a software program. ***Low:*** Instructing a new employee in the use of time clock.
Service Orientation	Attempts to provide others with needed services anticipating their needs and responding to their concerns	Actively looking for ways to help people	Peterson (1992)	Serves clients/ customers	***High:*** Directing relief agency operations in a disaster area. ***Medium:*** Making flight reservations for customers using airline reservation system. ***Low:*** Asking customers if they would like cups of coffee.

Mumford (1991), however, go on to point out that, based on these cues and one's understanding of the social situation, one must adjust one's pattern of interactions. These adjustments in interaction patterns, of course, require response coordination. As a result, *Response Coordination* can be viewed as our second higher order social skill. These adjustments in behavior might in turn serve two general purposes in an exchange theory model. First, the behavioral change might be intended to induce a change in others, as is the case in persuasion and negotiation. Second, this change might be intended to facilitate others' actions through coaching or service-related activities. Accordingly, our final two higher order constructs are labeled *Persuasion/Negotiation* and *Instructing/Service Orientation.* Figure 3-7 illustrates the nature of this higher order taxonomy.

Table 3-4 describes the technical and operational definitions formulated for each of these higher order constructs. Table 3-4 also presents a mapping of these skills onto the SCANS scales along with potential scale anchors. Of course, because the literature has for the most part focussed on lower order constructs, direct evidence bearing on the reliability and validity of these scales is not available. It should be noted, however, that the findings obtained for the response coordination and the perceptiveness or sensitivity scales do argue for the potential reliability and validity of these measures. However, in general it would seem that the lower order taxonomy provides a more appropriate description of the relevant domain.

Technical Skills

Technology in its varied forms represents a key component of many jobs. Some jobs, for example, involve working with telecommunications equipment. Other jobs involve designing new computer software and maintaining computer operating systems. Still other jobs, in production operations, require workers to monitor and control the operations of a process production plant.

Because so many jobs involve the development and application of various tools and technologies, there is reason to suspect that the skills involved in working with different pieces of technology might represent a set of cross-functional skills contributing to performance on a variety of different jobs. In fact, a number of studies have been conducted examining the impact of various technical skills on job performance. In two recent studies along these lines, Smith (1995) and Finke (1995) examined skill in product design. They found that engineers indeed

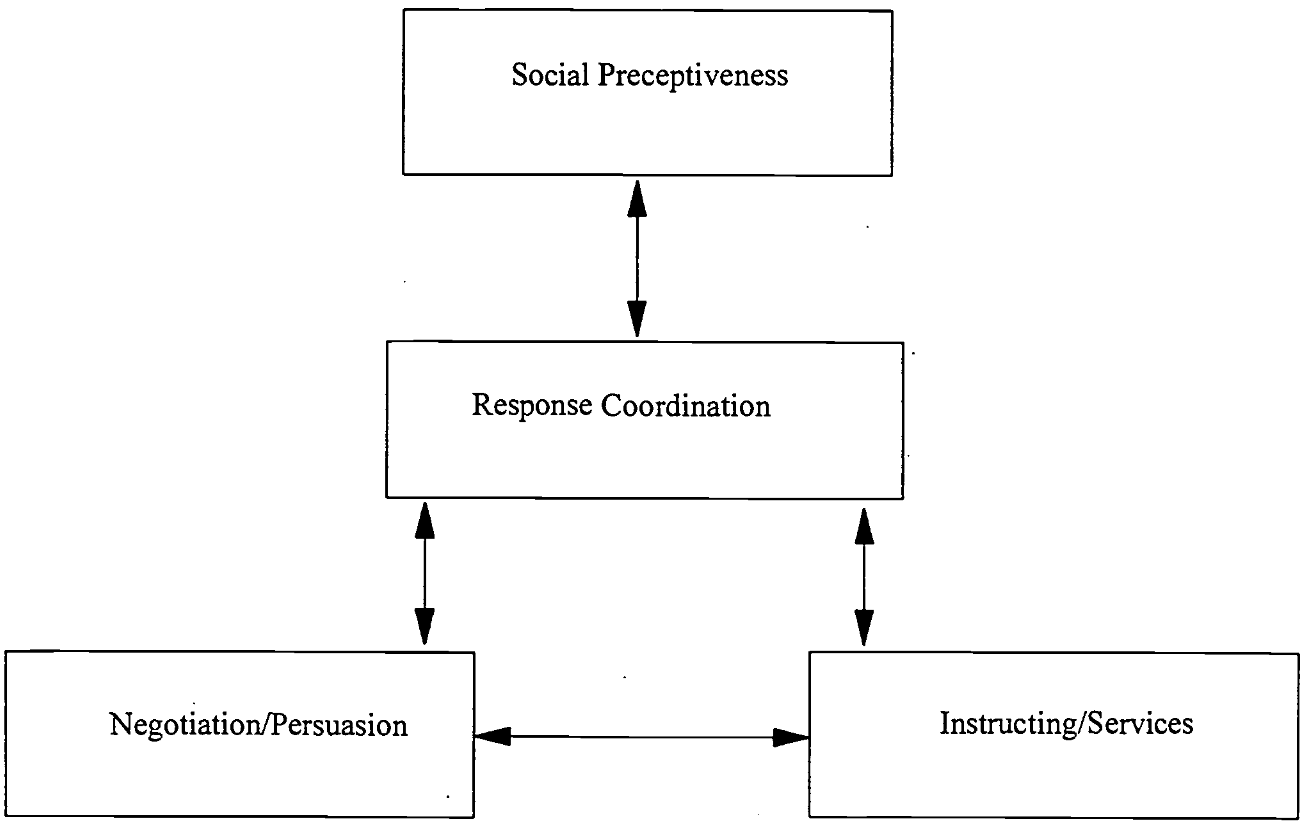


Figure 3-7
Description of Relationships among Higher Order Social Skill Constructs

Table 3-4
Higher Order Social Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors	
Social Perceptiveness	Can accurately diagnose and appraise social situations attending to others' reactions within the broader context of ongoing social interchanges	Is aware of others' reactions and can understand why they react the way they do	Gilbert & Fleshman (1992) Zaccaro, Gilbert, Thor, & Mumford (1991)	Participates as member of a team Leadership	*High:* *Medium:* *Low:*	Counsels depressive patients during a crisis period Is aware how someone's promotion will affect a work group Notices that a customer is angry with a waitress/waiter
Response Coordination	Is able to structure and adjust activities in accordance with the needs of others anticipating their actions and the demands implied	Can adjust actions in relation to others' actions	Gilbert & Fleishman (1992) Peterson (1992)	Participates as member of a team	*High:* *Medium:* *Low:*	Works as director of a consulting project calling for interactions with multiple subcontractors Serves as a nurse in an emergency room Works with others to put a new roof on a house
Persuasion/ Negotiation	Can persuade others to accept other views and negotiate with them to arrive at an agreement	Can get others to agree to an approach through persuasion and negotiation	Gilbert & Fleishman (1992) Peterson (1992)	Negotiates with others to arrive at a decision	*High:* *Medium:* *Low:*	Works as an ambassador to get multiple parties to agree to a treaty Convinces a distributor to start selling a new product line Justifies a salary increase to a supervisor
Instructing/Service	Tries to attend to the needs and expectations of others helping them develop new skills as necessary	Is aware of others' needs and tries to help them or provide requisite knowledge	Gilbert & Fleishman (1992) Peterson (1992)	Teachers others Serves clients/ customers	*High:* *Medium:* *Low:*	Serves as faculty in a school of education Conducts orientation courses for new employees Instructs a co-worker on how to operate a software program

differ in their ability to produce designs and that effective application of these design skills is influenced by the kind of information available. Other research by Barsalow (1989) has examined the heuristics or procedures used in isolating problems and has shown that error identification strategies can be taught, yielding improvement in machine repair. Along similar lines, Ward, Byrnes, and Overton (1990) have provided evidence that there are distinct measurable programming skills and that appropriate developmental interventions can lead to gains in performance on a transfer task.

Although these studies have demonstrated the existence and importance of various technical skills, these skills have for the most part been treated as discrete entities. Thus, these studies typically have not made any attempt to determine how technical skills are related to other types of skills, such as basic skills and problem solving skills. Further, no attempt has been made to formulate a systematic taxonomy of technical skills. Thus, it would be difficult, if not impossible to use the existing research literature to propose a systematic taxonomy of technical skills.

Background. On the other hand, it should be recognized that a variety of studies has examined the nature of technologically-oriented jobs (Bosshardt and Bowans, 1979). Many of these job analysis efforts have specifically sought to identify the kinds of activities performed on these jobs. Thus, one approach to constructing an initial taxonomy of cross-functional technological skills would be to review of a broad sample of job analyses examining different kinds of jobs to identify the recurring themes that appear in descriptions of the activities involved.

Accordingly, we began our effort to develop a taxonomy of cross-functional technological skills with a review of prior job analysis efforts. The job analysis studies included in this review were expressly selected based on three criteria. First, the job under consideration had to explicitly and directly call for the use of machines, tools, and technologies as a crucial component of job performance. Second, the kinds of activities performed on this job had to be described either as a separate component of the job analysis or, alternatively, in task statements. Third, the reports describing these activities had to describe explicitly the relevant job analysis procedures and provide information bearing on the frequency and importance of these activities.

Appendix 3-C summarizes the kinds of activities identified in these reports. More specifically, this appendix lists the title of the job under consideration and the kinds of technological activities listed in the job analysis report, and provides an evaluation of the importance of these activities and the frequency with which these activities occurred on the job.

Higher order taxonomy. When one considers the information summarized in Appendix 3-C, an argument can be made that technologically-oriented jobs appear to involve four basic kinds of activities: 1) *design,* 2) *set-up,* 3) *operations,* and 4) *correcting malfunctions.* The first major kind of activity might be referred to as *Design. Design* involves the initial development of technology, as well as laying out this technology so it operates within the context of other equipment and requisite human factors. Once a piece of technology has been developed and selected for application, it must be set up or put in place for operational use. Those kinds of *Set up* activities, of course, involve installation. They may also entail the development of programs or procedures for the on-site application of a given piece of technology. Once the technology has been *Set up*, it will be used for one purpose or another. Thus the next major category of activities pertains to routine *Operation* of the technology. The kinds of activities subsumed under *Operations* would, therefore, include: monitors operations, adjusts controls, performs routine maintenance, etc. In the final analysis, no matter how well machines or technology are used and applied, they will eventually break down. This observation leads to our fourth major type of technological activity, which is *Correcting Malfunctions. Corrections* is again a rather broad category of technological activities but would clearly include activities such as diagnosis and troubleshooting. These activities involve identifying the nature of the malfunction and the actions needed to correct it, such as repairing, replacing, or adjusting certain components.

Figure 3-8 describes the relationship among these four general or higher order categories of technological skills. Essentially, this model assumes that technology begins with initial design and then proceeds to set-up and operation of the technology. Once technology has been used, corrective actions must be taken to maintain these functions. Table 3-5 provides a technical and operational definition for each of these higher order technological skills, along with potential level anchors and a mapping of these skills onto the SCANS scales.

This kind of broad, second-order taxonomy is indeed parsimonious. Further, the results obtained in the SCANS study (Peterson, 1992) would lead one to suspect that reliable and valid ratings of these broad second-order technological skills can be obtained with relatively small samples of raters. On the other hand, because few have focussed on the development and assessment of these broad skills, it is difficult to say how readily they can be developed and assessed. By the same token, however, studies examining lower order components of these broad categories, such as programming and machine operation (Dyer, 1982, 1992; Reif, 1987; Rist, 1989; Ward, Byrnes and Overton, 1990), do indeed indicate that at least some of the lower order components of this broad taxonomy can be assessed using techniques such as training and job samples, and that many of these component skills can be systematically developed. One illustration of the successful development of these lower order components may be found in Air Force technical training programs.

Lower order taxonomy. The question that arises at this juncture is what would be the lower order component skills subsumed under this general, higher order taxonomy. Before proceeding to the specifics of these lower order components, a word of caution is in order. A variety of discrete activities might be subsumed under any one of these dimensions. Further, these activities might be broken down to progressively lower levels. Thus, the taxonomy that follows is not intended to produce an absolute definition and description of all types of technological skills. Instead, it is intended to capture the major kinds of activities falling under each of these four general dimensions.

Under the general *Design* category, there appear to be three major types of skills. Not only must individuals design the technology, but even before they begin to design the technology, they must analyze the technology needed in the situation at hand. Further, in designing technology and determining whether this technology should be applied in a given setting, they must be able to select the kind of components needed to do the job at hand. Thus, this general *Design* category includes three distinct sub-components, or first-order skills: *Operations Analysis*, *Technology Design*, and *Equipment Selection.*

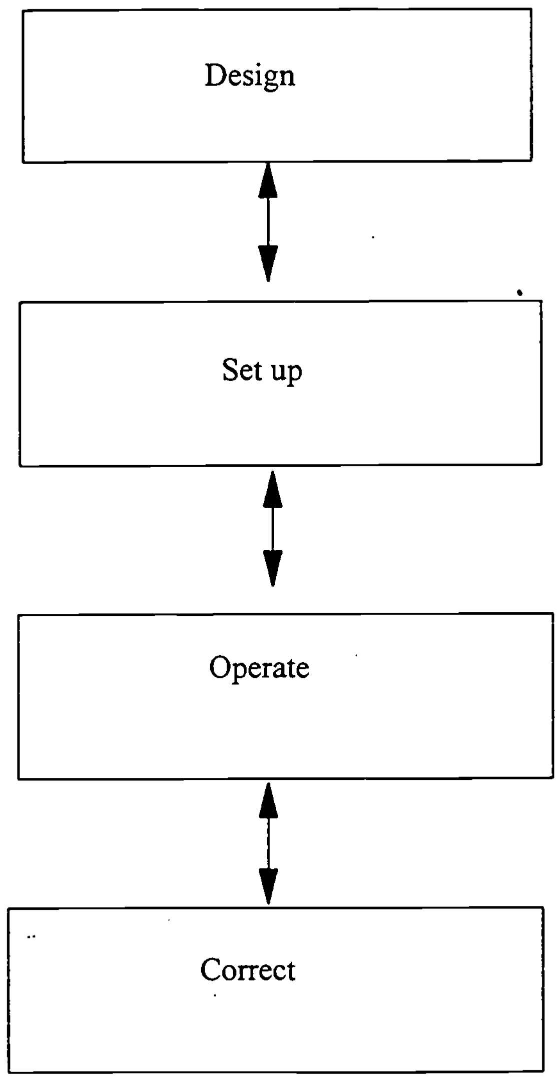


Figure 3-8
Higher Order Technological Skills

Table 3-5
Description and Definition of Higher Order Technical Skills

Construct Label	Technical Definition	Operational Definition	SCANS Scales	Level Scale Anchors
Design	Identifies technology requirements and develops or assembles requisite components to create an operating system	Identifies technology needs and creates tools needed to meet these needs	Selects technology Improves and designs systems	***High:*** Designs a new battery systems and selects appropriate motor for an electric car ***Medium:*** Identifies user requirements for a new computer system ***Low:*** Installs spark plugs in an engine
Set Up	Lays out programs or installs equipment and systems according to blueprints and specifications testing the system to see if it operates appropriately	Programs and installs new pieces of equipment	Applies technology Selects technology	***High:*** Supervises installation of a new telecommunication network for a Fortune 500 company ***Medium:*** Installs fluid control system on a jet aircraft ***Low:*** Installs spark plugs in an engine
Operate	Controls a piece of equipment or a particular operation used in the production of a product; monitoring operations and adjusting operations as necessary to insure a high quality product	Operates or controls equipment and computers	Applies technology to task Maintains and trouble sheets technology	***High:*** Oversees operations in an air traffic control system ***Medium:*** Operates a major piece of equipment in a process production plant ***Low:*** Uses simple hand tools to put shingles on a house
Correct	Diagnoses the sources of error in a system and identifies actions needed to correct these errors taking the appropriate corrective actions using requisite equipment or techniques	Identifies the source of a production problem or processing error and fixes the problem	Maintains and troubleshoots technology	***High:*** Identifies the sources of an overload, or flow problem in a global communications network ***Medium:*** Identifies the source of a coding error in a data processing program ***Low:*** Identifies a leak in a transmission system and fixes this leak

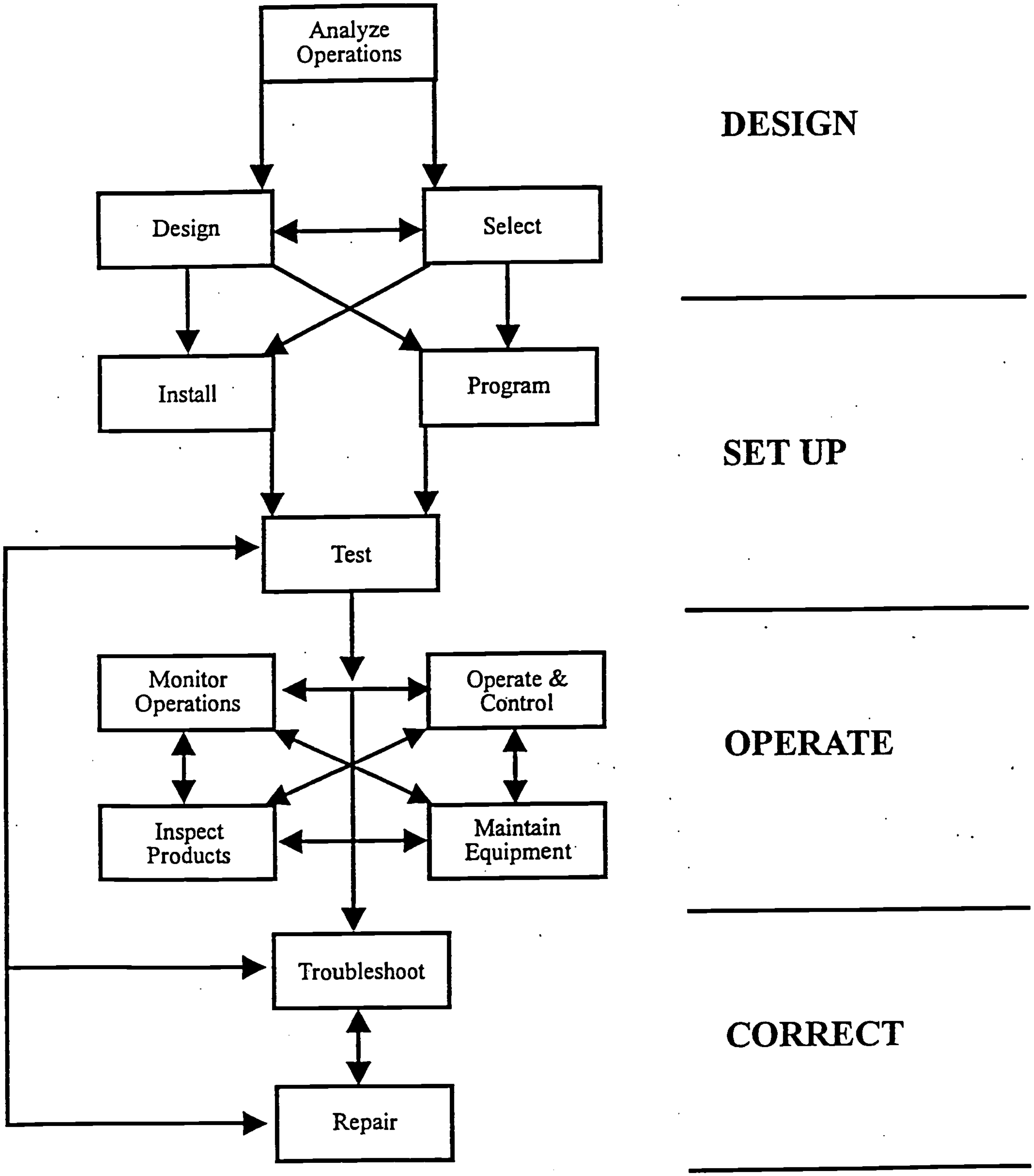


Figure 3-9
Relationships Among the Lower Order Technological Skills

Table 3-6
Technical Task Assignments to Requisite Skills

Job (Percentage of technical tasks in 12 requisite skills)	Analyze Operations	Design	Select	Install	Program	Test	Monitor Operations	Operate & Control	Inspect Products	Maintain Equipment	Trouble-shoot	Repair
Inside Wireman (100%)	0%	22%	0%	33%	0%	11%	0%	0%	11%	0%	11%	11%
Residential Wireman (100%)	0%	21%	0%	36%	0%	0%	0%	11%	11%	0%	16%	5%
Outside Lineman (100%)	0%	17%	17%	36%	0%	0%	0%	9%	9%	4%	4%	4%
Floor Inspector (100%)	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
Teller (100%)	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
Window Technician/ Finance Clerk (100%)	0%	0%	0%	0%	0%	0%	0%	80%	0%	0%	0%	20%
First-Term Radioman (100%)	0%	0%	0%	48%	0%	0%	0%	35%	0%	17%	0%	0%
Equipment Operator (100%)	0%	0%	0%	0%	0%	0%	30%	30%	10%	10%	10%	10%
Nuclear Control Room Operator (100%)	0%	0%	0%	0%	0%	0%	70%	20%	0%	0%	10%	0%
Machinist (100%)	0%	0%	0%	0%	15%	25%	0%	60%	0%	0%	0%	0%
Power Plant Operator (100%)	10%	0%	10%	0%	0%	0%	20%	40%	20%	0%	0%	0%
Average Percentage	1.5%	13.8%	3.6%	10.9%	1.1%	2.6%	10.9%	27.5%	18.6%	2.3%	3.6%	3.6%

Note: Some jobs have more technical tasks than others; this information can be obtained in Appendix 3-C.

During *Set-up*, three major kinds of activities are likely to occur. The technology or equipment under consideration must be installed to permit routine operation. In the case of many computer-based technologies, this installation will be coupled with the development of requisite software control programs. These control programs, like the technology itself, must also be tested to make sure the equipment or programs are working as expected. Thus *Testing, Programming,* and *Installation* represent the three major kinds of skills involved in initial set-up.

Once a piece of equipment has been set up, this equipment will be used to produce something. This transformation involves processing a set of inputs to get certain outputs. These kinds of processing activities require people to monitor the status of the system and the quality of the resulting product. Further, when problems arise in outputs or processing operations, adjustments must be made either in inputs or operations to correct these problems. Finally, routine maintenance must be performed to permit the system to continue operating effectively. Based on these observations, then, it might be argued that operations involve four crucial steps: *Operation and Control, Operations Monitoring, Product Inspection,* and *Equipment Maintenance*.

As we pointed out earlier, even when one has performed all requisite maintenance, problems will occur in the course of operating any complex system. To ensure continued operation of the system, therefore, one must be able to diagnose the nature of the problem and identify the kinds of actions needed to fix the problem. The need for these kinds of diagnostic and corrective activities, of course, underscores the importance of troubleshooting. Having identified the problem and the approach needed to solve it, the next necessary activity is repairing the fault. Thus, the *Corrections* category subsumes both *Troubleshooting* and *Repairing*. It should be noted, however, that testing skills will also be required after carrying out these repairs, just as was the case in initial *Set-up*.

Taken as a whole, then, there appear to be twelve major kinds of lower order skills subsumed under our four higher order categories. Figure 3-9 describes the relationships among these technical skills. There is some reason to suspect that many of these lower order skills, such as *Programming*, can be developed with practice (Reif, 1987; Ward, Byrnes, and Overton, 1990). The extent to which these skills transfer across technological systems based on very different operating principles is open to question. At least within a given type of operating system, there is good reason to believe that all of these skills can be assessed through techniques such as work samples or walk through performance assessments (Borman, 1991).

Appendix 3-D presents a technical and operational definition for each of these skills, a mapping onto the SCANS scales, and potential scale anchors. As might be expected, use of this lower order taxonomy will be more costly than the higher order taxonomy, simply due to the number of constructs included. On the other hand, the experience accrued in the job analysis study presented earlier suggests that people commonly define technological skills at this level. Furthermore, it appears that these skills can account for the kinds of actions identified in most of the prior job analysis efforts. More specifically, when the activities identified in these analyses (see Appendix 3-C for jobs and activities) were mapped onto these twelve categories, based on judges' assessments of similarity in meaning, virtually all of the technological activities mentioned could be accounted for. Table 3-6 summarizes the results of this mapping. It would seem more appropriate to apply the twelve lower level skills in our attempt to identify the kinds of technological skills needed on different jobs.

Systems Skills

In organizations, production is not based on the efforts of a single individual working with a single piece of equipment. Instead, the efforts of multiple individuals and a number of different pieces of equipment must be brought to bear in the production of competitive products (Katz and Kahn, 1978). As a result, with respect to both technology and the division of labor, organizations operate as complex socio-technical systems (Jaques, 1977; Burns and Stalker, 1961). This rather straightforward observation in turn poses another question. Is there a certain set of skills people need to perform well in the kind of complex socio-technical systems that characterize modern organizations?

Background. The skills needed to adapt to and perform well within complex socio-technical systems have not received substantial attention in the broader literature. One attempt to define these kinds of cross-functional skills, however, may be found in a recent effort by Peterson (1992). Peterson (1992) was concerned with the kinds of skills needed to work with complex technical systems. Using expert judgment techniques, he identified three skills that help to contribute to performance in complex technical systems: 1) understands systems, 2)

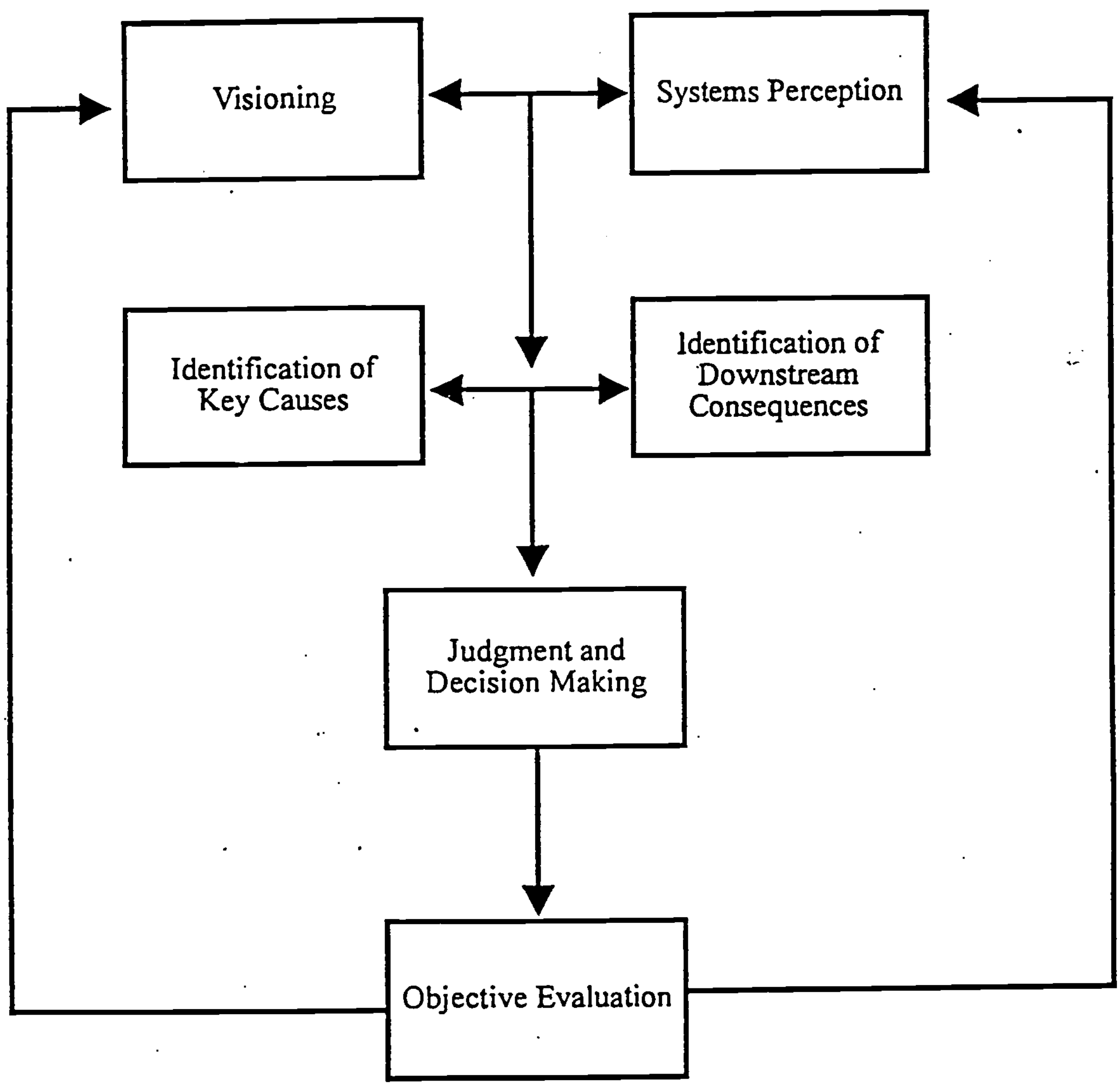


Figure 3-10
Model of Systems Skills

monitors and corrects performance, and 3) improves and designs systems.

The first of these three skills, understands systems, really refers to whether the individual understands how various parts and different operations interact and work together in producing a product. The second skill, monitors and corrects performance, holds that in complex systems, people must constantly monitor changes in system states and adjust their actions in relation to other events occurring in the system. The third and final system skill, improves and designs systems, has a strong technological component. However, this skill also has some unique implications for systems *per se* which extend beyond routine development and application of a particular piece of technology. For example, this skill implies that people must be able to identify and control significant systems interactions to allow the production process to flow smoothly.

In contrast to Peterson's (1992) focus on the technological aspect of systems, other investigators have focused on the skills that might be linked to the more social aspects of complex organizational systems. House and Howell (1992), for example, in their work on leadership, note that effective organizational leaders often use a vision, or a future-oriented cognitive structure describing optimal system operations, to guide the kinds of actions taken to influence organizational operations. This kind of guiding template is, of course, similar to an opportunistic planning model described by Hayes-Roth and Hayes-Roth (1979) and may serve an especially useful function when people must constantly make adjustments in a dynamic and rapidly changing situation.

Bass (1994), in still another study of systems leadership, points to yet another kind of skill that may be of importance. He notes that causal linkages may be obscure or difficult to diagnose in complex systems. Further, the effects of making a change are not necessarily linear and any change may be associated with a number of unanticipated, and not necessarily beneficial, consequences. These observations, in turn, suggest two other kinds of skills that may be important to understanding effective systems management: 1) identification of key causal variables, and 2) identification and analysis of downstream consequences.

A third approach that has been used to understand how people perform in complex systems focuses on human differences. This differential approach is nicely illustrated in the literature on wisdom (Arlin, 1990; Kitchner and Brenner, 1990; Orwell and Perlmutter, 1990; Sternberg, 1985, 1990). These studies have identified a number of characteristics that appear to be related to wisdom, including self-objectivity, self-reflection, systems perception, and judgment under uncertain conditions. Objectivity is, of course, an important component of performance under conditions where feedback is complex and subject to varying interpretation. Further, in complex systems, decisions must be made under conditions where tradeoffs and multiple conflicting demands are involved and where decision parameters may change over time. These observations indicate that judgment may represent a key aspect of decision making in complex systems. Finally, these wisdom studies, like Peterson's (1992) work on technology, suggest that understanding people and their interactions, or systems perception, may play an important role in shaping performance.

Taxonomy. When one considers the conclusions drawn from these three lines of research, it does appear possible to formulate a coherent taxonomy of systems skills. The nature of this taxonomy is illustrated in Figure 3-10. Essentially, this model holds that systems must be understood and acted upon in terms of a broader vision of how the system operates as an integrated whole and an awareness of the kind of interactions occurring among system elements. Thus, both *Visioning* and *Systems Perception* appear to represent key systems skills. Based on one's understanding of the system and the desired end state, action will be initiated to change the system. Before initiating these actions, however, people must identify the key causes to be manipulated and they must identify the downstream effects these changes would have on multiple system components. As a result, *Identification of Key Causes* and *Identification of Downstream Consequences* can be viewed as two additional systems skills. Based on an understanding of causes and anticipated consequences, judgment must then be exercised in decision making to identify the nature and timing of the changes most likely to improve and maintain system operations. Following the exercise of judgment in decision making, the outcome of a decision must be *Objectively Evaluated* to provide a basis for subsequent revisions in approach. This objective evaluation of outcomes may prove particularly important in complex systems because of the amount and ambiguity of the feedback information available (Mumford and Connelly, 1991).

Having presented this taxonomy of systems skills, the next question concerns the feasibility of developing and measuring these skills. Certainly, the evidence obtained by Smith and Baltes (1990) indicates that at least some of these skills, such as judgment, systems perception, and

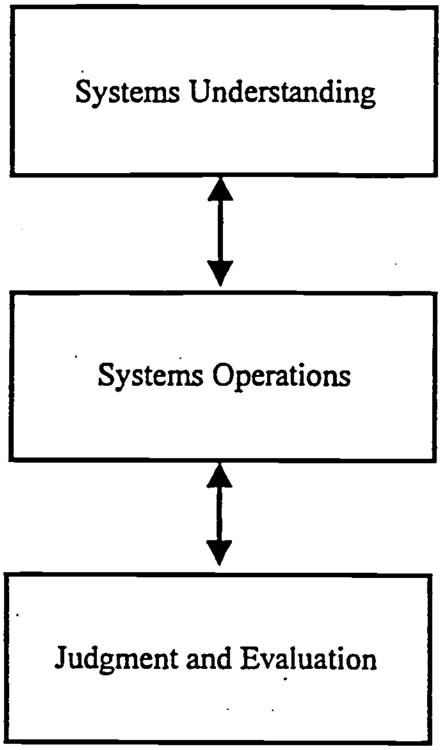


Figure 3-11
Higher Order Systems Skills

the identification of key causes, develop, in part, as a function of experience within a domain. The Smith and Baltes (1990) study, along with other work by Jacobs and Jaques (1989) and Bass (1994), suggests that it might be possible to develop objective measures of these kinds of skills. This research is only just beginning, making it difficult to draw strong conclusions about the validity of these measures. On the other hand, Peterson's (1992) findings indicate that it is possible to obtain good interrater agreement coefficients for at least some of these constructs using 15 to 30 judges. Further, these ratings are useful in discriminating occupations. Other work by Bass (1994) and Connelly (1995) indicates that these kinds of systems skills make a unique contribution to the prediction of leader performance even when problem solving skills are taken into account. Along similar lines, the observations of Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995) indicate that some of these skills, including visioning, systems perception, and objective evaluation, should contribute to team performance.

Given this evidence, and the apparent importance of social and technological systems in the emerging world of work, there would seem to be some justification for inclusion of these skills in the present effort. Appendix 3-E provides a technical and operational definition for each of these skills, along with their mapping onto the SCANS scales, and some potential anchors for a rating scale.

Because work on systems skills remains in its infancy, few systematic taxonomic studies have been conducted. As a result, a strong empirical basis for the development of a higher order taxonomy is not available. On the other hand, the nature of the first-order taxonomy does permit some hypotheses to be drawn concerning the type of variables likely to emerge at a higher level. Both *Visioning* and *Systems Perception* require an understanding of systems components and how they operate together. Thus, these two variables might be collapsed into a *Systems Understanding* variable. *Identification of Key Causes* and *Identification of Downstream Consequences* both require an analysis of systems operations, suggesting that a general *Systems Operations* variable might subsume these two lower order variables. Finally, *Judgment and Decision Making*, along with *Systems Evaluation*, might be collapsed into a general *Judgment and Evaluation* dimension. Figure 3-11 illustrates the relationships among these skills.

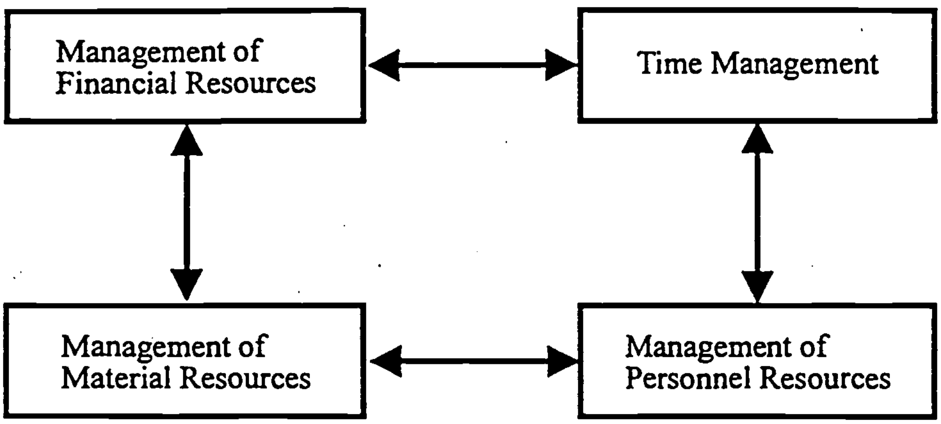


Figure 3-12
Model of Higher Order Resource Management Skills

Appendix 3-F provides the technical and operational definitions for each of these three higher order constructs. That appendix also provides level anchors and a mapping of these skills onto the SCANS scales. One further comment seems in order. As may be seen, the definitions developed for these higher order constructs are quite abstract. Thus, it is open to question whether these higher order dimensions will indeed discriminate among jobs. This observation, when considered with respect to the relatively small number of lower order variables, suggests that the first-order taxonomy should be used in an attempt to assess relevant systems skills.

Resource Management

All jobs involve working with available resources to transform some set of raw materials into some set of products (Katz and Kahn, 1978). One objective of any organization is to ensure the effective use of available resources in the production of these products (Ulrich and Wieland, 1981). To perform their work effectively, as one component of this transformation process, workers must also be able to allocate available resources effectively. Thus, *Resource Management* represents a potentially important set of cross-functional skills.

Background. Although people today are expected to allocate resources to various tasks on their own initiative, these kinds of resource management activities have more traditionally been viewed as a key part of the managerial role. Thus, one source of information bearing on the kinds of skills involved in resource management may be obtained by reviewing prior efforts to classify managerial activities. Recently, Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991) reviewed some sixty-four taxonomies of managerial and leadership behavior. They found that two broad dimensions appear to underlie virtually all of those taxonomies — one of which involves the management of personnel resources and the other of which involves the management of material resources.

Within these two broad resource management dimensions, Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991) identified a number of lower order dimensions. Management of material resources, for example, was held to subsume three lower order dimensions: 1) obtaining and allocating material resources, 2) utilizing and maintaining material resources, and 3) maintaining material resources. Management of personnel resources, on the other hand, included: 1) obtaining and allocating personnel resources, 2) motivating personnel resources, 3) developing personnel resources. This taxonomy of resource management activities is noteworthy, not only because it summarizes a variety of prior studies intended to describe managerial activities, but also because a variety of validation evidence has accrued for the meaningfulness or validity of this taxonomy. Fleishman, Mumford, Zaccaro, Levin, Hein and Korotkin (1991), for example, found that this taxonomy could account for the bulk of the management dimensions appearing in prior taxonomic efforts. Further, their study indicated that this dimensional structure was consistent with managers' intuitive notions of their job activities. In a later study, Mumford, Zaccaro, Harding, Fleishman, and Reiter-Palmon (1991) found that 22 percent of the tasks performed by managers in telecommunications, research and development, and military jobs involved managing personnel resources, while 11 percent of the tasks included managing material resources as defined by the lower order dimensions included in this taxonomy. The non-managerial tasks involved information acquisition and information use.

Although the Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991) taxonomy apparently provides a meaningful description of organizational management, because it focusses on direction of other activities, it may not cover significant resource management skills that are more intrinsic to the individual. Peterson (1992), as part of the SCANS project, developed a taxonomy of resource management skills more explicitly focussed on the individual. In this effort, Peterson (1992) identified four general, or higher order, resource management skills including: 1) allocates time, 2) allocates money, 3) allocates material and facility resources, and 4) allocates human resources. The latter two categories included in this taxonomy are, of course, similar to the categories of managing material and managing personnel resources identified by Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991). The two former categories, allocates time and allocates money, represent new categories, and potentially, unique kinds of skills.

Higher order taxonomy. When Peterson's (1992) work is considered in light of Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin's (1991) taxonomy, it suggests that resource management might be described using a four variable higher order taxonomy. These higher order variables would include *Management of Personnel Resources*, *Management of Material Resources*, *Management of Financial Resources*, and *Time Management*. *Time Management* refers to the prioritization of tasks and activities, as well as decisions about the effort to be invested in these activities at certain times. *Management of Financial Resources* includes allocating money to various activities, monitoring financial expenditures, and obtaining necessary financial support for various projects. Activities involving the direction and allocation of people, as well as identifying and developing requisite expertise, would fall under the rubric of *Managing Personnel Resources*. *Management of Material Resources*, on the other hand, involves the allocation of equipment, tools, and facilities to ensure their appropriate use in the development of a product.

Figure 3-12 illustrates the relationship among these four basic management functions. As may be seen, this figure assumes, in accordance with the observations of Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991), that the *Management of Personnel* and the *Management of Material Resources* will be closely linked skills based on the nature of the work at hand. *Management of Financial Resources* is held to be more closely related to material management while *Time Management* is held to be more closely related to *Management of Personnel Resources*.

The available evidence suggests that all of these management skills can be developed as a function of training and experience. For example, experiences such as exposure to more challenging managerial jobs will contribute to the development of these kinds of skills (Bray, Campbell, and Grant, 1974). Other work by Avolio and Bass (1994) indicates that training can develop even more complex resource management skills, such as those subsumed under the rubric of *Managing Personnel Resources*. There also is good reason to suspect that many of these skills can be effectively measured using assessment center or work simulation exercises and that these measures will predict job performance (Bray, Campbell, and Grant, 1974; Schneider and Schmitt, 1992).

If it is granted that measures of these skills will predict performance, then there is some justification for considering these skills for inclusion in the cross functional skills category. Table 3-7 provides a technical and operational definition for each of the four higher order resource management skills, along with their mapping onto the SCANS scales, and potential anchors for a level scale. The evidence compiled by Peterson (1992) suggests that adequate interrater agreement coefficients can be obtained for ratings of higher order resource management skills. Given the parsimony of this taxonomy, and its demonstrated utility, it may provide a particularly appropriate vehicle for assessing resource management.

Lower order taxonomy. The work of Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991) suggests how these four higher order dimensions might be broken down into a set of lower order dimensions. Fleishman et al. argue that managing material sources subsumes three lower order dimensions: *Obtaining and Allocating Material Resources*, *Maintaining Material Resources*, and *Utilizing and Monitoring Material Resources*. *Managing Personnel Resources* was broken down into four lower order dimensions, including: *Obtaining and Allocating Personnel Resources*, *Motivating Personnel Resources*, *Developing Personnel Resources*, and *Utilization and Monitoring Personnel Resources*. Because the lower order dimensions of Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991) appear to provide an adequate description of resource management activities within these two areas, these dimensions may provide an adequate definition of the relevant lower order skills.

The question that arises at this juncture, however, concerns the lower order skills subsumed under the rubrics of *Management of Financial Resources* and *Time Management*. With regard to *Time Management*, four lower order dimensions might be postulated. People must be able to prioritize tasks, allocating more time to the critical tasks confronting them. It is not sufficient, however, for people just to prioritize critical tasks. They must also be able to estimate the timeframe over which tasks will be completed, identify crucial periods requiring additional work, and determine the timing of the actions needed to complete a task. Finally, effective time management will require allocating or negotiating others' time commitments to ensure that relevant issues are addressed.

These observations in turn suggest that four lower order dimensions are subsumed under the rubric of *Time Management*: 1) *Prioritizing*, 2) *Timeframe Estimation*, 3) *Identification of Critical Periods*, and 4) *Allocation of Time*. *Management of Financial Resources* also subsumes a number of lower order dimensions. Initially, people must obtain the financial resources needed to complete certain work.

Table 3-7

Description and Definition of Higher Order Resource Management Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Time Management	Can manage own and other people's time, prioritizing, judging level of effort, identifying critical periods and allocating other people's time to key tasks	Managing one's own time and the time of others	Peterson (1992)	Allocating time	*High:* Allocating the time of scientists to multiple research projects *Medium:* Allocating time of subordinates to projects during the coming week *Low:* Keeping a monthly calendar of appointments
Management of Financial Resources	Obtains monetary or budget support of various projects; allocating funds to these projects and accounting for expenditures	Determining how money will be spent to get the work done and accounting for these expenditures	Peterson (1992)	Allocating money	*High:* Developing and approving yearly budgets for a large corporation obtaining financing as necessary *Medium:* Preparing and managing a budget for a short-term project *Low:* Taking money from petty cash to buy office supplies and recording the amount of the expenditure
Management of Material Resources	Obtains and allocates equipment, facilities, and material needed to do a job ensuring its maintenance and overseeing its use	Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work	Peterson (1992) Fleishman, Mumford, Zaccaro, Yarkin-Levin, Korotkin, & Hein (1991)	Allocates material and facility resources Leadership	*High:* Determining the computer system needs of a large corporation and monitoring use of equipment *Medium:* Evaluating an annual uniform service contract for delivery drivers *Low:* Renting a meeting room for a management meeting
Management of Personnel Resources	Recruits people with appropriate expertise and assigns them to relevant tasks, monitoring, developing, and motivating them as they work on these tasks	Motivating, developing, and directing people as they work, identifying the best people for the job	Peterson (1992) Fleishman, Mumford, Zaccaro, Yarkin-Levin, Korotkin, & Hein (1991)	Allocates human resources Leadership	*High:* Planning, implementing and managing recruitment, training and incentive programs for a high performance company *Medium:* Directing the activities of a road repair crew will minimal disruption of traffic flow *Low:* Encouraging a co-worker who is having difficulty finishing a piece of work

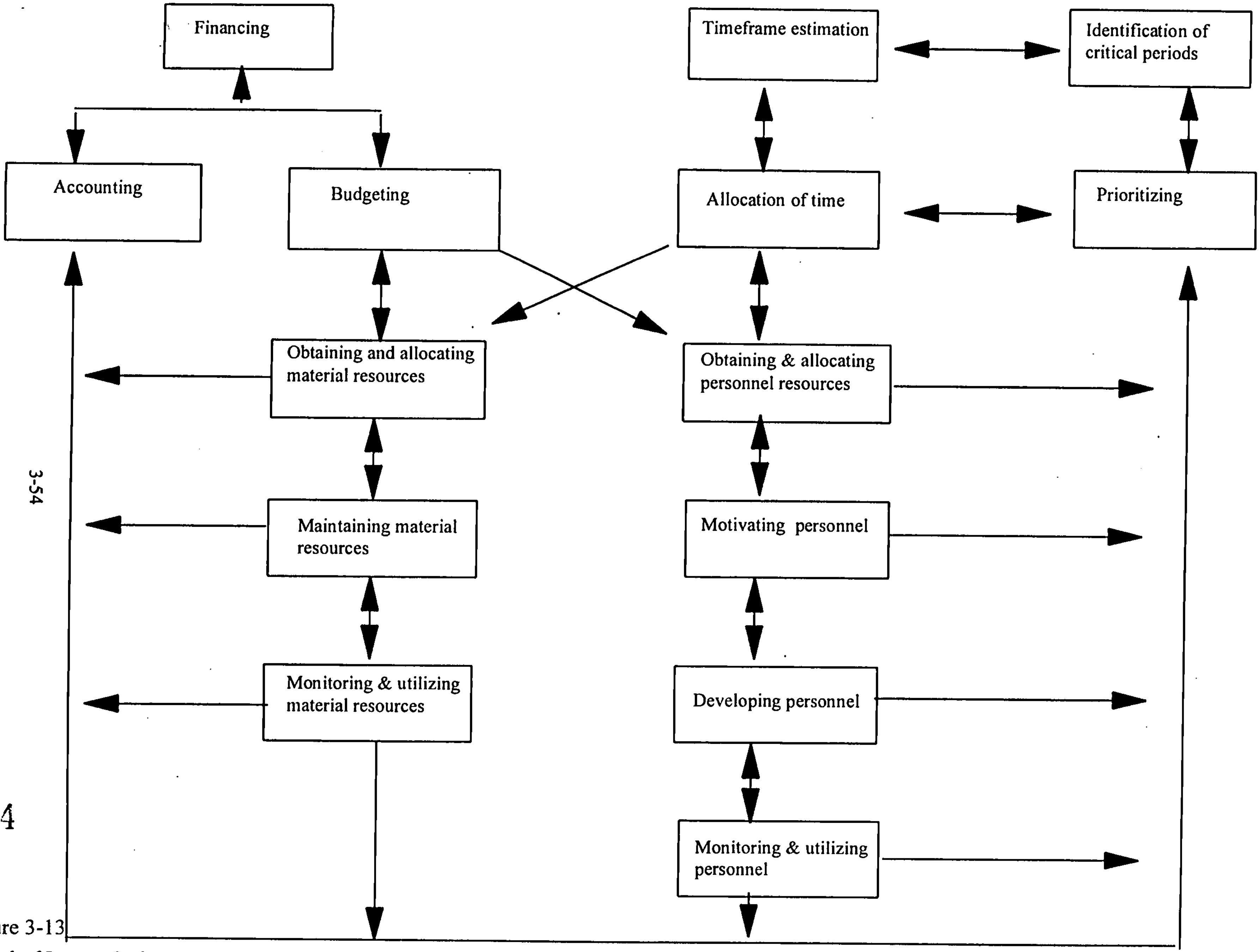


Figure 3-13
Model of Lower Order Resource Management Skills

Securing adequate financial resources may involve a variety of activities ranging from lobbying for additional equipment funds to proposing a stock offering. Once financial resources have been obtained, these funds must be allocated to various activities involved in the work, such as product development, operations, and marketing. Finally, expenditures of these funds must be monitored through the use of accounting techniques. Thus, *Management of Financial Resources* includes three distinct sub-dimensions: 1) *Financing*, 2) *Budgeting*, and 3) *Accounting*.

Figure 3-13 describes the relationships among these lower order dimensions. Appendix 3-G provides the technical and operational definitions formulated for each of these lower order dimensions, along with their mapping onto the SCANS scales, and some potential level anchors. As might be expected, these lower order scales are relatively costly with regard to the broader dimensions, simply because of the number of constructs postulated. On the other hand, these lower order dimensions clearly provide a more precise description of resource management activities. In considering this statement, however, it should be recognized that evidence bearing on the reliability and validity of these scales is not yet available. Thus, the higher order scales should be preferred unless a substantially more detailed description of skill requirements is needed in this area.

Use of the higher order scales in describing resource management skills seems appropriate based on one further consideration. Once one moves to the lower order resource management dimensions, many of the proposed skills (allocating, for example) become highly job specific, thus shading into the arena of occupation-specific skills. As a result, it appears that the higher order taxonomy provides a more appropriate basis for the specification of cross-functional resource management skills.

Conclusions

Given the material presented in this chapter, it does appear possible to formulate viable taxonomies of basic and cross-functional skills. Further, the procedures used in development of these taxonomies suggest that they might indeed provide a meaningful description of the skills domain. Not only are these skills consistent with earlier taxonomic efforts, such as those proposed by the Secretary's Commission on Achieving Necessary Skills, but also substantial support for the proposed skills can be found in prior theoretical and empirical work. Moreover, the proposed skills appear capable of describing an integrated performance sequence within the various domains under consideration.

Validation Evidence

To bolster these arguments for the meaningfulness of the proposed skill taxonomy, an additional step was taken to provide further evidence. A review of the extant literature was conducted to identify earlier studies proposing skill taxonomies at the cross-job level. A number of these taxonomies were identified, including taxonomies proposed by the Department of Education, The National Academy of Sciences, and the Office of Personnel Management.

Appendix 3-H provides a listing of the skills included in each of these 11 taxonomies. The appendix also presents the corresponding skills appearing in the current taxonomy. Bearing in mind that some taxonomies defined certain skills quite broadly, thereby subsuming a number of skills, and bearing in mind that some taxonomies included elements, such as self-esteem, which would not commonly be treated as skills, it is clear that virtually all the skills identified in these prior taxonomic efforts were accounted for by skills included in the present taxonomy.

The degree of observed overlap is, in fact, remarkable. The proposed taxonomic system directly accounts for all of the skills identified in prior efforts, with the notable exception of certain variables, such as flexibility, that might be treated as skills or alternatively as more enduring characteristics such as work styles. The degree of coverage of these alternative skill sets was nonetheless in excess of 90 percent for all of the alternative taxonomies examined. Thus, it appears that the proposed taxonomy provides a comprehensive description of the skill domain.

Some further support for the meaningfulness and comprehensiveness of this taxonomy has been provided in a recent study by Mumford and Supinski (1995). In this study some 700 tasks were identified describing the activities occurring in two job families in the telecommunications field — repair technicians and systems analysts. Analysts were asked to review the action verbs included in each task statement and then to assign tasks to the skills based on these action verbs. It was found that the analysts could reach agreement on 93 percent of the tasks. Apparently, then, these skills can also account for the actions that typically appear in task statements, thereby providing further evidence for the comprehensiveness of this taxonomic system.

Measurement

At least in a preliminary sense, there is some reason to suspect that the proposed taxonomies might provide a comprehensive and valid system for describing the skill requirements involved in various jobs. A related question that arises at this juncture is how one might go about appraising these skills. Most of the prior work involving these kinds of skills has used level and importance ratings (Peterson, 1992). These scales would also seem appropriate for use in describing jobs in terms of the basic and cross-functional skills proposed above. However, it should be recognized that the proposed level anchors were developed on an *a priori* theoretical basis. Thus, there is a need to collect evidence bearing on the meaningfulness of these level anchors.

It should also be recognized that skills, like knowledge, represent developed person requirements. As a result, it might also be useful to gather data bearing on when and where these skills were acquired. One approach to collecting this kind of information may be found in a scale examining the relative amount of a skill that needs to be acquired prior to job entry. This scale, along with the level and importance scales developed to measure each skill, is presented in Appendix A of Volume II.

Applications

If it is granted that a reasonably comprehensive taxonomy of skills has been developed which might be used to assess the skill requirements of different jobs, then a new questions arises: How might information about cross-job skill requirements be used in the proposed occupational information system?

Perhaps the most important application of information bearing on requisite skill requirements may be found in the development of human resources. Information about job skill requirements might help workers determine whether they are qualified for a job and the kind of experiences they should acquire to improve their qualifications. By identifying requisite skills and providing a framework for training development, information bearing on job skill requirements might do much to promote performance.

These skills, of course, also reflect general attributes or transferrable capacities that workers are likely to acquire as a function of experience on a job. Accordingly, by identifying other related jobs calling for similar cross-functional and basic skills, this information might be used to help redeploy workers during downsizing.

Information bearing on cross-functional and basic skills might be used to address two other issues. First, information about skill requirements might be used in job classification and the development of wage and salary systems intended to provide compensation based on qualifications rather than position occupancy. Second, information about skill requirements and associated experiences might be used to develop assessment systems for the selection and promotion of experienced workers.

In addition to helping organizations place and train workers, these skills might prove of value in helping government address a set of broader policy issues. This skills taxonomy would provide government, industrial groups, and educators with an understanding of the skills required by jobs. Further, systematic policy interventions intended to promote the development of those skills required for growing, high-wage jobs, might provide the necessary infrastructure needed to help prepare our work force for the 21st century. For example, educational and licensure programs might be designed to promote the development of key technical and problem solving skills.

Efforts along these lines are likely to prove especially useful for two reasons. First, the development of these broad basic and cross-functional skills will lay a foundation for the later acquisition of occupation-specific skills. Second, because these skills, unlike occupation-specific skills, are not tied to a single job, they should provide a set of credentials that transfer as workers move from job to job. By providing a stable set of general capacities, these skills may do much to help workers and employers cope with a rapidly changing world of work.

References

Ackerman, P.C. (1994). Typical intellectual engagement and personality: Reply to Rocklin. *Journal of Educational Psychology, 86,* 150-153.

Alexander, P.A., & Judy, J.E. (1988). The interaction of domain specific knowledge and strategic knowledge in academic performance. *Review of Educational Research, 58,* 375-404.

Anderson, J.R. (1993). Problem solving and learning. *American Psychologist, 48*, 35-44.

Arlin, P.K. (1990). Wisdom: The art of problem finding. In R.J. Sternberg (Ed.), *Wisdom: Its nature, origins, and development* (pp. 230-243). New York: Cambridge University Press.

Avolio, B.J., & Bass, B.M. (1994). *Improving organizational effectiveness through transformational leadership.* Thousand Oaks, CA: Sage.

Baer, J.M. (1988). Long-term effects of creativity training with middle school students. *Journal of Early Adolescence, 8,* 183-193.

Barsalow, L.W. (1989). *Diagnosis and repair of engine malfunctions.* Unpublished report, Georgia Institute of Technology.

Bass, B.M. (1994). Transformational leadership and team and organizational decision making. In B.M. Bass and B.J. Avolio (Eds.), *Improving organizational effectiveness through transformational leadership.* Thousand Oaks, CA: Sage.

Beck, I.L., & Carpenter, P.A. (1986). Cognitive approaches to understanding reading: Implications for instructional practice. *American Psychologist, 41*, 1098-1106.

Bejar, I.I., Caffin, R., & Embretson, S. (1991). *Cognitive and psychometric analysis of analogical problem solving.* New York: Springer-Verlag.

Borman, W.C. (1991). Job behavior, performance, and effectiveness. In M.D. Dunnette and L.M. Hough (Eds.), *Handbook of industrial and organizational psychology* (pp. 271-326). Palo Alto, CA: Consulting Psychologists Press, Inc.

Bray, D.W., Campbell, R.J., & Grant, D.L. (1974). *Formative years in business: A long-term AT and T study of managerial lives.* New York: Wiley.

Brown,, A. L., & Camponie, J. C. (1986). Psychological theory and the study of learning disabilities. *American Psychologist, 41,* 1059-1068.

Burns, T., & Stalker, G. M. (1961). *The management of innovation.* Chicago, IL: Quadrangle Books.

Campbell, J.P., McCloy, R.A., Oppler, S.H., & Sager, C.E. (1992). A theory of performance. In R. Schmitt and W.C. Borman (Eds.), *Personnel selection in organizations* (pp. 35-70). San Francisco, CA: Josey-Bass.

Camponie, J.C., & Brown, A.L. (1990). Guided learning and transfer: Implications for approaches to assessment. In W. Friedricksen, R. Glaser, A. Lesgold, and M. Shafto (Eds.), *Diagnostic monitoring of skill and knowledge acquisition.* Hillsdale, NJ: Erlbaum.

Cannon-Bowers, J.A., Tannenbaum, S.I., Salas, E., & Volpe, C.E. (1995). Defining competencies and establishing team training requirements. In G.A. Guzzo and E. Salas (Eds.), *Team effectiveness and decision making in organizations* (pp. 333-380). San Francisco, CA: Josey Bass.

Cantor, R., & Kihlstrom, J.F. (1984). Social intelligence and cognitive assessments of personality. In R.S. Wyer and T.K. Srull (Eds.), *Social intelligence and cognitive assessments of personality: Advances in social cognition* (Vol. 2, pp. 618-691). Hillsdale, NJ: Erlbaum.

Cantor, R., & Kihlstrom, J.F. (1987). *Personality and social intelligence.* Englewood Cliffs, NJ: Prentice-Hall.

Carey, S. (1986). Cognitive science and science education. *American Psychologist, 41,* 1123-1130.

Carlson, W.B. & Gorman, M.E. (1992). Cognitive framework to understand technological creativity: Bell, Edison, and the telephone. In R.J. Weber and D.N. Perkins (Eds.), *Inventive minds: Creativity in technology* (pp. 48-79). New York: Oxford Press.

Carroll, S.J., & Gillen, D.J. (1987). Are classical management functions useful in describing management work? *Academy of Management Review, 12,* 38-51.

Caspi, A., Bem, D.J., & Elder, G. H. (1989). Continuities and consequences of interactional style across the life course. *Journal of Personality, 57,* 375-405.

Chaffee, J. (1994). *Critical thinking at Laguardia College.* Washington, DC: National Center for Educational Statistics.

Chi, M. T. H., Bassock, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self explanations: How students study and use examples in learning to solve problems. *Cognitive Science, 13,* 145-182.

Chi, M. T. H., & Glaser, R. (1985). *Problem solving ability* (Report No. LRDC-1985/6 for the Office of Naval Research, Washington, DC). Learning Research and Development Center, University of Pittsburgh, PA.

Connelly, M.S. (1995). *Wisdom and problem solving as influences on leader performance.* Unpublished doctoral dissertation, George Mason University.

Covington, M.V. (1987). Instruction in problem solving and planning. In S.L. Friedman, E.K. Scholnick, and R.R. Cocking (Eds.), *Blueprints for thinking: The role of planning in cognitive development* (pp. 469-511). New York: Cambridge University Press.

Cronbach, L.J. (1960). *Essentials of psychological testing.* New York: Harper and Row.

Cureton, E.E. (1951). Validity. In E.F. Lundquist (Ed.), *Educational Measurement.* (pp. 621-694) Washington, DC: American Council on Education.

Daly, J.A. (1994). *Assessing speaking and listening: Preliminary considerations for a national assessment.* Washington, DC: National Center for Educational Statistics.

Danneman, M., & Carpenter, P.A. (1986). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior, 19,* 450-466.

Davidson, J.E., & Sternberg, R.J. (1984). The role of insight in intellectual giftedness. *Gifted Child Quarterly, 28,* 58-64.

Dewey, J. (1910). *How we think.* Boston: D.C. Heath.

Dweck, C.S. (1986). Motivational processes affecting learning. *American Psychologist, 41,* 1040-1048.

Dyer (1982). Personal communication.

Dyer (1992). Personal communication.

Feltovich, P.J., Spiro, R.T., & Coulson, R.L. (1993). Learning, Teaching, and Testing for Complex Conceptual Understanding. In N. Friedricksen, R.J. Mislevy, and I.I. Behar (Eds.) *Test Theory for a New Generation of Tests* (pp. 181-217). Hillsdale, NJ: Erlbaum.

Fine, S.A. (1988). *Functional job analysis scales: A desk aid.* Milwaukee, WI: Sidney A. Fine.

Finke, R.A., Ward, T.B., & Smith, S.M. (1992). *Creative cognition: Theory, research, and applications.* Cambridge, MA: MIT Press.

Finke, R.A. (1995). Creative insight and preinventive forms. In R.J. Sternberg, and J.E. Davidson (Eds.) *The nature of insight* (pp. 255-280). Cambridge, MA: MIT Press.

Fleishman, E. A. (1982). Systems for describing human tasks. *American Psychologist, 37,* 821-834.

Fleishman, E. A., & Hempel, W. E. (1955). The relation between abilities and improvement with practice in a visual discrimination reaction time task. *Journal of Experimental Psychology, 44,* 301-312.

Fleishman, E. A., & Mumford, M. D. (1991). Evaluating classifications of job behavior: A construct validation of the ability requirements scales. *Personnel Psychology, 44,* 523-575.

Fleishman, E.A., Mumford, M.D., Zaccaro, S.J., Levin, K.Y., Hein, M., & Korotkin, A.L. (1991). Taxonomic efforts in the description of leadership behavior: A synthesis and cognitive interpretation. *Leadership Quarterly, 2,* 245-287.

Fleishman, E.A., & Zaccaro, S.J. (1992). Towards a taxonomy of team performance functions. In J. Engestom (Ed.), *Team Performance.* (pp. 125-180). New York: Wiley.

Ford, M.E., & Tisek, M.S. (1983). A further search for social intelligence. *Journal of Educational Psychology, 75,* 196-206.

Fredericksen, N. (1984). Implications of cognitive theory for instruction in problem solving. *Review of Educational Research, 43,* 363-407.

Friedricksen, J.R. (1982). A componential theory of reading skills and their interactions. In R.J. Sternberg (Ed.), *Advances in the Psychology of Human Intelligence.* (pp. 125-180). Hillsdale, NJ: Erlbaum.

Friedricksen, J.R., Warren, B.M., & Rosenberg, A.S. (1985). A componential approach to training reading skills: Part 2. Decoding and use of context. *Cognition and Instruction, 2*, 41-130.

Getzels, J. W., & Csikszentmihalyi, M. (1976). *The creative vision: A longitudinal study of problem finding in art*. New York: Wiley.

Gilbert, J.A. (1994). *Leadership, social intelligence, and perceptions of environmental opportunities: A comparison across levels of leadership*. Unpublished doctoral dissertation, George Mason University.

Gilbert, J.R., & Fleishman, E.A. (1992). *Fleishman's job analysis survey: Social and interpersonal abilities*. Fairfax, VA: Center for Behavioral and Cognitive Studies.

Greeno, J.G., & Simon, H.A. (1988). *Problem solving and reasoning*. New York: Wiley.

Greeno, S.P. (1985). Cognition and Problem Solving. *Cognitive Science, 15*, 171-186.

Guion, R.M. (1966). *Personnel selection*. New York: McGraw-Hill.

Guilford, J.P. (1050) Creativity. *American Psychologist, 5*, 1-13

Hackman, J.R., & Morris, C.G. (1975). Group tasks, group interaction process, and group performance effectiveness: A review of a proposed integration. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol, 8). New York: Academic Press.

Halpern, D. (1994). *A national assessment of critical thinking skills in adults: Taking steps toward the goal*. Washington, DC: National Center for Educational Statistics.

Hayes, J.R., & Flower, L.S. (1986). Writing research and the writer. *American Psychologist, 41*, 1106-1113.

Hayes-Roth, B., and Hayes-Roth, K. (1979). A cognitive model of planning. *Cognitive Science, 3*, 275-310.

Hogarth, R.E. (1086) *Judgement and Choice.* New York: Wiley

Hoover, S.M., & Feldhusen, J.F. (1990). The scientific hypothesis formulation ability of gifted ninth grade students. *Journal of Educational Psychology, 82*, 838-848.

House, R. J., & Howell, J.M. (1992) Personality and Charismatic Leadership. *Leadership Quarterly, 3,* 81-108

Howard, A., & Bray, D.W. (1988). *Managerial lives in transition: Advancing age and changing times.* New York: Guilford Press.

Isaksen, S.G., & Parnes, S.J. (1985). Curriculum planning for creative thinking and problem solving. *Journal of Creative Behavior, 19*, 1-29.

Jacobs, T.O., & Jaques, E. (1989). Leadership in complex systems. In J.A. Ziedner (Ed.), *Human Productivity Enhancement, Volume II: Organizations and Personnel.* (pp.201-245). New York: Paengol.

Jaeger, R.M. (1989). Certification of student competence. In N.M. Linn (Ed.), *Educational Measurement.* New York: MacMillan

Jaques, L.R. (1977). *A general theory of bureaucracy.* London: Heineman.

Jensen, A. (1980). The relationship between learning and intelligence. *Learning and Individual Differences, 1*, 37-62.

Jones, E.A. (1994). *Essential skills in writing, speech, and listening, and critical thinking for college graduates: Perspectives of faculty, employers, and policy makers.* Washington, DC: U.S. Department of Education.

Just, M.A., & Carpenter, P.A. (1980). A theory of reading: From eye fixations to comprehension. *Psychological Review*, *87*, 324-354.

Kane, R.J., & Meltzer, W.C. (1990). *Upgrading training for employed workers.* Washington, DC: U.S. Department of Labor Employment and Training Administration.

Kanfer, R., & Ackerman, P.L. (1989). Motivation and cognitive abilities: An integrative aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology*, *74*, 657-690.

Katz, D., & Kahn, R.L. (1978), *The social psychology of organizations (2nd ed.).* Revised New York: Wiley.

Keating, D.P. (1978). A search for social intelligence. *Journal of Educational Psychology*, *70*, 218-223.

Kilkarni, D., & Simon, H.R. (1990). The process of scientific discovery: The strategy of experimentation. *Cognitive Science*, *12*, 134-175.

Kitchener, K., & Brenner, H. G. (1990). Wisdom and reflective judgement: Knowing in the face of uncertainty. In R. J. Sternberg (Ed.), *Wisdom: Its nature, origins, and development* (pp. 212-229). New York: Cambridge University Press.

Knapp, M.L., & Vangelisti, A.L. (1992). *Interpersonal communication and human relations.* Boston: Allyn and Bacon.

Krietler, S., & Krietler, H. (1987). The Psychometric aspects of the self. In T. Horess, and K. Yardley (Eds.), *Self and identify: Perspectives across the life span* (pp. 61-101). New York: Rutledge.

Kuhn, T. S. (1970). *The structure of scientific revolutions.* Chicago: University of Chicago Press.

Linn, R.C. (1982). Minimum competency testing: Cautions on the state of the art. *American Journal of Education, 91*, 1-35.

Lopez, F.M., Kesselman, G.A., & Lopez, F.E., (1981). An empirical test of a trait-oriented job analysis technique. *Personnel Psychology, 34*, 479-502.

Lord, R.G., Devader, C.C., & Alliger, G.M. (1986). A meta-analysis of the relationship between personality traits and leadership perceptions: An application of validity generalization procedures. *Journal of Applied Psychology, 71*, 402-410.

Marlowe, H.A. (1986). Social intelligence: Evidence for multi-dimensionality and construct independence. *Journal of Educational Psychology, 78*, 52-58.

Mayer, R.E. (1985). Mathematical ability. In R.J. Sternberg (Ed.), *Human Abilities: An Information Processing Appraisal*. (pp.212-232) New York: Freeman.

Merrifield, P.R., Guilford, J.P., Christensen, P.R., & Frick, J.W. (1962). The role of intellectual factors in problem solving. *Psychological Monographs, 76*, 1-21.

Mobley, M.I., Doares, L.M., & Mumford, M.D. (1992). Process analytic models of creative capacities: Evidence for the combination and reorganization process. *Creativity Research Journal, 5*, 125-155.

Moss, F.A., Hunt, J., Omwake, K.T., & Woodward, C.G. (1955). *Manual for the George Washington University series social intelligence test*. Washington, DC: Center for Psychological Service.

Mumford, M.D., Baughman, W.A., Supinski, E.P., Costanza, D.P., & Threlfall, K.V. (1994). *Cognitive and metacognitive skill development: Alternative measures for predicting leadership potential*. Fairfax, VA: Center for Behavioral and Cognitive Studies, George Mason University.

Mumford M.D., & Connelly, M.S. (1991). Leaders as creators: Leader performance and problem solving in ill-defined domains. *Leadership Quarterly, 2*, 289-315.

Mumford, M.D., Mobley, M.I., Uhlman, C.E., Reiter-Palmon, R., & Doares, L.M. (1991). Process analytic models of creative capacities. *Creativity Research Journal, 4*, 91-122.

Mumford, M.D., Snell, A.M. & Reiter-Palmon, R. (1994). Personality and Background Data: Life History and Self-concepts in an Ecological System. In G.S. Stokes, M.D. Mumford, & W.A. Owens (Eds.) *Biodata handbook: Theory, research, and use of biographical information for selection and performance prediction* (pp. 555-582). Palo Alto, CA: Consulting Psychologists Press.

Mumford, M.D., & Supinski, E.P. (1995) *Identification and assessment of occupation-specific skills in telecommunications jobs.* Washington, DC: American Institutes for Research.

Mumford, M.D., Threlfall, K.V., Costanza, D.P., Baughman, W.A., & Smart, B. (1992). *Analysis of Kidder, Peabody account executive jobs.* Fairfax, VA: Authors.

Mumford, M.D., Zaccaro, S.J., Harding, F.D., & Fleishman, E.A. (in press). *The thinking leader: Developing creative leaders for a changing world.* Hillsdale, NJ: Erlbaum.

Mumford, M.D., Zaccaro, S.J., Harding, F.D., Fleishman, E.A., & Reiter-Palmon, R. (1991). *Cognitive and temperament predictors of executive ability: Principles for developing leadership capacity.* Washington, DC: Management Research Institute.

Needles, M.C., & Knapp, M.S. (1994). Teaching writing to children who are underserved. *Journal of Educational Psychology, 86*, 339-349.

Office of Personnel Management (1991). *Leadership effectiveness survey.* Washington, DC: U.S. Office of Personnel Management.

Office of Personnel Management (1994). *Professional and administrative careers: Occupational survey.* Washington, DC: U.S. Office of Personnel Management.

Okuda, S.M., Runco, M.A., & Berger, D.E. (1991). Creativity and the finding and solving of real-world problems. *Journal of Psychoeducational Assessment, 9,* 45-53.

Orwell, L., & Perlmutter M. (1990). The study of wise persons: Integrating a personality perspective. In R.J. Sternberg (Ed.), *Wisdom: Its nature, origins, and development* (pp. 160-177). New York: Cambridge University Press.

Owens, W.A. (1969). Cognitive, noncognitive, and environmental correlates of mechanical ingenuity. *Journal of Applied Psychology, 53,* 199-208.

Paul, R. (1990). *Critical thinking: What every person needs to survive in a rapidly changing world.* Rohrert Park, CA: Center for Critical Thinking and Moral Critique, Somona State University.

Pelligrino, J.W., & Goldman, S.R. (1989). Mental cronometry and individual differences in cognitive processes: Common pitfalls and their solutions. *Learning and Individual Differences, 2,* 203-207.

Perkins, D.N. (1992). The topography of invention. In R.J. Weber and D.N. Perkins (Eds.), *Inventive minds: Creativity in technology.* (pp. 238-250). New York: Oxford University Press.

Perkins, D.P., Jay, E., & Tishman, S. (1994). *Assessing thinking: A framework for measuring critical thinking and problem solving skills at the college level.* Washington, DC: National Center for Educational Statistics.

Peterson, N.G. (1992). *Methodology for identifying SCANS competencies and foundation skills.* Washington, DC: American Institutes for Research.

Qin, Y., & Simon, H.A. (1988). Laboratory replication of scientific discovery processes. *Cognitive Science*, *14*, 281-312.

Redmond, M.R., Mumford, M.D., & Teach, R. (1993). Putting creativity to work: Effects of leader behavior on subordinate creativity. *Organizational Behavior and Human Decision Processes*, *55*, 120-151.

Reif, F. (1987). Interpretation of scientific or mathematical concepts: Cognitive issues and instructional implications. *Cognitive Science*, *11*, 395-416.

Reiter-Palmon, R., Uhlman, C.E., Clifton, T., Connelly, M.S., DeFlippo, B., & Mumford, M.D. (1990). *Describing sales position requirements. GE Lighting Division, SME Meeting Report* (Tech. Rep. CBCS 90-3). Fairfax, VA: George Mason University.

Resnick, J.B. (1984). Beyond error analysis: The role of understanding in elementary school arithmetics. In H.N. Cheek (Ed.), *Diagnostic and Prescriptive Mathematics: Issues, ideas, and insights*. Kent, OH: Research Council for Diagnoses and Prescriptive Mathematics Research.

Resnick, L.B., & Omanson, S.F. (1987). Learning to understand arithmetic. In R. Glaser (Ed.), *Advances in Instructional Psychology*. Hillsdale, NJ: Erlbaum.

Rist, R. S. (1989). Schema creation in programming. *Cognitive Science*, *13*, 314-389.

Rubin, R.B. (1985). The validity of the communication competency assessments survey. *Communication Monographs*, *52*, 173-185.

Runco, M.A. (1991). The evaluative, valuative, and divergent thinking of children. *Journal of Creative Behavior*, *25*, 311-319.

Runco, M.A. (1994). Conclusions concerning problem finding, problem solving, and creativity. In R.A. Runco (Ed.), *Problem finding, problem solving, and creativity* (pp. 71-240). Norwood, NJ: Abler.

Runco, M.A., & Vega, L. (1990). Evaluating the creativity of children's ideas. *Journal of Social Behavior and Personality, 5*, 439-452.

Schmeck, R.R. (1988). *Learning strategies and learning styles.* New York: Plenum.

Schmeck, R.R., and Grove, E. (1979). Academic achievement and individual differences in the learning processes. *Applied Psychological Measurement, 3*, 43-49.

Schmidt, W.H., Porter, A.C., Schwille, J.R., Floden, R.E., & Freeman, D.J. (1983). Validity as a variable: Can the same certification test be valid for all students? In C.F. Madau (Ed.), *The courts, validity, and minimum competency testing.* (pp. 116-183). Hingham, MA: Kluner-Nijhoff.

Schneider, J.N., & Schmitt, N. (1992). An exercise design approach to understanding assessment center dimensions and exercise constructs. *Journal of Applied Psychology, 77*, 32-41.

Shrout, P.E., & Fleiss, J.L. (1979) Interclass Correlations: Uses in Assessing Rater Reliability. *Psychological Bulletin, 86*, 420-428

Siegler, R.S., and Richards, J.D. (1982). The development of intelligence. In R.J. Sternberg (Ed.), *Handbook of Human Intelligence.* New York, NY: Cambridge University Press.

Silverman, B.G. (1985) The Use of Analogs in the Innovative Process: A Software Engineering Protocol Analysis. *IEEE Transactions of Systems, Man and Cybernetics, 15*, 30-44.

Smilansky, J. (1984). Problem solving and the quality of invention: An empirical investigation. *Journal of Educational Psychology, 76*, 377-386.

Smith, J., & Baltes, P.B. (1990). Wisdom-related knowledge: Age/cohort differences in response to life-spanning problems. *Developmental Psychology*, 26, 494-504.

Smith, L. (1992). *Skills of human resource managers at the National Security Agency*. Unpublished report, The National Security Agency.

Smith, S.M. (1995). Getting into and out of mental ruts: A theory of fixation, incubation, and insight. In R.J. Sternberg and J.E. Davidson (Eds.), *The nature of insight* (pp. 229-252). Cambridge, MA: MIT Press.

Snow, R.E., & Lohman, D.F. (1989). Implications of cognitive psychology for educational measurement. In R.L. Linn (Ed.), *Educational Measurement* (3rd ed.). New York: Macmillan.

Snow, R.E., & Swanson, T. (1992). Instructional psychology: Aptitude, adaptation, and assessment. *Annual Review*, *43*, 583-626.

Spearman, C.E. (1927). *The abilities of man*. London: MacMillan.

Spencer, L.M., & Spencer, S.M. (1993). *Competence at work: Models for superior performance*. New York: Wiley.

Stahl, S.P., Jacobson, M.G., David, C.E., & Davis R.L. (1989). Prior knowledge and difficult vocabulary in the comprehension of unfamiliar text. *Reading Research Quarterly*, 24, 27-43.

Steiner, I. (1972). *Group process and productivity*. New York: Academic Press.

Sternberg, R.J. (1985). Implicit theories of intelligence, creativity, and wisdom. *Journal of Personality and Social Psychology*, *49*, 607-627.

Sternberg, R.J. (1986). Toward a unified theory of human reasoning. *Intelligence*, *10*, 281-314.

Sternberg, R.J. (1990). Wisdom and its relations to intelligence and creativity. In R.J. Sternberg (Ed.), *Wisdom: Its nature, origin, and development.* (pp. 145-159). New York: Cambridge University Press.

Sternberg, R.J. & Lubart, T.I. (1991). An investment theory of creativity and its development. *Human Development, 34*, 1-31.

Swanson, H.L. (1990). Influence of metacognitive knowledge and aptitude on problem solving. *Journal of Educational Psychology, 82*, 306-314.

Sweller, J. (1989). Cognitive technology: Some procedures for facilitating learning and problem solving in mathematics and science. *Journal of Educational Psychology, 81*, 457-466.

Thorndike, R.L., & Stein, S. (1937). An evaluation of attempts to measure social intelligence. *Psychological Bulletin, 23*, 275-285.

Tyler, L.E. (1965). *The psychology of human differences.* Englewood Cliffs, NJ: Prentice-Hall.

Ulrich, J., & Wieland, K. (1981). *Organizational theory.* New York: Irwin.

Van Meter, P., Yoki, L., & Pressley, M. (1994a). College students, theory of notetaking derived from their perceptions of notetaking. *Journal of Educational Psychology, 86*, 323-338.

Van Meter, P., Yoki, L., & Pressley, M. (1994b). Encoding of surveys when 10-to-14-years-old process isolated survey sentences: More evidence of improved encoding during childhood resulting from elaborative instructions. *Journal of Educational Psychology, 86*, 402-413.

Wagner, R.K. (1991). Managerial problem solving. In R.J. Sternberg, and P.A. Frensch (Eds.), *Complex problem solving,* (pp. 115-148). Hillsdale, NJ: Erlbaum.

Wallas, G. (1926). *The art of thought*. New York: Harcourt-Brace.

Ward, S.L., Byrnes, J.P., & Overton, W.F. (1990). Organization of knowledge and conditional reasoning. *Journal of Educational Psychology, 82*, 832-837.

Wise, L., Chia, W.J., & Rudner, L.M. (1990). *Identifying necessary job skills: A review of previous approaches.* Washington, DC: American Institutes for Research.

Zaccaro, S.J., Gilbert J.A., Thor, K.K., & Mumford, M.D. (1991). Leadership and social intelligence: Linking social perceptiveness and behavior flexibility to leader effectiveness. *Leadership Quarterly, 2*, 317-342.

pendix 3-A

scription and Definition of Basic Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scale	Level Scale
Reading Comprehension	Decodes, interprets, & comprehends information drawn from written documents, books, etc.	Understanding written sentences & paragraphs in work related documents	Hayes & Flower (1986) Friedrickson (1982)	Reading	*High:* Reading a scientific journal article describing surgical procedures. *Medium:* Reading a memo from management describing new personnel policies. *Low:* Reading step-by-step instructions for completing a form.
Active Listening	Receives, interprets, & attends to verbal information & monitors comprehension of this material asking questions as appropriate	Listening to what other people are saying & asking questions as appropriate	Daly (1994) Beck & Carpenter (1986)	Listening	*High:* Presiding as judge in a complex legal disagreement. *Medium:* Answering inquiries regarding credit references. *Low:* Taking a customer's order.
Writing	Communicates thoughts, ideas, information, & messages in writing; planning, generating, & revising text	Communicating effectively with others in writing as indicated by the needs of the audience	Hayes & Flower (1986) Needles & Knapp (1994)	Writing	*High:* Writing novel for publication. *Medium:* Writing a memo to staff outlining new directives. *Low:* Taking a telephone message.
Speaking	Communicates thoughts, ideas, & information orally attending to the comprehension of listeners & the demands of the setting	Talking to others to effectively convey information	Daly (1994)	Speaking	*High:* Arguing a legal case before the Supreme Court. *Medium:* Interviewing applicants to obtain personal and work history. *Low:* Greeting tourists and explaining tourist attractions.
Mathematics	Understands mathematical problem solving procedures & how these procedures might be used to address various problems	Using mathematics to solve problems	Greeno & Simon (1988)	Mathematics Arithmetic	*High:* Developing a mathematical model to simulate and resolve an engineering problem. *Medium:* Calculating the square footage of a new home under construction. *Low:* Counting the amount of change to be given to a customer.

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scale	Level Scale
Science	Understands basic scientific problem solving procedures & how these procedures might be used to address various problems	Using scientific methods to solve problems	Feltovich, Spiro, & Coulson (1993) Kilkarni & Simon (1990) Carey (1986)	None	*High:* Conducting analyses of aerodynamic systems to determine the practicality of an aircraft design. *Medium:* Conducting product tests to insure safety standards are met, following written instructions. *Low:* Conducting standard tests to determine soil quality.
Critical Thinking	Recognizes & can analyze the strengths & weaknesses of arguments & propositions using logic to establish the validity of these propositions	Using logic & analysis to identify the strengths & weaknesses of different approaches	Halpern (1994) Perkins, Jay, & Tishman (1994)	Reasoning Self-Management Knowing How to Learn	*High:* Writing a legal brief challenging a federal law. *Medium:* Evaluating customer complaints and determining appropriate responses. *Low:* Determining whether a subordinate has a good excuse for being late.
Active Learning	Works with new information & concepts actively seeking to identify the meaning & implications of these concepts as they apply to problem solving	Working with new material or information to grasp its implications	Chi, Bassock, Lewis, Reimann, & Glaser (1989) Schmeck & Grove (1979)	Knowing How to Learn	*High:* Identifying the implications of a new scientific theory for product design. *Medium:* Determining the impact of new menu changes on a restaurant's purchasing requirements. *Low:* Thinking about the implications of a newspaper article for job opportunities.
Learning Strategies	Identifies & uses various alternative strategies for working on learning tasks, looking for examples, taking notes, & identifying alternating strategies for working with this material	Using multiple approaches when learning or teaching new things	Mumford, Baughman, Supinski, Costanza, & Threlfall (1994) Greeno & Simon (1988) Sweller (1989)	Knowing How to Learn	*High:* Applying principles of educational psychology to developing new teaching methods. *Medium:* Identifying an alternative approach that might help trainees who are having difficulties. *Low:* Learning a different method of completing a task from a co-worker.
Monitoring	Establishes expected standards for performance & monitors the attainment of these standards changing behavior & approach as indicated by feedback information	Assessing how well one is doing when learning or doing something	Brown & Camponie (1986) Snow & Swanson (1992)	Monitors & Corrects Performance	*High:* Reviewing corporate productivity and developing a plan to increase productivity. *Medium:* Monitoring a meeting's progress and revising the agenda to ensure that important topics are discussed. *Low:* Proofreading and correcting a letter.

pendix 3-B

scription and Definition of Complex Problem Solving Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Problem Identification	Reflects the restructuring of an ill-defined situation such that the basic nature of the problem & requisite problem solving strategies are identified	Identifying the nature of problems	Getzels & Csikszentmihalyi (1976) Redmond, Mumford, & Teach (1993) Hoover & Feldhusen (1990)	Creative Problem solving Decision making Reasoning	*High*: Analyzing corporate finances to develop a restructuring plan. *Medium:* Identifying and resolving customer complaints. *Low:* Comparing invoices of incoming articles to ensure they meet required specifications.
Information Gathering	Searches for key diagnostic information needed to address a problem using appropriate search strategies	Knowing how to find information & identifying essential information	Qin & Simon (1988) Perkins (1992) Davidson & Sternberg (1984)	Problem solving Decision making Reasoning	*High:* Analyzing industry indicies and competitors' annual reports to determine feasibility of expansion. *Medium:* Conducting an employee opinion survey. *Low:* Looking up procedures in a manual.
Information Organization	Uses appropriate concepts & schema to organize information identifying essential features & concept relationships	Finding ways to structure or classify multiple pieces of information	Davidson & Sternberg (1984) Kuhn (1970) Mumford, *et al.* (1991)	Problem solving Decision making Reasoning	*High:* Developing a prototype for a new database system. *Medium:* Classifying library materials according to subject matter. *Low:* Laying out tools to complete a job.
Synthesis/ Reorganization	Reorganize & restructure applicable schema to create new ways or conceptual systems needed to understand a problem situation	Reorganizing information to get a better approach to problems or tasks	Owens (1969) Finke, Ward & Smith (1992) Mobley, Doares, & Mumford (1992)	Creative Problem solving Reasoning	*High:* Determining the best order in which to present evidence in a criminal trial. *Medium:* Redesigning floor layout to take advantage of new manufacturing techniques. *Low:* Rearranging a filing system to make it easier to get needed material.
Idea Generation	Uses understanding of situation and/or key features of this relevant schema to generate or identify alternative problem solutions	Generating a number of different approaches to problems	Guilford (1950) Runco (1991,1994)	Creative Problem solving	*High:* Developing alternative transportation plans for a growing urban area. *Medium:* Developing recruitment strategies. *Low:* Finding alternative routes while making deliveries.

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Idea Evaluation	Uses available expertise or mental models to identify various consequences of a proposed solution recommending changes or implementation as appropriate	Evaluating the likely success of an idea in relation to the demands of the situation	Runco & Vega (1990) Mumford, Zaccaro, Harding & Fleishman (in press)	Decision making Problem solving Reasoning	***High:*** Analyzing probable outcomes of public health policies to combat disease epidemic. ***Medium:*** Evaluating and selecting employee suggestions for possible implementation. ***Low:*** Determining which procedure to apply to get a report typed more quickly.
Implementation Planning	'Creates a mental representation or formal plan for implementing a solution & identifies appropriate actions & timing of actions to implement plan.	Developing approaches for implementing an idea	Krietler & Krietler (1987) Covington (1987) Carrol & Gillen (1987)	Problem solving Creative Reasoning	***High:*** Developing and implementing a plan to provide emergency relief for a major metropolitan area. ***Medium:*** Scheduling deliveries based on distance between sites, staffing time, availability of vehicles, and cost. ***Low:*** Scheduling and coordinating a one-day meeting.
Solution Appraisal	Observes & evaluates problem solving activities using observations to adjust strategies & structure experience	Observing & evaluating the outcomes of problem solution to identify lessons learned or redirect efforts	Brown & Camponie (1986) Sternberg (1986)	Monitoring Decision making Problem solving	***High:*** Reviewing, assessing, and modifying the implementation of a new business plan. ***Medium:*** Measuring customer satisfaction after introduction of new billing procedures. ***Low:*** Identifying and correcting an error made in preparing a report.

Summary of Technical Tasks and Key Technical Tasks

Reference Study	Job (Number & Percent of Technical Activities)	Technical Activities	Frequent and Important Technical Activities
Job Analysis of Three Electrical Worker Positions	Inside Wireman (9, 35%)	• Develop on-site safety program • Install protective devices when working with live conductors • Study blueprints to determine placement of conduit • Install power feeder and control wiring systems • Balance loads on various circuits • Calculate necessary bends and saddles • Study blueprints to determine where motors and equipment will be placed and establish layout • Study blueprints to identify circuits • Study blueprints to determine where motors and equipment will be placed and establish layout	• Develop on-site safety program • Install protective devices when working with live conductors • Study blueprints to determine placement of conduit • Install power feeder and control wiring systems
	Residential Wireman (16, 25%)	• Study blueprints and specifications • Install protective devices when working with live conductors • Plan how many wires can be pulled in each conduit • Determine where there will need to be junction boxes • Install switch boxes • Check and repair faults • Determine problem through testing • Localize faulty unit or component • Install "homeruns" from panel box, including 110v, 220v and low voltage circuits • Make electrical connections in fixtures and receptacles • Install circuits • Install boxes • Determine which lighting fixture or piece of equipment is not working properly • Wire service panel to ground rod • Wire breaker panel to water pipe • Replace or repair as necessary	• Study blueprints and specifications • Install protective devices when working with live conductors • Plan how many wires can be pulled in each conduit • Determine where there will need to be junction boxes

Reference Study	Job (Number & Percent of Technical Activities)	Technical Activities	Frequent and Important Technical Activities
		• Study blueprints and specifications • Install protective devices when working with live conductors • Select proper transformer primary and secondary voltage rating, KVA rating, polarity, and impedance • Operate platform to reach distribution or transmission lines • Set up pulling and tensioning devices • Install ground wire • Install ground rods • Install new transformer • Install lightning protection device to protect transformer • Install disconnects • Select appropriate insulator for voltage • Develop on-site safety program • Operate bucket truck to reach distribution or transmission lines • Determine correct transformer connection • Determine proper fuse rating • Inspect wires for problems	• Study blueprints and specifications • Install protective devices when working with live conductors • Select proper transformer primary and secondary voltage rating, KVA rating, polarity, and impedance
A Report on Job Analysis and Selection for Floor Inspectors	Floor Inspector (5, 10%)	• Applies gauges to specific area of parts to measure various characteristics • Reads wide variety of gauges or other measuring devices • Decides whether or not obtained measure is acceptable or not, following tolerances provided on audit instructions • Identifies on blueprint the measurements that must be added/subtracted to obtain the desired distance • Uses sensitive measuring device requiring an extremely steady hand; for example, hardness testers, electronic probes, micro finish checks, etc.	• Applies gauges to specific area of parts to measure various characteristics • Reads wide variety of gauges or other measuring devices
Significant Tasks and Job Requirements for C&S Tellers	Teller (8, 7%)	• Input teller terminal • URDs and JV printer • Debit or credit IOC • Sign-off terminal • ARIS • Input into teller terminal the proper transaction(s) to service the customer • Complete transactions using the "check-link" key • Follow steps to balance teller record at end of work day	• Input teller terminal • URDs and JV printer • Debit or credit IOC • ARIS

Reference Study	Job (Number & Percent of Technical Activities)	Technical Activities	Frequent and Important Technical Activities
Final Report on Job Analysis for Window Services Technician and Clerk, Finance Station	Window Technician/Finance Clerk (6, 7%)	• Ensure that money order imprinters, stock credits, meter heads, and rounddaters are secured • Resolve discrepancies resulting from incorrect meter settings • Update Clerk's disk when rates change on domestic/international • Update Express Mail network in Integrated Rate Terminal (IRT) when Zip Codes change or when cut off times change • Operate IRT programs when changes are received	• Ensure that money order imprinters, stock credits, meter heads, and rounddaters are secured • Resolve discrepancies resulting from incorrect meter settings • Update Clerk's disk when rates change on domestic/international • Update Express Mail network in Integrated Rate Terminal (IRT) when Zip Codes change or when cut off times change • Operate IRT programs when changes are received
Predicting Job Performance of Electrical Power Plant Operators: A Literature Review	Equipment Operator (4, 9%)	• Inspect equipment • Diagnoses on equipment problems. Make minor electrical and mechanical adjustments • Switches lines and equipment • Operates and observes support systems	• Inspect equipment • Diagnoses on equipment problems. Make minor electrical and mechanical adjustments • Switches lines and equipment • Operates and observes support systems
	Nuclear Control Room Operator (4, 5%)	• Operate the nuclear reactor during start-up • Shut down power plant equipment • Operate power plant during steady state power condition • Respond to off-normal situation	• Operate the nuclear reactor during start-up • Shut down power plant equipment • Operate power plant during steady state power condition • Respond to off-normal situation
Development of a Selection Test Battery for Machinists	Machinist (10%)	• Turn crank or handwheel to set machine for required depth of cut • Operate metal hardness testing devices • Mark layout guidelines on material using scribe, center punch, surface gauge and divider • Control furnace operation for heat treatment • Check dimensions of part with precision measuring instruments such as micrometers, calipers, and gauges. • Use micrometers to measure or check dimensions of work • Use scales, calipers, and micrometers to determine layout dimensions	• Turn crank or handwheel to set machine for required depth of cut • Operate metal hardness testing devices • Mark layout guidelines on material using scribe, center punch, surface gauge and divider • Control furnace operation for heat treatment

Reference Study	Job (Number & Percent of Technical Activities)	Technical Activities	Frequent and Important Technical Activities
Development and Validation of an Industry-Wide Electric Power Plant Operator Selection System	Power Plant Operator (8, 18%)	• Monitor reactor core parameters and log readings from control room instrumentation • Inspect, monitor, and operate control systems related to nuclear reactor safety • Inspect and operate air compressor systems • Determine operating priorities inside and outside control room as required by system demands • Prepare boiler for lighting off following established procedures • Manipulate nuclear reactor controls to adjust reactivity for load changes • Execute orders received for load dispatching or switching and/or synchronizing equipment to the system • Analyze trends recorded in log or on instrumentation	• Monitor reactor core parameters and log readings from control room instrumentation • Inspect, monitor, and operate control systems related to nuclear reactor safety • Inspect and operate air compressor systems • Determine operating priorities inside and outside control room as required by system demands • Prepare boiler for lighting off following established procedures
Final Report: Job Analysis and Critical Task Selection for the First-Term Navy Radioman Job	First-Term Radioman (7, 20%)	• Use routing guide to determine distribution or routing of incoming messages • Set up crypto code • Set up teletypes • Patch communications equipment pieces together • Set up satellite transceivers • Operate reperforator • Transmit messages via VDT terminal	• Use routing guide to determine distribution or routing of incoming messages • Set up crypto code • Set up teletypes • Patch communications equipment pieces together

pendix 3-D

scription and Definition of Technical Skills

Construct Label	Technical Definition	Operational Definition	SCANS Scales	Scale Anchors
Operations Analysis	Identifies the requirements for a new technology including user needs, product requirements, and production, or operating, requirements for a system, tool, or type of technology	Analyzing needs and product requirements to create a design	Improves and designs technology	*High*: Identifying the control system needed for a new process production plant. *Medium:* Suggesting changes in software to make a system more user friendly. *Low*: Selecting a photocopy machine for an office.
Technology Design	Uses principles and knowledge of technology to create new technologies or adapt existing technologies to user needs laying out blueprints or parameters for operating the systems consistent with needs, site, and technology	Generating or adapting equipment and technology to serve user needs	Improves and designs technology Selects technology	*High*: Creating new technology for producing industrial diamonds. *Medium:* Redesigning the handle on a hand tool for easier gripping. *Low*: Adjusting exercise equipment for use by customer.
Equipment Selection	Identifies the kind of technology, equipment or tools available most likely to satisfy user requirements in a cost-effective fashion	Determining the kind of tools and equipment needed to do a job.	Selects technology	*High:* Identifying the equipment needed to produce a new product line. *Medium:* Choosing a software application to use to complete a work assignment. *Low:* Selecting a screwdriver to use in adjusting vehicle carburator.
Installation	Uses design specifications and understanding of local situation to install equipment or technological systems in such a way as to meet user needs	Installing equipment, machines, wiring, or programs to meet specifications	Improves and designs technology	*High:* Installing "one of a kind" process production molding machine. *Medium:* Installing new switches for a telephone exchange. *Low:* Installing a new air filter in an air conditioner.
Programming	Writes computer software in one of more languages to provide the procedures needed to accomplish one or more tasks	Writing computer programs for various purposes	Applies technology to task Uses computers to process	*High:* Writing expert system programs to analyze ground radar geological data for probable existence of mineral deposits. *Medium:* Writing statistical analysis programs to analyze demographic data. *Low:* Writing a program in BASIC to sort objects in a database.

Construct Label	Technical Definition	Operational Definition	SCANS Scales	Scale Anchors
..sting	Uses appropriate tools, techniques, and procedures to establish whether a machine or program is operating in accordance with specifications or design layouts	Conducting tests to determine whether equipment, software, or procedures are operating as expected	Applies technology to task Selects technology	*High:* Developing procedures to test a prototype of a new computer system. *Medium:* Starting a machine to obtain a first-run workpiece and verify dimensional tolerances. *Low:* Using a test station to assess whether a car meets emission requirements.
Operations Monitoring	Monitor the inflow and operations involved in producing a product; identifying changes likely to affect production or continued operations	Watching gauges, dials, or other indicators to make sure a machine is working properly	Applies technology to task	*High:* Monitoring and integrating control feedback in a petrochemical processing facility to maintain production flow. *Medium:* Monitoring machine functions on an automated production line. *Low:* Monitoring completion times in running a computer program.
Operation and Control	Uses information and system status to make necessary changes in system status applying appropriate controls	Controlling operations of equipment or systems	Applies technology to task	*High:* Controlling aircraft approach and landing at a large airport during a busy period. *Medium:* Adjusting the speed of assembly line equipment based on the type of product being assembled. *Low:* Adjusting the settings on a copy machine to make reduced size photocopies.
Product Inspection	Inspects and evaluates the products of a process or procedure to make sure they are meeting design specifications, error tolerances, and user needs	Inspecting and evaluating the quality of products	Applies technology to task	*High:* Establishing and monitoring quality control procedures for a large manufacturing operation. *Medium:* Measuring new part requirements for tolerance to specifications. *Low:* Inspecting draft of memorandum for clerical errors.
Equipment Maintenance	Evaluates the servicing needs of a machine or system conducting requisite maintenance or obtaining support for conducting this maintenance	Performing routine maintenance and determining when and what kind of maintenance is needed	Troubleshoots and maintains technology Applies technology to task	*High:* Conducting maintenance checks on an experimental aircraft. *Medium:* Clearing moving parts in production machinery. *Low:* Adding oil to an engine as indicated by a gauge or warning light.

Construct Label	Technical Definition	Operational Definition	SCANS Scales	Scale Anchors
Troubleshooting	Identifies and diagnoses the sources of operating errors in a machine, computer, or electrical system, and determines the actions to be taken to fix this error	Determining what is causing an operating error and deciding what to do about it	Maintains and troubleshoots technology	*High:* Directing the debugging of control code for a new operating system. *Medium:* Identifying the circuit causing an electrical system to fail. *Low:* Identifying the source of a leak by looking under a machine.
Repairing	Uses tools and procedures to repair faulty components of an operating system or machine	Repairing machines or systems using the needed tools	Maintains and troubleshoots technology	*High:* Repairing structural damage to a building following an earthquake. *Medium:* Replacing a faulty hydraulic valve. *Low:* Tightening screw to get a door to close properly.

Appendixes 3-E

Description of Definition of Systems Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Visioning	Create and apply a cognitive template or mental model describing how components of a system should interact under ideal conditions	Developing an image of how a system should work under ideal conditions	House and Howell (1992) Mumford, Snell, Reiter-Palmon (1994)	Systems understanding	*High:* Creating a new vision for a large manufacturing organization that lets the company respond to changes in market and technology *Medium:* Preparing a presentation detailing the role of a work unit in relation to the organizational structure *Low:* Understanding a co-workers' roles in finishing a job
Systems Perception	Understands how various components of a system work together and monitors key diagnostics to identify changes in system states and the nature of operations	Determining when important changes have occurred in a system or are likely to occur	Zaccaro, Gilbert, Thor, & Mumford (1991)	Systems understanding	*High:* Identifying how changes in tax laws are likely to affect preferred sites for manufacturing operations in different industries *Medium:* Observing conditions that may impede the flow of work on an assembly line notifying personnel that corrective action is necessary *Low:* Identifying how an argument among team members might affect the day's work
Identification of Downstream Consequences	Can identify the effects on different systems of a change in a given variable and how these changes will effect operations over time	Determining the long-term outcomes of a change in operations	Bass (1994) Jacobs & Jaques (1989)	Systems understanding Improves and designs systems	*High:* Identifying changes that might occur in an industry if a new piece of legislation is passed *Medium:* Identifying how introduction of a new piece of equipment will affect production rates *Low:* Identifying how loss of a team member will affect completion of a job
Identification of Key Causes	Can identify those variables that have the strongest effects on system operations and the variables to be manipulated to bring about desired outcomes	Identifying the things that must be changed to achieve a goal	Bass (1994)	Improves and designs systems	*High:* Identifying the changes in organizational policy needed to encourage research and development efforts *Medium:* Identifying the major reasons why a client might be unhappy with a product *Low:* Determining which route to take to deliver a passenger to a destination quickly

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Judgement and Decision Making	Weighs the pros and cons of various actions in relation to broader goals under conditions where complete information is not available	Weighing the relative costs and benefits of a potential action	Peterson (1992) Hogarth (1986) Sternberg (1990)	Decision making Monitors and corrects performance	*High:* Deciding whether a manufacturing company should invest in a new robotics technology *Medium:* Evaluating a loan application for degree of risk *Low:* Deciding how scheduling a break will affect work flow
Objective Evaluation	Actively seeks out multiple sources of information about different system outcomes appraising the potential biases in this information and acting accordingly	Looking at many indicators of system performance taking into account their accuracy	Peterson (1992) Mumford and Connelly (1991)	None	*High:* Evaluating the long-term performance problems of a company *Medium:* Determining why a manager has underestimated production costs *Low:* Determining why a co-worker has been overly optimistic about how long it would take to complete a task

Appendix 3-F

Description and Definition of Higher Order System Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Level Scale Anchors
Systems Understanding	Understands how systems operate and the variables influencing their operation using this understanding to define goals and monitor changes in operations	Knows why a system works the way it does and can identify important changes	Peterson (1992) Zaccaro, Gilbert, Thor, & Mumford (1991)	Systems understanding Monitors and corrects performance	*High:* Understands how various components of an organization (e.g., design, manufacturing, etc.) operate to produce a new car model. *Medium:* Identifies how the members of a team work together to produce a proposal. *Low:* Understanding how someone being out sick will affect the performance of a group.
Systems Operations	Identifies the key variables that influence system operations and how changes in the variables will affect various organizational outcomes now and in the future	Knows which actions to take to change a system and how these actions will affect long term outcomes	Bass (1994) Jacobs & Jaques (1989)	Systems understanding Improves and designs systems	*High:* Identifies how a bill before Congress will affect the development of new technologies needed by an industry. *Medium:* Identifies the actions that need to be taken in integrating a new piece of equipment and knows how they will affect production. *Low:* Identifies how to get co-workers to collaborate with other team members.

Judgement and Evaluation	Weighs the strengths and weaknesses of different courses of actions and obtains objective information bearing on the quality of this decision from various sources	Can make decisions when things are uncertain and objectively evaluate those decisions	Hogarth (1986) Mumford & Connelly (1991)	Decision making Monitors and corrects performance	*High:* Assesses the costs and benefits associated with introducing a new technology to a large manufacturing operations. *Medium:* Appraises whether a change in personnel policy is having the intended effect on motivation. *Low:* Assesses whether taking a break will disrupt the work of other team members.

escription and Definition of Lower Order Resource Management Skills

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Scale Anchors
Financial	Obtains requisite funds from either internal or external sources	Obtains needed operating budgets or start-up money	Peterson (1992)	Allocating money	*High:* Obtains financial support needed to start a new division of a Fortune 500 company. *Medium:* Obtains increase in yearly promotional budget to address new competition. *Low:* Requests a raise to bring salary into line with peers.
Budgeting	Allocates funds to various aspects of operations including production, product development, and marketing	Allocates funds to accomplish relevant work	Peterson (1992)	Allocating money	*High:* Develops yearly operating budget for a Fortune 500 company. *Medium:* Proposes a budget for an advertising campaign. *Low:* Suggests changes in a budget proposal to allow for more promotional activities.
Accounting	Monitors and evaluates the use of funds and the return on investment	Determines how funds are being spent and whether these funds are being spent wisely	Peterson (1992)	Allocating money	*High:* Develops new procedures for monitoring the employee reimbursements in a large corporation.. *Medium:* Does payroll accounting for a midsize corporation. *Low:* Assesses whether net pay is correct after checking deductions.
Timeframe Estimation	Can estimate roughly how long it will take to accomplish certain tasks using knowledge of available material and personnel needed	Can tell how long it will take to complete a task	Peterson (1992)	Allocates time	*High:* Estimates how many people will need to be hired to complete development of a new aircraft. *Medium:* Determines how many months it will take to finish building a house. *Low:* Determines how long it will take to assemble a night stand.
Identification of Critical Periods	Can determine the points on a task or project where critical events requiring extra resources will occur	Can tell at what points in a project extra attention or extra help will be needed	Peterson (1992)	Allocates time	*High:* Determines when problems will arise in the development of an auto prototype. *Medium:* Determines when building schedules will require additional subcontractors. *Low:* Determines when failure to complete a task will affect others' work.

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Scale Anchors
Prioritizing	Can identify those tasks or problems that require immediate attention and schedules or reschedules activities to address this issue	Knows what issues are important and deals with things accordingly	Peterson (1992)	Allocates time	***High:*** Establishes the daily agenda for the President during a foreign crisis. ***Medium:*** Delays arrival at a routine meeting to deal with a serious personnel issue. ***Low:*** Completes tasks in the order specified by a supervisor.
Allocation of Time	Can allocate one's own and other's time to various tasks in a manner which will allow for their timely completion within the context of other ongoing activities	Allocates time to tasks in accordance with current needs	Peterson (1992)	Allocates time	***High:*** Rearranges the schedules of personnel in a manufacturing plant to get a product to market on time. ***Medium:*** Determines how many person-hours will be needed to complete a consulting project. ***Low:*** Determines how long it will take to get a message to someone.
Obtaining and Allocating Material Resources	Identifies the materials, equipment, and facilities that need to be leased or purchased and allocates these in accordance with the needs of the organization	Determines what equipment, materials, or facilities need to be leased or purchased	Fleishman, Mumford, Zaccaro,Levin, Hein and Korotkin (1991)	Allocates material resources	***High:*** Directs acquisition of new telecommunications equipment for a phone company. ***Medium:*** Identifies a new type of equipment that will reduce production time in an assembly plant. ***Low:*** Suggests changing a work rule to allow better distribution of shared tools and equipment.
Maintaining Material Resources	Ensures that materials, equipment, and facilities are in good working order, inspecting materials and arranging for repairs as necessary	Ensures that equipment, materials, and facilities are in good working order	Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991)	Allocates material resources	***High:*** Proposes new occupational health and safety guidelines. ***Medium:*** Ensures that scheduled equipment maintenance has been done. ***Low:*** Makes sure that an engine has adequate oil.
Monitoring and Utilizing Material Resources	Ensures that equipment, materials, and facilities are used in the intended fashion and applied efficiently in completing requisite tasks	Ensures that materials, equipment, and facilities are used efficiently	Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991)	Allocates material resources	***High:*** Develops a Quality Management program for a Fortune 500 company. ***Medium:*** Identifies changes in working procedures that will reduce material waste in a factory. ***Low:*** Ensures that rules involving equipment "sign-outs" are followed.

Construct Label	Technical Definition	Operational Definition	Citations	SCANS Scales	Scale Anchors
btaining and Allocating Personnel Resources	Identifies and recruits people with expertise needed by the organization and assigns people to tasks calling for this expertise	Recruits and selects people needed to do the job	Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991)	Allocates material resources	*High:* Establishes a hiring system for a research and development organization that promotes long-term growth. *Medium:* Identifies the candidates for job openings who seem to have the best overall qualifications. *Low:* Identifies who on a team has the skills to replace a sick team member.
Motivating Personnel	Takes necessary actions needed to encourage others to complete a task using techniques such as goal setting, consensus building, etc.	Can motivate people to get the job done	Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991)	Allocates personnel resources Leadership	*High:* Creates an overriding vision for a large organization to guide it during a period of change. *Medium:* Identifies the kind of outcomes or rewards employees want and assigns them to projects likely to provide these outcomes. *Low:* Praises a co-worker who has done a particularly good job.
Developing Personnel	Identifies the developmental needs of personnel and initiates actions needed to develop necessary skills	Teaches people things they need to know to get a job done	Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991)	Allocates personnel resources Leadership	*High:* Identifies the implications of technology changes for work force development and initiates requisite training. *Medium:* Instructs subordinates in a better way to complete a task. *Low:* Helps new co-worker learn office procedures.
Monitoring and Utilizing Personnel	Monitors personnel performance and providing requisite performance feedback as necessary and adjusting performance demands as indicated	Provides others with feedback about their performance and how to improve it	Fleishman, Mumford, Zaccaro, Levin, Hein, and Korotkin (1991)	Allocates personnel resources Leadership	*High:* Evaluates the strengths and weaknesses of senior staff and suggests assignments likely to maximize performance. *Medium:* Observes the performance of a work group and conducts performance appraisal sessions. *Low:* Identifies an error in someone else's products.

Appendix 3-H

Relationships with Other Skill Taxonomies

Peterson 1992	Current Taxonomy
Reading	Reading
Writing	Writing
Mathematics	Mathematics
Arithmetic	Mathematics
Listening	Active listening
Speaking	Speaking
Creative thinking	Problem identification, synthesis/reorganization
Decision making	Judgment and decision making
Problem solving	Idea generation, idea evaluation, implementation planning
Representative information	Information organization, technology design
Know how to learn	Learning strategies
Reasoning	Critical thinking
Identifies information	Information gathering
Organizes information	Information organization
Interprets and communicates information	Implementation planning
Understands status quo	Systems perception
Uses computers to process information	Programming, testing
Selects technology	Equipment selection, installation
Applies technology to task	Operation and control, operations monitoring, equipment maintenance, product inspection
Maintains and troubleshoots technology	Troubleshooting, repairing
Improves and designs systems	Technology design, operations analysis
Understands systems	Systems perception
Anticipates and identifies consequences	Identification of key causes, identification of downstream consequences
Monitors and corrects performance	Operations monitoring, systems evaluation, solution appraisal
Works with diversity	Social perceptiveness
Negotiates to arrive at decision	Negotiation
Exercise leadership	Persuasion

Note: "None" indicates not in skills taxonomy

Note: "None/______" indicates other relevant taxonomy

Serves clients/customers	Service orientation
Teaches others new skills	Instructing
Participates as member of team	Coordination
Allocates time	Time management
Allocates money	Management of financial resources
Allocates material and facility resources	Management of material resources
Allocates human resources	Management of personnel resources
Kane and Meltzer (1990)	**Current Taxonomy**
Learning to learn	Active learning, learning strategies
Listening	Active listening
Oral communication	Speaking
Creative thinking	Problem identification, synthesis/reorganization, idea generation
Problem solving	Information gathering, information organization, idea evaluation, implementation planning
Self-esteem	None/Work Style
Goal setting	Visioning
Career development	Active learning
Interpersonal skills	Instructing, service orientation
Team work skills	Coordination, social perceptiveness
Negotiator skills	Negotiation, persuasion
Organizational effectiveness	Systems perception, identification of key causes, identification of downstream consequences
Leadership	Judgment and decision making
Smith (1992)	**Current Taxonomy**
Data analysis	Programming
Briefing	Speaking
Counseling	Instructing
Discussion facilitation	Persuasion, service orientation
Instructional design	Technology design
Interviewing	Active listening
Listening	Active listening
Marketing	Persuasion

Note: "None" indicates not in skills taxonomy
Note: "None/_____" indicates other relevant taxonomy

Measuring/evaluative	Testing
Meeting management	Time management, management of personnel resources, troubleshooting, judgment and decision making
Negotiation	Negotiation
Organizational politics	Systems perception
Organizing/prioritizing	Time management
PC applications	Programming
Problem solving	Information gathering, information organization, idea generation, implementation planning, solution appraisal
Program development	Operations analysis, technology design
Research techniques	Critical thinking, problem identification
Staffing	Management of personnel resources
Teaching methods	Instructing
Visioning/forecasting	Visioning, identification of downstream consequences
Writing	Writing

Jones (1994)	Current Taxonomy
Categorizing	Information organization
Detecting persuasion	Persuasion
Examining ideas	Idea evaluation
Analyzing arguments	Idea evaluation, critical thinking
Evaluating information	Information gathering
Questioning evidence	Instructing
Developing hypotheses	Problem identification
Argumentation	Critical thinking
Reflection	Systems evaluation
Context analysis	Systems perception, social perceptiveness
Message development	Information gathering
Communication	Speaking
Situation analysis	Social perceptiveness
Relationship management	Persuasion, time management, management of personnel resources

Note: "None" indicates not in skills taxonomy
Note: "None/______" indicates other relevant taxonomy

Conversation management	Active listening
Writing	Writing
Drafting	Technology design, problem identification, visioning
Collaborative	Coordination
Organizing	Implementation planning, information organization
Purpose identification	Problem identification
Revising	Solution appraisal

OPM (1994) Professional and Administrative Competencies	Current Taxonomy
Reading	Reading
Writing	Writing
Arithmetic	Mathematics
Mathematical reasoning	Mathematics
Oral communication	Speaking
Creative thinking	Problem identification, synthesis/reorganization
Decision making	Judgment and decision making
Reasoning	Critical thinking
Problem solving	Information organizing
Mental visualization	Operations analysis, technology design
Learning	Learning strategies
Self-esteem	None/Work Style
Team work	Coordination
Integrity/honesty	None/Work Style
Self-management	None/Work Style
Interpersonal skills	Coordination
Planning and evaluating	Idea evaluation, implementing planning, solution appraisal
Financial management	Management of financial resources
Managing human resources	Management of personnel resources
Leadership	Persuasion
Teaching others	Instructing
Customer service	Service orientation

Note: "None" indicates not in skills taxonomy
Note: "None/______" indicates other relevant taxonomy

Organizational awareness	Social perceptiveness
Influencing/negotiating	Negotiation
Technology application	Operation and control, troubleshooting, repairing
Flexibility	None/Work Style
Technical competence	Technology design, programming, installation
Perceptual speed	None/Ability
Physical strength	None/Ability
Memory	None/Ability
Eye/hand coordination	None/Ability
Vision	None/Ability
OPM (1991) Managerial Competencies	**Current Taxonomy**
Written communication	Writing
Oral communication	Speaking, active listening
Problem solving	Information gathering, information organization, idea generation
Cultural awareness	Social perceptiveness
Vision	Visioning
Creative thinking	Problem identification, synthesis/reorganization
Flexibility	None/Work Style
Decisiveness	Judgment and decision making
Leadership	None/Work Style
Conflict resolution	Coordination
Self-direction	None/Work Style
Influencing/negotiating	Persuasion, negotiation
Planning and evaluating	Implementation planning, solution appraisal
Financial management	Management of financial resources
Human resources management	Management of personnel resources
Client orientation	Service orientation
External awareness	Systems perception
Team building	Instructing
Technology management	Operations analysis, equipment selection

Note: "None" indicates not in skills taxonomy
Note: "None/______" indicates other relevant taxonomy

Integrity	None/Work Style
Technical competence	Technology design, testing
Lopez, Kesselman, and Lopez (1981)	**Current Taxonomy**
Numerical computation	Mathematics
Oral expression	Speaking, active listening
Written expression	Reading, writing
Planning	Implementation planning
Decision making	Judgment and decision making
Craft skill	All technical skills
Personal appearance	Social perceptiveness
Tolerance	Social perceptiveness, service orientation
Influence	Persuasion
Cooperation	Coordination
Comprehension	Critical thinking
Problem solving	Information gathering, information organization, idea generation, idea evaluation
Creativity	Problem identification, synthesis/reorganization
Perception	Monitoring, solution appraisal
Concentration	Systems evaluation
Memory	None/Ability
NAS Competencies from Wise, et al. (1990)	**Current Taxonomy**
Reasoning and problem solving	Critical thinking and all problem solving skills
Reading	Reading
Writing	Writing
Computation	Mathematics, programming
Science and technology	Science and all technical skills
Oral communications	Speaking, active listening
Interpersonal relationships	Social perception, persuasion, negotiation
Social and economic	Management of financial resources, management of material resources
Spencer and Spencer (1993) Managerial Competencies	**Current Taxonomy**
Impact and influence	Persuasion

Note: "None" indicates not in skills taxonomy
Note: "None/______" indicates other relevant taxonomy

Achievement orientation	None/Work Styles
Team work	Coordination
Analytical thinking	Critical thinking, implementation planning, idea evaluation
Initiative	None/Work Styles
Developing others	Instructing
Self-confidence	None/Work Styles
Directiveness	None/Work Styles
Information seeking	Information gathering, information organization
Team leadership	Visioning
Conceptual thinking	Problem identification, synthesis/reorganization, idea generation
Spencer and Spencer (1993) Sales Competencies	**Current Taxonomy**
Impact and influence	Persuasion
Achievement orientation	None/Work Styles
Initiative	None/Work Styles
Interpersonal understanding	Social perception
Customer service orientation	Service orientation
Self-confidence	None/Work Styles
Relationship building	Instructing
Analytical thinking	Critical thinking, implementation planning, idea evaluation
Conceptual thinking	Problem identification, synthesis/reorganization, idea generation
Information seeking	Information gathering, information organization
Organizational awareness	System perception
Spencer and Spencer (1993) Technical Professional Competencies	**Current Taxonomy**
Impact influence	Persuasion
Conceptual thinking	Problem identification, synthesis/reorganization, idea generation
Analytical thinking	Critical thinking, implementation planning, idea evaluation
Initiative	None/Work Styles

Note: "None" indicates not in skills taxonomy
Note: "None/______" indicates other relevant taxonomy

Self-confidence	None/Work Styles
Interpersonal understanding	Social perception
Concern for order	None/Work Styles
Information seeking	Information gathering, information organization
Team work and cooperation	Coordination, instructing
Customer service orientation	Service orientation
Achievement orientation	None/Work Styles

Note: "None" indicates not in skills taxonomy
Note: "None/______" indicates other relevant taxonomy

Self-confidence	None/Work Styles
Interpersonal understanding	Social perception
Concern for order	None/Work Styles
Information seeking	Information gathering, information organization
Team work and cooperation	Coordination, instructing
Customer service orientation	Service orientation
Achievement orientation	None/Work Styles

Note: "None" indicates not in skills taxonomy
Note: "None/______" indicates other relevant taxonomy

Chapter 4
Knowledges
Table of Contents

Tables

Figures

Appendices

Chapter 4
Knowledges

Edwin A. Fleishman, David P. Costanza, Leon I. Wetrogan,
Charles E. Uhlman, & Joanne C. Marshall-Mies
Management Research Institute, Inc.

Introduction

Occupational knowledge represents an important component of worker attributes in the proposed content model guiding the revision of the Dictionary of Occupational Titles (DOT) (Department of Labor, 1991). The study of occupational knowledge impacts any effort concerning person/job matching, job training and retraining, career counseling, vocational interests, and creation of job families or clusters. This chapter describes the development of a taxonomy of job-required knowledges and its associated measurement system.

Knowledge Definition. Knowledge is defined as a collection of discrete but related and original facts, information, and principles about a certain domain. Knowledge is acquired through formal education or training, or accumulated through specific experiences. The fact that these pieces of information are organized into some coherent structure is critical to the definition (Chase & Simon, 1973; Chi, Glaser, & Rees, 1983; Halff, Hollan, & Hutchins, 1986; Lesgold, 1984). Some knowledges are more general than others in that they are important to successful performance in a greater variety of jobs in the economy. Other knowledges are more specific and apply to a narrower range of jobs, white still others are occupation-specific.

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

This chapter describes an attempt to develop a taxonomy and measurement system for the domain of job-related knowledge requirements (Costanza & Fleishman, 1992). It also describes the steps undertaken to tailor the Knowledge Requirements Taxonomy and measurement system developed by Fleishman, Costanza, and their colleagues (Costanza & Fleishman, 1992) for use in the prototype occupational information system known as O*NET..

Development of the Knowledge Requirements Taxonomy. The first step in development of the Knowledge Requirements Taxonomy was to conduct a literature search to find previously identified job knowledges. Historically, cognitive scientists have been the primary investigators of knowledge, its acquisition and structure, and associated cognitive processes. As a consequence, much of the literature has focused on the nature of the structures, and the processes involved in developing and analyzing knowledge, rather than on taxonomies of knowledges themselves.

The initial literature review revealed that only a few lists or taxonomies of knowledges exist. Such lists were contained in several articles in the vocational literature (e.g., Prediger, 1989), the supplemental knowledge section of the Fleishman-Job Analysis Survey (F-JAS) scales (Fleishman, 1992), and various government reports and studies regarding the demands placed on workers and the knowledges required to perform job duties (e.g., SCANS, 1991). Considering all of these potential sources, it was clear that there was no extant, comprehensive listing of knowledges on which one could begin to base a taxonomy of knowledge requirements.

Approach to Developing a Work-Oriented Knowledge Taxonomy. Since the literature provided limited information of the type needed for development of a work-oriented knowledge taxonomy, a different approach was taken. It was decided that a taxonomy might be developed by analyzing job descriptions and looking for tasks and/or behaviors that were representative of underlying knowledges. The most useful source for these job descriptions, where the most jobs are explicitly identified and described, was the Department of Labor's Dictionary of Occupational Titles (DOT) (Department of Labor, 1991).

Therefore, the DOT was used to develop an initial list of job knowledges. Each job description in the DOT was read and examined. Because the DOT's descriptions are task based, the tasks in each job description were examined and the relevant knowledges that were specified as necessary to perform those tasks were listed. Effort was made to be neither too specific (e.g., knowledge of how to insert a drill bit into a drill) nor too general (e.g., knowledge of science). If, however, there was any doubt as to the level of specificity of a knowledge, the decision was to include rather than exclude the knowledge. Each subsequent job description in the DOT was analyzed and the knowledges needed for it were compared to the previously identified knowledges. If a previously unidentified knowledge was present, it was added to the list. Then, for each knowledge a definition was developed using the cluster of job tasks to which the knowledge pertained and the content of the knowledge's use. This rationally-based review and analysis of the DOT job descriptions yielded 68 qualitatively different knowledges.

The next step was to review several other research efforts (e.g., Prediger, 1989; McKinney & Greer, 1985; Campbell et al., 1990; Fleishman, 1992) to identify additional knowledges. The consolidated list was then reviewed, looking for omissions, ambiguities, or redundancies. The final list consisted of 86 knowledges. Once this list of knowledges had been developed, task examples indicating high, medium, and low amounts of the knowledge were generated using job descriptions and other information.

Identification of Knowledge Categories. At this point in the process, it became clear that the level of specificity still varied somewhat across the knowledges. Further, it appeared that the knowledges seemed to be grouped around several broader, superordinate areas. Hence, a search was undertaken to identify pre-existing taxonomies of job families or job groups into which the knowledges could be categorized. By grouping the knowledges into larger categories based on similarity, the specificity issue could be addressed to improve the usefulness of the taxonomy. It was felt that this would not only simplify the list of knowledges and improve its organization, but it would also provide some initial validation evidence for the knowledges themselves. That is, if each knowledge could be grouped with others into larger categories, it would provide further evidence to support their meaningfulness in terms of their relationship to each other, and to identify additional knowledge areas that might be combined or eliminated.

Work by Guilford, Christensen, Bond, and Sutton (1954), Lorr and Suziedelis (1973), Holland (1976), Rounds and Dawis (1979), Kuder (1977), Zytowski (1976), and Pearlman (1980)

63. Mechanical Knowledge

This is the knowledge of how basic mechanical equipment (like gears, pulleys, and levers) works. It does not include knowledge ofhand tools or common mechanical or electrical tools and their uses

How Mechanical Knowledge is Different From Other Abilities		
Mechanical Knowledge: Involves knowing how **basic mechanical equipment** like gears, pulleys, and levers **work.**	vs.	*Knowledge of Tools and Uses:* Involves knowing about **hand tools,** common **mechanical** and **electrical tools,** and their uses.
		Electrical/Electronic Knowledge: Involves knowing how **AC/DC current** work, and basic information about **vacuum tube and semiconductor operation** and other general information about electricity and electronics.

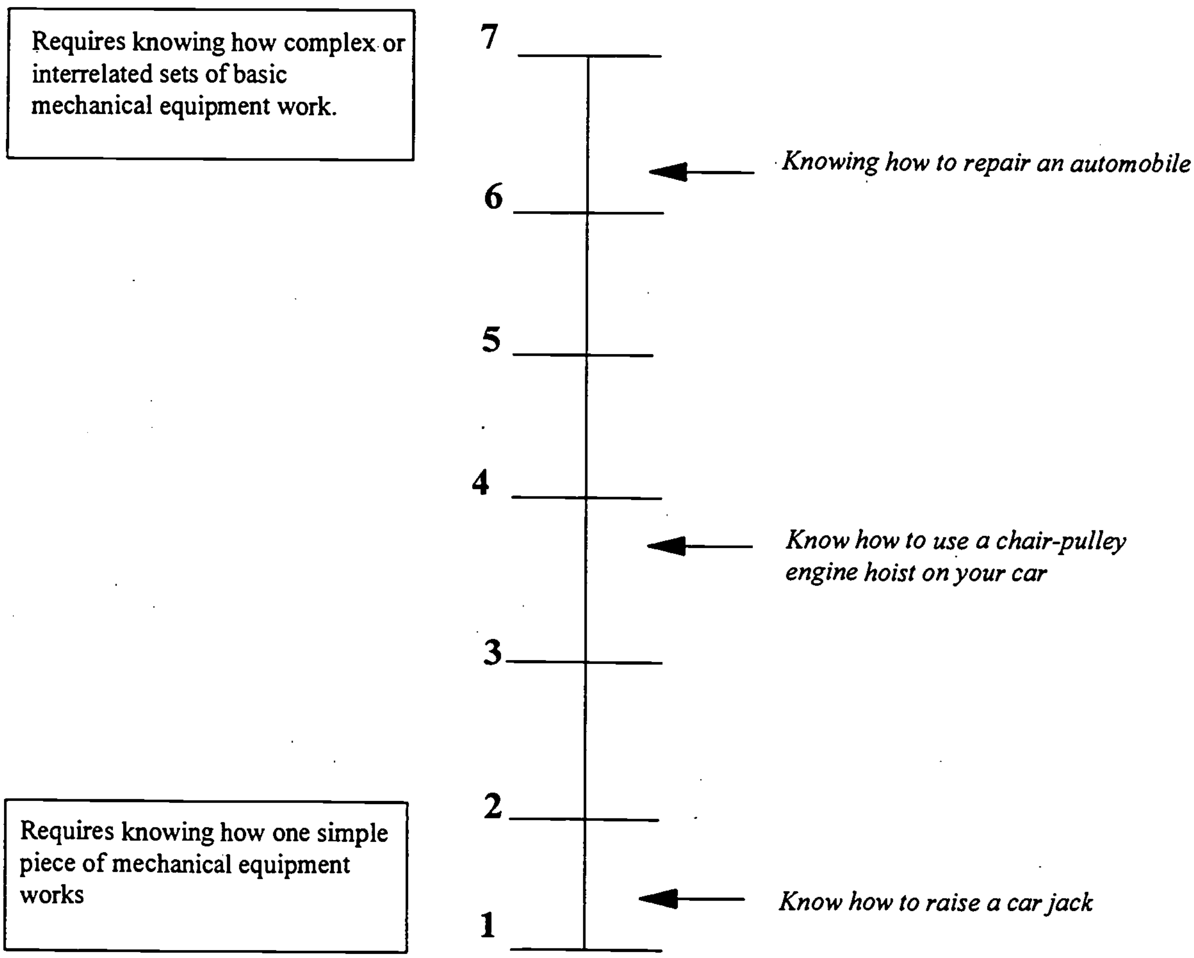


Figure 4-1

Example of the F-JAS Knowledge Requirements Scale for Mechanical Knowledge ishman, 1992)

Table 4-1.
*Source of Original Knowledges**

	Knowledge	Source*			
		DOT	Prediger	Fleishman	McKinney & Greer
1	Administration & Management	●	●		●
2	Anthropology & Sociology	●			
3	Art	●			
4	Biology & Physiology	●			
5	Building & Construction	●			
6	Chemistry	●			
7	Clerical	●	●	●	
8	Computers	●			
9	Designing	●			
10	Ecology	●			
11	Economics & Accounting	●			●
12	Education & Training	●			
13	Electricity	●		●	
14	Electronics	●		●	
15	Engineering & Technology	●			
16	Food Preparation	●			
17	Food Production	●			
18	Geography & Map Reading	●		●	
19	Geology & Mineralogy	●			
20	History & Archeology	●			
21	Legal, Gov't Regulations, & Jurispruden	●			●
22	Maintenance & Repair	●			
23	Materials	●			
24	Mathematics	●	●	●	
25	Measurement	●			
26	Mechanical	●	●	●	
27	Medicine & Dentistry	●			
28	Meteorology	●			
29	Money	●			
30	Music	●			
31	Personal Care &n Hygiene	●			
32	Personnel & Human Resources	●			●
33	Philosophy & Theology	●			
34	Physics	●			
35	Politics & Lobbying	●			
36	Production & Processing	●			
37	Psychology	●			
38	Public & Customer Service	●			●
39	Safety & Security	●			
40	Sales & Marketing	●	●		
41	Sanitation & Cleaning	●			
42	Supply, Packing, & Shipping	●			
43	Technical Drawing	●		●	
44	Telephone & Telegraph	●			
45	Television & Radio	●			
46	Therapy & Counseling	●			
47	Transportation	●			
48	Weaponry & Military	●			
49	Writing, Language, & Grammer	●	●	●	

* Sources are DOT (1991), Prediger (1989), Fleishman (1992), and McKinney & Greer (1985).

provided potential schemes for categorizing the list of work-oriented knowledges. Also, a report by the Department of Labor's Secretary's Commission on Achieving Necessary Skills (SCANS, 1992; Peterson, 1992) and the knowledges identified from the DOT provided potential categories. Based on this prior work, it was decided that seven higher level taxonomic categories, artistic/creative, business/administrative, mechanical/skilled trades, outdoor work, professional, scientific, and service sector, captured both the overlap in the categorization attempts and the bulk of the proposed list of knowledges. The initial knowledge list was sorted into these seven categories and again reviewed for completeness, ambiguity, and reasonableness by seven psychologists. Their comments and suggestions were incorporated into the list resulting in the combining of several knowledges and the deletion of others. The consolidated list contained 52 knowledges. The increased parsimony of the taxonomy at this stage was at least partially attributable to the assignment of the knowledges to superordinate categories.

It should be noted that throughout this effort, the issue of specificity level was addressed in several ways. First, the level-of-specificity of the knowledges was initially targeted to conform to the level of the abilities in the existing F-JAS system. Second, since the present effort was intended to be work-oriented but not job-specific, the focus of the knowledges was on cross-job knowledges rather than occupation-specific knowledges. Third, an underlying "criterion" for the identification and selection of knowledges for the taxonomy was undergraduate college departments and major areas of study. It was hypothesized that if the identified knowledge area was the focus of a department or major, it represented a sufficiently broad yet domain-specific enough knowledge to warrant inclusion. While this final consideration was not explicitly nor rigidly applied, it served as a useful guideline for the selection of knowledges in the taxonomy. Further evidence bearing on the validity and utility of the taxonomy was the observation that many of the 52 knowledges were in fact represented by college departments and/or by educational major subjects and that there were few academic areas that were not covered by this effort.

Scaling of Knowledges. In earlier work, Fleishman (1992) had developed scales for eleven general knowledges included as experimental supplements to the F-JAS ability scales. Figure 4-1 provides an example for one of these scales, which uses the format found reliable for determining ability requirements (see Chapter 8). The same approach was adapted for the development of scales for the 52 knowledges in the knowledge taxonomy, except that for greater simplicity, the table showing distinctions with other abilities was dropped.

The list of tasks developed from the review of the DOT, together with other tasks identified based on the reviewers' comments, was incorporated into a questionnaire covering the 52 knowledges. Raters were asked to make two determinations about each task for a given knowledge: 1) does the task require any amount of the knowledge; and 2) on a scale of 1 to 7, how much of the knowledge is required for performance of the task. Raters also were instructed to make suggestions or changes they felt were necessary to the definitions of the knowledges. The questionnaire was completed by 19 raters including non-academic professionals and Ph.D. candidates in psychology.

The data yielded several important findings. First, the interrater reliabilities of the individuals' ratings on the different tasks in terms of the 52 knowledges ranged from .89 to .98, indicating a high degree of agreement among raters in the determination of whether or not a task required some level of the knowledge and what level was required. Second, the range of means and low standard deviations obtained provided further indications that the raters were generally in agreement when rating tasks with respect to their knowledge requirements. Ratings of the "amount of knowledge required" varied across the range of responses; certain tasks were clearly rated as high, medium, or low in requiring a particular knowledge. Therefore, the rated tasks were appropriate for use in a behaviorally-anchored rating scale (BARS) format, following the methodology used by Fleishman (1975; 1992) in developing the ability requirement scales. Third, there was consensus that three of the knowledges should be combined, resulting in the final list of 49 knowledges (two were combined and one was deleted based on rater feedback). This final list was noted by reviewers to be reasonably complete, comprehensive, and well-defined. Table 4-1 lists and identifies the primary source (i.e., Department of Labor/DOT, 1991; Prediger, 1989; Fleishman, 1992; and McKinney & Greer, 1985) of the 49 knowledges in the knowledge requirements taxonomy.

It should be noted that the task anchors incorporated in the final task-anchored scale format were selected on the basis of: 1) the dispersion of their means along the entire range of the scale; 2) their low standard deviations, which were generally below 1.0, indicating rater

Table 4-2
Empirically-Derived Anchors for the Knowledge "Biology and Physiology"

Task	Mean	Standard Deviation
Use a microscope	2.33	1.32
Know that food goes to the stomach	1.31	0.61
Plant seeds *	1.70	0.95
Dissect a frog*	4.17	0.76
Analyze a DNA strand for mutations	6.92	0.27
Analyze blood specimens in a medical laboratory	5.54	0.51
Teach students how to dissect worms	4.85	1.17
Isolate a microscopic virus*	6.77	0.80
Know what the heart does	2.85	1.19
Use an adhesive bandage	1.00	0.00
Diagnose the cause of back pain	5.62	0.75
Give a back massage	2.20	0.98
Tape an ankle	3.00	1.07
Choose good walking shoes	2.33	1.23
Know the functions of every internal organ	5.46	0.94

* Denotes that the task was chosen as a task anchor on the final "Biology and Physiology" scale. Among the knowledge scales, dimensions such as engineering and technical, computers, personnel, and physics were selected. Job incumbents were asked to rate these knowledges and abilities on the level necessary for successful job performance. Across the 75 different jobs, the knowledge scales evidenced substantial reliability, using an average of approximately 20 raters per job, with interrater reliabilities averaging over .90.

agreement regarding where the selected anchor task fell on the scale; and 3) their familiarity and accessibility to the general population. Tasks depicting common, everyday incidents and written at an acceptable reading level were preferred to more abstract, esoteric tasks. For example, Table 4-2 contains all of the experimentally derived task anchors for the knowledge "Biology and Physiology." Although the task "Analyze a DNA strand for mutations" received the highest rating, accompanied by a very low standard deviation, it was deemed written at too high a level for the general population. The asterisks in Table 4-2 depict the anchors selected for the final scale.

Evaluation of the Knowledge Requirements Taxonomy and Measurement System. Several studies have been conducted that demonstrate the Knowledge Requirements Taxonomy and measurement system's utility in describing and understanding job performance. One large-scale study of 75 jobs involved 18 of the knowledge scales (Hauke, Costanza, Baughman, Mumford, Stone, Threlfall, & Fleishman, 1995). In this effort, a major governmental agency was interested in validating the key selection measures used by the agency for entry-level positions. The objective was to cluster the jobs into job families and to select those jobs in each family that best met the requirements for a test validation study. Additionally, because the organization was facing staff reductions and a change in organizational direction, there also was interest in information about job families that could be used in cross training or job placement of current employees.

Based on a combination of ability and knowledge ratings, 15 job families were identified. Inclusion of the knowledge scales substantially improved the quality and parsimony of the solution. For example, addition of the knowledge scales allowed employees in a number of personnel related positions to be grouped together in a "Personnel Support" job family. Other job families included "Information Assessment", "Computers", and "Graphics". In each case, the knowledges were critical in helping to both differentiate and describe the resulting job families.

The knowledge scales have been evaluated in a study of several State Police jobs (Trooper, Corporal, Sergeant, Lieutenant), and interrater reliabilities for knowledge profiles were from .90 to .95 when 23 raters were used (Management Research Institute, 1995). Furthermore, the knowledge profiles differentiated the requirements for the different jobs involved.

In another effort for a large financial firm (Mumford, Threlfall, Costanza, Baughman, & Smart, 1992), the critical tasks performed by stock brokers and the knowledges, skills, abilities, and other characteristics (KSAOs) which contributed to performance on these tasks were identified. Specifically, the job incumbents identified four of the knowledges as important to job performance: Economics; Government Regulations & Legal; Sales & Marketing; and Writing, Language & Grammar. The results of this study gave some initial indication that the knowledge scales, albeit a limited number in this industry, were useful in helping to understand job performance.

Adaptation of the Knowledge Requirements Scales for the DOT Project. Given the amount of effort invested in development of the Knowledge Requirements Taxonomy and measurement system (Costanza & Fleishman, 1992) it was hoped that this work could be adapted to provide the type of cross-occupation descriptive system required by O*NET. Toward that end, the Knowledge Requirements Scales were pre-tested in the current effort on a sample of job incumbents from approximately 30 jobs. The interrater reliabilities obtained for the profiles of knowledges were above .70 for most jobs, despite the use of very small numbers of raters.

The results of this pilot administration and subsequent feedback from the Department of Labor field staff (OAFCs) provided guidance for making revisions to the knowledge taxonomy and rating scales. Based on this feedback, staff undertook a systematic process to review and edit the knowledges, the measurement scales, and the instructions for completing these scales. This process was designed to make the knowledge taxonomy and measurement scales more suitable for large-scale administration on the DOT project. Specific objectives of this review were to:

- Ensure the taxonomy's comprehensiveness in covering all knowledges required by jobs;
- Standardize the level of specificity of the knowledges;
- Reduce the rating demand by reducing the number of rating scales;
- Allow incumbents to identify knowledge specialty areas required by their jobs; and
- Provide a mechanism by which the knowledge data could be linked to a national database of job demands and educational information.

This process involved the following four steps: 1) update and extend the literature review; 2) revise the knowledges and knowledge clusters; 3) revise the knowledge rating scales; and 4) identify and incorporate specialty areas into the knowledge rating scales.

Step 1. Update and extend the literature review. The first step in refining the Knowledge Requirements Taxonomy and measurement system for use in the new occupational information system was to update and extend the literature review. This review was extended to update the previous review of literature on the content and structure of knowledge in both the job and educational domains.

Knowledge Content and Structure. The beginning of this chapter reviewed an initial search of the literature to identify and classify knowledges related to the world of work, i.e., knowledges required to perform the population of jobs. As noted earlier, much of this literature focuses on the structure and acquisition of knowledge rather than on the definition of knowledge content required in jobs. Similarly, the earlier review did not uncover a basis or mechanism for classifying or grouping the large numbers of knowledges required across jobs that were tentatively identified.

Therefore, ensure the comprehensiveness of the knowledge taxonomy, project staff again reviewed the literature on the structure and content of knowledge with an emphasis this time on hierarchical structures for classifying knowledges related to the world of work. In addition, the review was extended to the classification of knowledges in the educational domain.

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

In addition to literature related to the job domain, literature dealing with specific educational knowledge content was covered. An example of this literature is the Classification of

Instructional Programs (CIP) (Morgan, Hunt, Carpenter, 1990), a document which lists academic courses of instruction being offered through U.S. colleges and universities. While this literature is relevant, it is not comprehensive enough for our purposes. Since it focuses on the curriculum taught by our educational institutions, it does not reflect all knowledge requirements of U.S. jobs. For example, many jobs require knowledges that are acquired on the job and/or are learned in non-academic settings (e.g., apprenticeships).

The expanded search did not reveal a comprehensive taxonomy of job-related knowledges. However, it did reveal an emerging system for combining and classifying Occupational Employment Statistics (OES) information and CIPS educational information. This system, currently under development by the National Occupational Information Coordinating Committee (NOICC), is an evolving hierarchical system for grouping 244 National Units of Analysis (NUA) into 42 Broad Groups and 15 Super Clusters (NOICC, 1995). The NOICC clustering hierarchy links these NUAs to over 800 OES occupations and over 1400 CIP programs. This clustering hierarchy provides a mechanism for matching job market demand and institutional supply data gathered at the state level by State Occupational Information Coordinating Committees (SOICC).

Although the NOICC clustering hierarchy is still under development, the system was deemed most appropriate for evaluating the comprehensiveness and classification of knowledges in the knowledge taxonomy. This hierarchical clustering information, made available through the cooperation of NOICC, served as a basis for carrying out Step 2 (revising the knowledges and knowledge clusters) and for Step 4 (identifying and designing a mechanism for adding specialty area information to the knowledge rating scales).

Step 2. Revise the knowledges and knowledge clusters. Following the review of recent literature, the second step was to revise the knowledges and knowledge clusters. This involved an examination of the comprehensiveness and organization of the knowledge list and standardization of the level of specificity across the knowledges. The goal was to develop a more parsimonious set of knowledges classified into broader clusters. One means of establishing the content validity of the knowledge classification scheme was to compare the original classification with that created using an independent methodology, i.e., the NOICC scheme.

Although not identical, the NOICC system and our knowledge classification schema were very similar in terms of the numbers and content of knowledges and knowledge clusters. For example, the Knowledge Requirements Taxonomy had 14 knowledge clusters and 49 knowledges compared to 15 NOICC super clusters and 42 broad groups. Unlike the Knowledge Requirements Taxonomy, NOICC further decomposed the 42 broad knowledge groupings into 244 Units of Analysis which combine information from job demands and institutional supply. This comparability in the numbers and content of the knowledge and clusters suggests a similar overall level of specificity in the two systems.

A more direct comparison of the Knowledge Requirements Taxonomy and NOICC structures provided additional information related to the comprehensiveness and level of specificity of the knowledges. Each of the 49 knowledges was mapped onto the 42 NOICC broad groups by five research psychologists familiar with the original knowledge definitions and measurement system. This comparison revealed that the knowledges in our taxonomy covered all areas contained in the NOICC system. In some instances, the two classification systems were virtually identical. For example, the Legal, Government, & Jurisprudence knowledge mapped directly onto NOICC Legal Services; and the Education & Training knowledge mapped onto the NOICC Education group, etc. In other instances, a single knowledge covered several NOICC broad groups and vice versa. For example, the single Sales & Marketing knowledge covered two NOICC broad groups of Marketing/Advertising and Sales; and the single NOICC broad group of Management covered two knowledges of Administration & Management and Personnel & Human Resources.

These differences between the Knowledge Requirements Taxonomy and NOICC knowledge classification systems were carefully reviewed to determine the most appropriate level of specificity for the knowledges to be used in the O*NET. In instances where NOICC provided several broad groups to cover a single knowledge area or where several of the knowledges covered a single NOICC broad group, research staff determined if the knowledge should be combined with others or further broken down. Based on this evaluation and a requirement to reduce the demands on raters, several of the 49 knowledges were combined. The result was a more parsimonious set of 33 knowledges. These revised knowledges appeared to:

- Encompass a discrete body of facts related in terms of its organizing principles and structure;
- Have a simple structure, i.e., overlapping as little as possible with other knowledges;
- Have sufficient homogeneity of content to be ratable on a single scale;
- Be useful in discriminating between jobs and job levels; and
- Be useful in classifying people in terms of level of knowledge.

Once these revisions were made, the revised 33 knowledges were grouped into 10 knowledge clusters, again examining the NOICC 15 super cluster structure for comparability. Then, the 33 knowledges were mapped onto the NOICC 42 Broad Groups to provide a crosswalk between the two systems (see Table 4-3).

Attention was given to the order of presentation of the revised knowledge clusters and the specific knowledges within each cluster. Initial data from the limited range of jobs in the pilot study suggested that some of the original 49 knowledge constructs differed according to their general applicability across occupations. That is, some of the knowledges appeared to be applicable to a broader range of jobs, whereas other knowledges seemed to apply to a narrower range of jobs. Therefore, a decision was made to organize the scales in a more meaningful way.

To assist in reorganization of the knowledge clusters and knowledges within these clusters, a panel of four psychologists rationally grouped the knowledges into clusters, based on their perceived similarity and relatedness. Cluster headings were then reviewed to ensure their meaningfulness to the raters. Next, the knowledges were independently rated by another panel of four psychologists to determine the likelihood that they would be relevant across the general population of jobs in the economy. Knowledges that were found to apply to a broader variety of occupations were labeled cross-functional, and knowledges considered likely relevant to a smaller range of jobs were called occupation-specific. Within each cluster, the knowledges were arranged so that the more general cross-functional knowledges appeared first, followed by the more occupation-specific knowledges. Table 4-4 presents the reordered Knowledge Requirements Taxonomy, including the cluster headings. Clusters with a higher proportion of cross-functional knowledges were placed toward the beginning of the questionnaire. This reordering was done to ensure that more raters will encounter knowledges relevant to their jobs earlier in the questionnaire.

Step 3. Revise the knowledge rating scales. A panel of six research psychologists undertook an extensive review of the 33 knowledge rating scales. The goal of this review was to combine the definitions, level descriptors, and task anchors from any of the 49 original knowledge scales that had been combined. The panel, first independently and then as a group, edited each knowledge rating scale including the knowledge definition, the high and low level descriptors, and the task anchors. In those instances where several knowledges had been combined, the definitions and high/low descriptors were revised to reflect the broader knowledge; and task anchors were revised, deleted, or added as needed. All scale values for task anchors were reviewed to ensure their proper placement. In cases where new task anchors were added to the scales, the precise scale values of all existing and new task anchors were determined, first by individual ratings and then by group consensus. (Appendix 4-A presents a list of the scale values for all task anchors across the 33 knowledge areas.)

In addition to revising the knowledge scale content, the editing process was designed to increase the scales' clarity and make the reading level more appropriate for incumbents whose jobs require less demanding reading levels and cognitive skills. Scale anchors were checked and, if necessary, replaced to make them less esoteric and more readily identifiable by different incumbent populations. Other anchors were reviewed to ensure that they reflected sufficient amounts of the knowledge required and did not appear trivial to job incumbents.

To recap, Steps 1 through 3 were considered effective in meeting the stated objectives of ensuring the comprehensiveness of the taxonomy to cover all knowledge domains required by jobs, standardizing the level of specificity of the knowledges, and reducing the rating demand on incumbents. The result of these steps was a set of 33 knowledges classified into 10 broader knowledge clusters.

Step 4. Identify and incorporate specialty areas into the knowledge rating scales. The final step in refinement of the knowledge rating scales was to enable raters to identify their specialties within each of the 33 knowledges, doing so in an efficient manner. This step heavily relied on the work currently underway by NOICC to group job demand and institutional supply information as represented by OES occupations and CIP programs. In doing this, we designed a flexible mechanism for linking the O*NET knowledge taxonomy to the NOICC and other national databases.

Table 4-3
Crosswalk between Knowledge Requirements Taxonomy and NOICC Knowledge Broad Groups

NOICC KNOWLEDGE BROAD GROUPS

O*NET KNOWLEDGES	(01) Fine & Perf. Arts	(02) Design	(03) Architecture	(04) Engineering	(05) Engineering Techno.	(06) Appl./Lgt. Eq./Inst. Rep.	(07) Eng. & Hvy Eq. Rep	(08) Utility System Opn.	(09) Construction	(10) Printing/Publishg.	(11) Metal Prod./Proc.	(12) Other Production	(13) Land Transport.	(14) Air & Sea Trans.	(15) Natural Sc. Tech.	(16) Quantitative Res.	(17) Computer Systems	(18) Social Science	(19) Nat. Res./Agricul.	(20) Hlth Diagn./Treat.	(21) Health Tech.	(22) Health Therapy	(23) Health Assistant	(24) Other Health	(25) Social Services	(26) Legal Services	(27) Education	(28) Infor. Coll./Diss.	(29) Management	(30) Finance	(31) Secrtr/Steno	(32) Other Clerical	(33) Marketing/Advertising	(34) Sales	(35) Personal Service	(36) Persnl Care Serv.	(37) Hospital/Trvl Serv.	(38) Cleaning Ser.	(39) Food Ser.	(40) Food Prep.	(41) Prtct. Ser./Pub.Sfty	(42) Humanities
(01) Admin. & Mgmt																													■													
(02) Clerical																															■	■										
(03) Economics & Acctg.																													□	■												
(04) Sales & Mktg.																																	■	■								
(05) Cust. & Pers. Serv.																																		□	■	■	■	■	■	□		
(06) Personnel & Hum. Res.																													■													
(07) Production & Proc.										□	□	□																														
(08) Food Production																			■																				□	□		
(09) Computers & Electron.					□												■																									
(10) Engineering & Tech.				■	■																																					
(11) Design		■	■	□					□																																	
(12) Building & Construct.			□	□					■																																	
(13) Mechanical				□	□	■	■	□	□																																	
(14) Mathematics				□												■														□												
(15) Physics				□											■																											
(16) Chemistry															■																											
(17) Biology															■					□																						
(18) Psychology																		■		□		□			■																	
(19) Sociology & Anthrop.																		■							□																	
(20) Geography													□	□					□																							
(21) Medicine & Dentistry																				■	□	□	□	□																		
(22) Therapy & Counseling																						□	□		■																	
(23) Education & Training																											■															
(24) English Language	□									□																		□			□											□
(25) Foreign Language	□									□																					□											
(26) Fine Arts	■		□																																							□
(27) History & Archeology																																										□
(28) Philosophy & Theology																									■																	□
(29) Public Safety & Security																																									■	
(30) Legal, Gov't, & Jurispru.																										■															□	
(31) Telecommunications					□																																					
(32) Communications & Media										□																		■					□									
(33) Transportation													■	■																												

Legend: ■ = Definitely related content □ = Somewhat related content

Table 4-4
Knowledge Requirements Taxonomy Organized by Cluster

Business and Management

1. Administration and Management
2. Clerical
3. Economics and Accounting
4. Sales and Marketing
5. Customer and Personal Service
6. Personnel and Human Resources

Manufacturing and Production

7. Production and Processing
8. Food Production

Engineering and Technology

9. Computers and Electronics
10. Engineering and Technology
11. Design
12. Building and Construction
13. Mechanical

Mathematics and Science

14. Mathematics
15. Physics
16. Chemistry
17. Biology
18. Psychology
19. Sociology and Anthropology
20. Geography

Health Services

21. Medicine and Dentistry
22. Therapy and Counseling

Education and Training

23. Education and Training

Arts and Humanities

24. English Language
25. Foreign Language
26. Fine Arts
27. History and Archeology
28. Philosophy and Theology

Law and Public Safety

29. Public Safety and Security
30. Legal, Government, and Jurisprudence

Communications

31. Telecommunications
32. Communications and Media

Transportation

33. Transportation

To identify specialty areas within each of the 33 knowledges, staff derived the crosswalk information presented earlier in Table 4-3. For each knowledge area, five research psychologists rated the extent to which the knowledge and the NOICC broad groups were related. For each knowledge, the staff examined all related NOICC broad groups, units of analysis and their associated demand and supply information. It was from the 244 NOICC units of analysis and related demand and supply information that representative specialty areas were derived. Rules for selecting/creating specialty areas included the following:

- First, research staff selected the NOICC units of analysis that best represented the knowledge. Here, the goal was to generate between 2 and 10 specialty areas within each knowledge.

- If the NOICC units of analysis were too numerous (i.e., were greater than 10 in number), those with the largest populations of demand and supply were selected. In some instances, related NOICC units of analysis were combined (e.g., separate Engineering and Engineering Technology units of analysis were combined).

- If the NOICC units of analysis were too sparse (i.e., fewer than 2), the demand and supply information was examined to derive specialty areas.

- To the extent possible, NOICC units of analysis terminology was used to name the specialty areas. When it was necessary to use the demand or supply information, the terms were modified to reflect content areas rather than job titles or course names.

This step resulted in a set of 214 specialty areas (see Appendix 4-B) across the 33 knowledges. These specialty areas are intended to gather information only for those knowledges that apply to an incumbent's job. When a given knowledge is deemed not applicable to the job, no specialty area ratings will be required. In this way, the rating process should be able to gather more information while reducing the demand on any single rater.

Figure 4-2 shows the format of the final knowledge rating scales. These rating scales ask the respondent to provide three ratings for each knowledge. First, they are asked, "What level of this knowledge do I need to perform this job?" If the knowledge is not relevant (NR) at all for performance on the job, then the rater moves to the next knowledge. If the knowledge is relevant for performance on the job, the rater is asked "How important is this knowledge to performance on this job?" after which he/she selects those specialties that are relevant. The complete knowledges questionnaire is Appendix B in Volume II.

Conclusion

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

Preliminary use of the scales has revealed their high reliability across raters and their utility in describing and understanding worker performance for multiple jobs. The scales have also proven useful in meaningfully classifying jobs in terms of the underlying knowledges needed to perform the jobs. As part of the O*NET, the taxonomy of knowledge requirements and its companion measurement system should make an important contribution in the understanding of worker attributes required to successfully perform a very wide variety of jobs. The inclusion of occupational specialty data with each rating scale will allow linkage of the knowledges to other national occupational and educational databases. The knowledge content, structure, and scales should prove useful in areas such as job analysis, person/job matching, job training and retraining, career/occupational counseling, job analysis, vocational interest assessment, and the development of job families. Used in concert with the other descriptive systems within O*NET, the knowledge scales will help us to more completely and accurately describe and understand the world of work at both cross-functional and occupation-specific levels.

1. Administrative and Management

Knowledge of planning, coordination, and execution of business functions, resource aallocation, and production

Level

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

7

Required knowledge o f high-level business administration such as being the CEO of a major industrial company

6

Manage a $10 million company

5

Administer a large retirement and nursing care facility

Monitor progress of a project to ensure timely completion

4

3

Plan an effective staff meeting

2

Sign a pay voucher

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

1

NR Not relevant at all for performance on this job

Importance

How important is this knowledge to performance on this job?

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

Job Specialty Requirements

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

R NR Business Administration

R NR Construction Management

R NR Engineering, Mathematical, and Sciences Management

R NR Food Service and Lodging Management

R NR Medical Service Management

R NR Personnel and Human Resource Management

R NR Public Administration

Other(s) ______________________________
(Please specify)

Figure 4-2
Sample Knowledge Requirements Scale for Administration & Management

References

Campbell, J., Ford, P., Rumsey, M., Pulakos, E., Borman, W, Felker, D., De Vera, M., & Riegelhaupt, B. (1990). Development of multiple job performance measures in a representative sample of jobs. *Personnel Psychology, 43,* 277-300.

Chi, M.T., Glaser, R., & Rees, E. (1983). Expertise in problem solving. In R. Sternberg (Ed.), *Advances in the psychology of human intelligence*. Hillsdale, N.J.: Lawrence Earlbnaum Associates.

Corts, D.B., & Gowing, M.K. (1992). *Dimensions of effective behavior: executives, managers, and supervisors*. Washington, DC: U.S. Office of Personnel Management, Personnel Research and Development.

Costanza, D.P., & Fleishman, E.A. (1992). *Fleishman Job Analysis Survey* (Part III). Bethesda, MD: Management Research Institute.

Ericsson, K.A., & Charness, N. (1994). Expert performance: Its structure and acquisition. *American Psychologist, 49,* 725-747.

Fleishman, E.A. (1975). Towards a taxonomy of human performance. *American Psychologist, 30,* 1127-1149.

Fleishman, E.A. (1992). *Fleishman-Job Analysis Survey* (F-JAS). Palo Alto, CA: Consulting Psychologists Press.

Fleishman, E.A., & Mumford, M.D. (1991). Evaluating classifications of job behavior: A construct validation of the ability requirement scales. *Personnel Psychology, 44,* 523-575.

Fleishman, E.A., & Quaintance, M. (1984). *Taxonomies of human performance: The description of human tasks.* Orlando, FL: Academic Press.

Guilford, J.P., Christensen, P.R., Bond, N.A. Jr., & Sutton, M.A. (1954). A factor analysis study of human interest. *Psychological Monographs: General and Applied, 68.*

Halff, H.M., Hollan, J.D., & Hutchins, E.L. (1986). Cognitive science and military training. *American Psychologist, 41,* 1131-1139.

Hauke, M., Costanza, D.P., Baughman, W., Mumford, M.D., Stone, L., Threfall, V., & Fleishman, E.A. (1995). *Developing job families on the basis of ability and knowledge requirements profiles.* Bethesda, MD: Management Research Institute.

Holland, J.L. (1976). Vocational preferences. In M.D. Dunnette (Ed.), *Handbook of industrial and organizational psychology.* Chicago, IL: Rand McNally.

Kuder, G.F. (1977). *Activity interests and occupational choice.* Chicago, IL: Science Research Associates.

Lesgold, A.M. (1984). Acquiring expertise. In J.R. Anderson & S.M. Kosslyn (Eds.), *Tutorials in learning and memory: Essays in honor of Gordon Bower.* New York, NY: Freeman & Co.

Lorr, M., & Suziedelis, A. (1973). A dimensional approach to the interests measured by the SVIB. *Journal of Counseling Psychology, 20,* 113-119.

Management Research Institute (1995). Reliabilities of ability and knowledge scales in describing state police requirements. (Unpublished report).

McKinney, W.R., & Greer, D.L. (1985). The construction and validation of the IDPRE: Personnel selection examination for Illinois Directors of Parks and Recreation. *Public Personnel Management, 14,* 181-189.

Mogan, R.L., Hunt, E.S., & Carpenter, J..M. (1990). *Classification of instructional programs.* Washington, DC: Department of Education, Institutional Studies Branch, Postsecondary Education Statistics Division, NCES.

Mumford, M.D., Threlfall, K.V., Costanza, D.P., Baughman, W.A., & Smart, B.D. (1992). *Analysis of Kidder, Peabody account executives.* Fairfax, VA: Authors.

National Occupational Information Coordinating Committee. (1995). Informal communication to American Institutes for Research and Management Research Institute.

Pearlman, K. (1980). Job families: A review and discussion of their implications for personnel selection. *Psychological Bulletin, 87,* 1-28.

Peterson, N.G. (1992). *Methodology for identifying SCANS competencies and foundation skills.* Washington, DC: American Institutes for Research.

Prediger, D.J. (1989). Ability differences across occupations: More than g. *Journal of Vocational Behavior, 34,* 1-27.

Rounds, J.B., Jr., & Dawis, R.V. (1979). Factor analysis of Strong Vocational Interest Blank items. *Journal of Applied Psychology, 64,* 132-143.

Secretary's Commission on Achieving Necessary Skills (SCANS) (1992). *Skills and tasks for jobs: A SCANS report for America 2000.* Washington, DC: U.S. Department of Labor.

U.S. Department of Labor, U.S. Employment Service. (1991). *Dictionary of Occupational Titles.* Washington, D.C.: U.S. Government Printing Office.

Zytowski, D.G. (1976). Factor analysis of the Kuder Occupational Interest Survey. *Measurement and Education in Guidance, 9,* 120-123.

Appendix 4-A

*Scale Values of Tasks Representing Different Knowledges**

Selected Knowledge -task items	Scale Value
1. Administration and Management	
Manage a $10 million company.	5.9
Administer a large retirement and nursing care facility.	5.0
Monitor progress of a project to ensure timely completion.	4.3
Plan an effective staff meeting.	2.5
Sign a pay voucher.	1.8
2. Clerical	
Organize storage system for company forms.	5.2
Type 30 words per minute.	3.1
File old letters alphabetically.	2.2
3. Economics and Accounting	
Keep a major corporation's financial records.	6.1
Approve a multi-million dollar loan to a real estate developer.	6.1
Develop financial investment programs for individual clients.	4.5
Keep financial records for a family business.	3.6
Answer billing questions from credit card customers.	2.2
4. Sales and Marketing	
Develop a marketing plan for a nationwide phone system.	5.8
Call a list of clients to introduce them to a new product line.	4.0
Sell cakes at a bake sale.	1.7
5. Customer and Personal Service	
Respond to citizen's request for assistance after a major natural disaster.	6.5
Cater a large wedding.	5.0
Work as a day care aide supervising ten children.	4.0
Run a hospital cleaning service.	4.0
Provide air flight arrival times over the phone.	2.0
Process customer dry-cleaning drop-off.	2.0
6. Personnel and Human Resources	
Design a new personnel selection and promotion system for the Army.	6.4
Conduct negotiations between labor and management to settle a dispute over wages	5.0
Interview applicants for a secretarial position.	3.2
Fill out a medical claim form.	2.3

Appendix 4-A (continued)
*Scale Values of Tasks Representing Different Knowledges (con't)**

Selected Knowledge -task items		Scale Value
7.	Production and Processing	
	Manage a food processing plant.	6.0
	Manage an international shipping company distribution center.	6.0
	Supervise an appliance assembly line.	4.5
	Pack glassware to be shipped airmail.	2.8
	Put a computer back into its packing materials.	1.5
8.	Food Production	
	Run a 100,000 acre farm.	6.4
	Operate a commercial fishing boat.	4.8
	Keep an herb box in the kitchen.	2.2
9.	Computers and Electronics	
	Create a program to scan computer disks for viruses.	6.0
	Fix a two-way radio in order to transmit a message.	5.0
	Use a word processor.	3.0
	Operate a VCR to watch a pre-recorded training tape.	1.2
10.	Engineering and Technology	
	Design an efficient and clean power plant.	6.7
	Plan for the impact of weather in designing a bridge.	5.8
	Design a more stable grocery cart.	3.8
	Install a door lock.	1.9
11.	Design	
	Develop detailed design plans for a new high rise office complex.	6.3
	Understand air conditioning and heating diagrams.	5.0
	Plan for the remodeling of a kitchen.	4.2
	Make furniture layouts for your home.	2.3
	Draw a straight line 4 3/16 inches long.	1.8
12.	Building and Construction	
	Build a high rise office tower.	6.5
	Estimate the cost of developing a housing project.	5.2
	Fix a plumbing leak in the ceiling.	4.0
	Choose the proper type of wood for adding a deck onto a house.	2.5
	Saw a board in half.	1.2

Appendix 4-A (continued)
*Scale Values of Tasks Representing Different Knowledges (con't)**

Selected Knowledge -task items		Scale Value
13.	Mechanical	
	Overhaul an airplane jet engine.	6.5
	Replace a valve on a steam pipe.	4.7
	Fix a leaky faucet.	2.5
	Replace the filters in a furnace.	2.0
14.	Mathematics	
	Derive a complex mathematical equation.	6.0
	Analyze data to determine areas with the highest sales.	4.2
	Add two numbers.	1.1
15.	Physics	
	Design a cleaner burning gasoline engine.	6.1
	Calculate water pressure through a pipe.	3.8
	Use a crowbar to pry open a box.	1.2
16.	Chemistry	
	Develop a safe commercial cleaner.	6.3
	Use proper concentration of chlorine to purify a water source.	4.0
	Use a common household bug spray.	1.5
17.	Biology	
	Isolate and identify a microscopic virus.	6.8
	Investigate the effects of pollution on marine plants and animals.	5.4
	Dissect a frog.	3.0
	Feed domestic animals.	1.2
18.	Psychology	
	Treat a person with a severe mental illness.	6.4
	Develop a job performance appraisal system.	5.5
	Understand the impact of alcohol on human responses.	3.8
	Soothe a sad friend.	2.3
	Monitor several children on a playground.	1.8
19.	Sociology and Anthropology	
	Develop a new theory about the development of early civilizations.	6.5
	Write a pamphlet about cultural differences.	4.8
	Read a story about another culture.	2.4

Appendix 4-A (continued)
*Scale Values of Tasks Representing Different Knowledges (con't)**

Selected Knowledge -task items		Scale Value
20.	Geography	
	Develop a map of the world showing mountains, deserts, and rivers.	6.5
	Identify Turkey on a world map.	4.0
	Know the capital of the United States.	1.9
21.	Medicine and Dentistry	
	Do open-heart surgery.	6.9
	Diagnose appendicitis from a patient's symptoms.	5.5
	Fill a tooth cavity.	4.5
	Take a person's blood pressure.	2.7
	Use a small bandage.	1.1
22.	Therapy and Counseling	
	Counsel an abused child.	6.0
	Design a physical therapy program to rehabilitate stroke victims.	6.0
	Provide job counseling to the unemployed.	4.2
	Put ice on a sprained ankle.	1.9
23.	Education and Training	
	Design a training program for new employees.	5.9
	Teach a high school general sciences course.	5.0
	Lead a quality improvement seminar.	4.2
	Show someone how to bowl.	1.9
24.	English Language	
	Teach a college English class.	5.8
	Edit a feature article in a local newspaper.	4.2
	Read a complicated historical novel.	3.5
	Write a thank-you note.	1.5
25.	Foreign Language	
	Provide spoken translation of a political speech while listening to it at an international meeting.	6.8
	Write an English language review of a book written in a foreign language.	5.4
	Use a foreign language dictionary to translate a business letter.	3.8
	Ask directions in a foreign city.	2.9
	Say "please" and "thank you" in a foreign language.	1.5

Appendix 4-A (continued)
*Scale Values of Tasks Representing Different Knowledges (con't)**

Selected Knowledge -task items		Scale Value
26.	Fine Arts	
	Compose a symphony.	6.8
	Design an artistic display for a major trade show.	5.0
	Play a minor part in a local theater play.	3.1
	Teach students how to mix primary colors.	2.0
	Attend a popular music concert.	1.1
27.	History and Archeology	
	Determine the age of bones for placing them in the fossil history.	6.2
	Assess the impact of the industrial revolution on manufacturing.	5.4
	Teach local history to school children.	4.0
	Take a class in U.S. history.	2.7
28.	Philosophy and Theology	
	Compare the teaching of major philosophers.	5.7
	Understand another culture's religious practice.	3.9
	Read a chapter in a popular philosophy or religious book.	1.8
29.	Public Safety and Security	
	Command a military operation.	6.2
	Secure a crime scene.	5.0
	Inspect a building site for safety violations.	4.0
	Load and shoot a weapon.	2.5
	Use a seatbelt.	1.1
30.	Legal, Government, and Jurisprudence	
	Be a judge in a federal court.	6.0
	Argue a criminal case in court.	5.1
	Lobby for political support of a new bill.	4.0
	Prepare documents and title papers for the purchase of a house.	3.7
	Register to vote in a national election.	2.0
31.	Telecommunications	
	Develop a new, world-wide telecommunications network.	6.8
	Find the cause of static on a line.	4.3
	Operate a television camera.	3.2
	Install a satellite TV dish.	2.2
	Dial a phone.	1.2

Appendix 4-A (continued)
*Scale Values of Tasks Representing Different Knowledges (con't)**

Selected Knowledge -task items		Scale Value
32.	Communications and Media	
	Produce a combined TV, radio, and newspaper campaign to inform the public about world hunger.	6.4
	Write a novel.	5.2
	Be a disk-jockey on the radio.	3.8
	Write a thank-you note.	1.8
33.	Transportation	
	Control air traffic at a major airport.	6.0
	Steer a large freighter through a busy harbor.	5.0
	Select the best way to transport senior citizens to shopping areas.	3.0
	Arrange to transport a large crate from the U.S. to the Orient.	3.0
	Take a train to work.	1.5

*Adapted from Fleishman (1992) and Costanza and Fleishman (1992).

Appendix 4-B
Selected Specialties within the Knowledge Requirements Taxonomy

1. Administration and Management
   - Business Administration
   - Construction Management
   - Engineering Mathematics and Science
   - Food Service and Lodging Management
   - Medical Service Management
   - Personnel and Human Resource Management
   - Public Administration

2. Clerical
   - Banking Support
   - Bookkeeping
   - Computer Operations
   - Data Entry
   - Health Unit Coordinating
   - Legal Secretarial
   - Medical Secretarial
   - Office Clerical
   - Receptionist
   - Stenography
   - Stock and Warehousing

3. Economics and Accounting
   - Accounting
   - Economics
   - Financial Management
   - Securities and Investments

4. Sales and Marketing
   - Advertising and Public Relations
   - Fashion and Apparel
   - Food Marketing
   - Insurance
   - Purchasing
   - Real Estate
   - Retailing and Wholesaling
   - Vehicle Sales and Service

5. Customer and Personal Service
   - Barbering and Cosmetology
   - Bartending
   - Cashiering
   - Child Care and Home Management
   - Flight Attending
   - Food Preparation
   - Food Service
   - Hospitality Service
   - Housekeeping and Custodial
   - Laundry and Dry Cleaning
   - Meatcutting and Butchering
   - Travel Service

6. Personnel and Human Resources
   - Human Resource Management
   - Interviewing and Hiring
   - Labor Relations
   - Management Analysis
   - Personnel Research
   - Training

7. Production and Processing
   - Clothing Production
   - Food Processing Production
   - Home Furnishing Production
   - Line Supervision
   - Metal Production and Processing
   - Printing and Publishing
   - Quality Control and Inspection

8. Food Production
   - Agricultural and Business Management
   - Agricultural Sciences
   - Animal Husbandry and Production
   - Animal Sciences
   - Crop Production
   - Fishing and Wildlife Management
   - Food Services

9. Computers and Electronics
   - Computer Programming
   - Computer Science
   - Computer Technology
   - Electrical and Electronics Technology
   - Systems Analysis

10. Engineering and Technology
    - Aeronautical and Astronautical Engineering
    - Chemical Engineering
    - Civil Engineering
    - Electrical Engineering
    - Industrial Engineering
    - Materials Engineering
    - Mechanical Engineering
    - Mining, Petroleum, and Nuclear Engineering
    - Surveying

11. Design
    - Architecture
    - Drafting
    - Industrial Design
    - Interior Design
    - Technical Theater Design
    - Physical and Theoretical Chemistry

Appendix 4-B (continued)
Selected Specialties within the Knowledge Requirements Taxonomy

12. Building and Construction
    - Bricklaying
    - Carpentry
    - Concrete
    - Construction and Building Inspection
    - Construction Equipment Operations
    - Drywall and Plaster
    - Electrical Power
    - Painting and Paperhanging
    - Plumbing
    - Structural Metal

13. Mechanical
    - Agricultural Mechanics
    - Aircraft Mechanics
    - Appliance Repair
    - Automobile Mechanics
    - Building Maintenance
    - Engine Repair
    - Heavy Equipment Repair
    - Instrument Repair
    - Light Equipment Repair

14. Mathematics
    - Accounting
    - Actuarial Science
    - Applied Mathematics
    - Operations Research
    - Statistics

15. Physics
    - Astronomy
    - Astrophysics
    - Atmospheric Sciences and Meteorology
    - Earth and Planetary Sciences
    - General Physics
    - Geology
    - Nuclear Physics
    - Oceanography
    - Optics and Acoustics

16. Chemistry
    - Analytical Chemistry
    - Biochemistry
    - Inorganic Chemistry
    - Medicinal and Pharmaceutical Chemistry
    - Organic Chemistry
    - Polymer Chemistry

17. Biology
    - Biochemistry
    - Botany
    - Cell and Molecular Biology
    - Ecology
    - Genetics
    - Marine and Aquatic Biology
    - Microbiology and Bacteriology
    - Nutritional Science
    - Physiology
    - Zoology

18. Psychology
    - Clinical Psychology
    - Cognitive Psychology
    - Community Psychology
    - Counseling Psychology
    - Developmental Psychology
    - Experimental Psychology
    - Industrial/Organizational Psychology
    - Physiological/Biological Psychology
    - Social Psychology

19. Sociology and Anthropology
    - Anthropology
    - Archeology
    - Criminology
    - Demography and Population
    - Sociology
    - Urban Affairs

20. Geography
    - Cartography
    - Geography

21. Medicine and Dentistry
    - Chiropractic
    - Community and Home Health
    - Dentistry
    - Medicine
    - Nursing
    - Pharmacology
    - Psychiatry
    - Speech Pathology and Audiology
    - Surgery
    - Veterinary Medicine

Appendix 4-B (continued)
Selected Specialties within the Knowledge Requirements Taxonomy

22. Therapy and Counseling
    - Educational Counseling
    - Occupational Therapy
    - Physical Therapy
    - Psychiatric and Mental Health Counseling
    - Recreational Therapy
    - Speech Pathology and Audiology
    - Social Work
    - Vocational Counseling

23. Education and Training
    - Educational Administration
    - Instructional Design
    - Pre-School Education
    - Elementary Education
    - Secondary and Vocational Education
    - College and University Education
    - Special Education
    - Adult and Continuing Education
    - Professional Training

24. English Language
    - Editing
    - English Literature
    - Creative Writing
    - Journalistic Writing
    - Linguistics
    - Technical and Business Writing

25. Foreign Language
    - Foreign Language Interpretation
    - Foreign Language Literature
    - Foreign Language Translation
    - Linguistics
    - Specify Language(s) required

26. Fine Arts
    - Art and Crafts
    - Dance
    - Dramatic and Theatrical Arts
    - Film-Video Making and Cinematography
    - Music
    - Photography

27. History and Archeology
    - African History
    - American History
    - Archeology
    - Asian History
    - European History
    - General History
    - History of Science and Technology

28. Philosophy and Theology
    - Ministry
    - Missions and Missionary Studies
    - Pastoral Counseling
    - Philosophy
    - Religious Education
    - Theology

29. Public Safety and Security
    - Corrections
    - Criminal Investigation
    - Fire Fighting
    - Fire Inspection and Investigation
    - Military Technologies
    - Police Patrol
    - Security Services

30. Legal, Government and Jurisprudence
    - Jurisprudence
    - Legal Representation
    - Paralegal and Legal Support Services
    - Political Science and Government

31. Telecommunications
    - Central Office and Switches
    - Electrical and Electronics Engineering
    - Radio and Television Broadcasting Technology
    - System Installation and Repair

32. Communications and Media
    - Archival Science
    - Creative Writing
    - Journalism
    - Library Science
    - Printing and Publishing
    - Radio and Television Broadcasting
    - Technical and Business Writing

33. Transportation
    - Airplane Piloting
    - Air Traffic Control
    - Railroad Operations
    - Truck and Bus Transportation
    - Water Transportation

Chapter 5: Education
Table of Contents

Tables

Figures

Chapter 5
Education

Lance E. Anderson
American Institutes for Research

Introduction

This chapter deals with issues related to job knowledge discussed in Chapter 4, but the emphasis here is different. In this chapter, we focus on identifying types of education, coursework, and other training required for the job. Therefore, we do not focus on knowledge per se, but on how and when it must be acquired. While the concepts "knowledge required" and "education required" appear somewhat redundant, the two often are quite distinct in actual use-- educational programs often do not map well onto knowledges needed to perform the job (Commission on the Skills of the American Workforce, 1990). Yet, educational experience often is the only information available about individuals to indicate knowledge acquisition. This likely is the reason that information on education is commonly sought by users of the DOT (Westat, 1993). Therefore, we have chosen to examine education as a separate issue in this chapter.

As the APDOT report (U.S. Department of Labor, 1993) notes, formal education or learning acquired through secondary schools, vocational-technical schools, colleges, and universities should be considered within the framework of O*NET. Education requirements have traditionally been important in characterizing occupations. The reason for this is simple — there is a clear intuitive link between education and the development of basic skills and knowledge needed to do a job. Education naturally has a significant influence on the development of general knowledges and skills (Snow & Swanson, 1992; Ward, Byrnes, & Oventon, 1990). Recognition of the relationship between education and the acquisition of general knowledge and relevant basic skills (Halpern, 1994) has led many investigators to use educational experience as a proxy for information bearing on general knowledges and skills. Because educational experiences represent a developed capacity of the individual influencing the acquisition of knowledge and basic skills, requisite educational background may also represent another attribute of the worker that should be used to describe cross-job differences in terms of relevant person requirements.

For this reason, education has and will continue to have a significant role in the selection of employees (Dye & Reck, 1988). In fact, research has indicated that over the past 30 years there has been a growing reliance on education for selecting employees (Monahan & Muchinsky, 1983). This is likely due to the fact that evaluations of education are relatively cheap and easily accessible. The widespread use of educational variables as entrance criteria into occupations makes them essential to many users of the DOT (U.S. Department of Labor, 1991). According to a recent survey of DOT users (Westat, 1993), a majority of users in virtually every user group viewed information on education to be "very important". Some of the current uses of information about education include:

- career selection
- career planning
- curriculum development
- human resources management
- vocational rehabilitation counseling

This means that education data collected on jobs are currently used (at a minimum) by career counselors, employers, students, training developers, and job seekers.

There is evidence that education data will become even more important in the future. The U.S. workplace has changed and will continue to change in a number of ways that will increase the importance of accurate education information. The workplace will likely become more complex as technology and the prospects for a global economy grow (Goldstein & Gilliam, 1990). Individuals will need to be better educated to deal with these complexities. In addition, national demographic trends predict that those segments of our population that are growing the fastest have tended to be from less educated circumstances (Fullerton, 1985). Various commissions (e.g., Commission on the Skills of the American Workforce, 1990; Commission on Workforce Quality and Labor Market Efficiency, 1989) have agreed that our present workforce too often is poorly prepared for high-performance work because of

Some actions have been taken at the national level to encourage academic institutions to provide education that has a direct link to preparing individuals for joining the workforce. The Secretary's Commission on Achieving Necessary Skills (SCANS), formed by the former Secretary of Labor, examined the demands of the workplace and defined a set of competencies and foundation skills needed by today's and tomorrow's workplace (SCANS, What Work Requires of Schools, 1991; SCANS, Learning a Living: A Blueprint for High Performance, 1992). Education 2000 was a broad policy initiative of the Department of Education that laid out what citizens of all ages should know and be able to do to live and work productively and what educational and training institutions must do to help meet those needs. The federal Departments of Labor and Education jointly have launched National Skill Standards to promote the development of voluntary skill standards in different industries by involving all stakeholders, industry associations, unions, and educators. Thus, it is fitting that O*NET should incorporate a taxonomy of education descriptors that will enable the educational requirements of different jobs to be identified and compared.

Taxonomy Development

Our approach to developing a taxonomy of education items for the O*NET was to:

- define what users want in terms of education data
- examine education literature for education taxonomies
- examine how educational data are gathered in organizations
- develop brief, clear, easy to read items

What users want from education descriptors. Based on an examination of the results from the recent Westat (1993) and APDOT (1993) report , it is clear that users want an indication of:

- the **amount** of formal education needed to enter the job
- the **type** of education needed to enter the occupation
  - education setting (e.g., high school, college, certificate program)
  - type of instructional program and subject areas
- the degrees and certificates required

Examination of education literature for taxonomies. Some of the education data that users desire could fit within a taxonomic scheme, while other pieces of data do not. Types of education, such as the course major, the education setting, and the subject areas can be described through taxonomies. A single variable, such as the "amount" of formal education needed to do a job does not require a taxonomy — it stands on its own. Accordingly, we set out to find taxonomies for course major, education setting, and subject area. An examination of the education literature and educational taxonomies currently in use revealed these four kinds of taxonomies:

- Bloom's (1956) taxonomy of educational objectives — which focuses on levels of knowing (e.g., comprehension vs. synthesis vs. evaluation).
- Gagne's (1985) taxonomy of learning — where intricate learning hierarchies have been developed that focus on instructional techniques
- Classification of Instructional Programs (U.S. Department of Education, 1990)
- Subject taxonomies used in recent national teacher surveys (U.S. Department of Education, 1993)

The first two taxonomies are useful for understanding how individuals learn, and how best to develop training to address a given subject and audience. But they are not particularly useful in an occupational information system. The variables in these taxonomies are not likely to vary greatly across jobs, and in fact, do not focus on what users are most concerned about when it comes to looking at educational data.

The third and fourth taxonomies contain descriptors of great interest to a broad audience concerned about the educational requirements of different occupations. Both taxonomies have been developed and used by the U.S. Department of Education.

The APDOT transition team (Campion, Gowing, Lancaster, & Pearlman, 1994) suggested that the Classification of Instructional Programs (CIP) may be a useful starting place in deriving an instructional programs taxonomy. Examination of the CIP revealed a taxonomy of many different instructional programs, including high school programs, certificates at various levels, undergraduate and graduate programs, and adult education programs. This taxonomy is particularly useful because it is crosswalked to the current DOT and the Occupational Employment Statistics job families. Accordingly, we decided to use the CIP "Academic and Occupationally Specific Programs" listing to code open-ended responses to an item regarding course major. This taxonomy has three levels of specificity. The shortest, most general level lists 40 program categories listed. At a more specific level, these 40 categories are subdivided into at least 300 programs, and a yet more specific level subdivides these 300-plus programs into upwards of 1800 programs. Figure 5-1 provides examples from each level of the CIP taxonomy of Academic and Occupationally Specific Programs.

Level 1 (40 categories)	Level 2 (300+ categories)	Level 3 (1800+ categories)
• Agricultural Business and Production • **Agricultural Sciences** ☛ • Conservation and Renewable Natural Resources • Architecture and Related Programs • Area, Ethnic, and Cultural Studies • Marketing Operations/ Marketing Distribution • Communications • Communications Technologies	• Agriculture/Agricultural Sciences, General • Animal Sciences • Food Sciences and Technology • **Plant Sciences** ☛ • Soil Sciences • Agriculture/Agricultural Sciences, Other	• Plant Sciences, General • Agronomy and Crop Science • Horticulture Science • Plant Breeding and Genetics • Agricultural Plant Pathology • Plant Protection (Pest Management • Range Science and Management • Plant Sciences, Other

Figure 5-1
Classification of Instructional Programs (CIP): Academic and Occupationally Specific Programs. Examples from the Three Levels of Specificity

We have chosen to use the most general level of the taxonomy (Level 1) to describe jobs in the new Occupational Information System. We decided to use this level of specificity because:

- it fits with the level of specificity at which jobs will be described by other variables within O*NET
- users would not likely need more specific information
- specific instructional program taxonomies might change over time which would lead to high maintenance costs
- it would be the least burdensome in terms of coding requirements

The taxonomy of instructional program (at the most general level) is presented in Table 5-1. Each category is listed according to its CIP code number.

While the CIP taxonomy may be useful for describing course major, we also need a taxonomy to describe coursework/subjects required for the job. Another taxonomy developed by the undergraduate and graduate programs, and adult education programs. This taxonomy is particularly useful because it is crosswalked to the current DOT and the Occupational Employment Statistics job families. Accordingly, we decided to use the CIP "Academic and Occupationally Specific Programs" listing to code open-ended responses to an item regarding course major. This taxonomy has three levels of specificity. The shortest, most general level lists 40 program categories listed. At a more specific level, these 40 categories are subdivided into at least 300 programs, and a yet more specific level subdivides these 300-plus programs into upwards of 1800 programs. Figure 5-1 provides examples from each level of the CIP taxonomy of Academic and Occupationally Specific Programs.

Level 1 (40 categories)

- Agricultural Business and Production
- **Agricultural Sciences** ☞
- Conservation and Renewable Natural Resources
- Architecture and Related Programs
- Area, Ethnic, and Cultural Studies
- Marketing Operations/ Marketing Distribution
- Communications
- Communications Technologies

Level 2 (300+ categories)

- Agriculture/Agricultural Sciences, General
- Animal Sciences
- Food Sciences and Technology
- **Plant Sciences** ☞
- Soil Sciences
- Agriculture/Agricultural Sciences, Other

Level 3 (1800+ categories)

- Plant Sciences, General
- Agronomy and Crop Science
- Horticulture Science
- Plant Breeding and Genetics
- Agricultural Plant Pathology
- Plant Protection (Pest Management
- Range Science and Management
- Plant Sciences, Other

Figure 5-1
Classification of Instructional Programs (CIP): Academic and Occupationally Specific Programs. Examples from the Three Levels of Specificity

We have chosen to use the most general level of the taxonomy (Level 1) to describe jobs in the new Occupational Information System. We decided to use this level of specificity because:

- it fits with the level of specificity at which jobs will be described by other variables within O*NET
- users would not likely need more specific information
- specific instructional program taxonomies might change over time which would lead to high maintenance costs
- it would be the least burdensome in terms of coding requirements

The taxonomy of instructional program (at the most general level) is presented in Table 5-1. Each category is listed according to its CIP code number.

While the CIP taxonomy may be useful for describing course major, we also need a taxonomy to describe coursework/subjects required for the job. Another taxonomy developed by the

Table 5-1
Taxonomy of Instructional Programs (U.S. Department of Education, 1990)

01. Agricultural Business and Production
02. Agricultural Sciences
03. Conservation and Renewable Natural Resources
04. Architecture and Related Programs
05. Area, Ethnic and Cultural Studies
08. Marketing Operations/Marketing and Distribution
09. Communications
11. Computer and Information Sciences
12. Personal and Miscellaneous
13. Education
14. Engineering
15. Engineering-Related Technologies
16. Foreign Languages and Literatures
19. Home Economics, General
20. Vocational Home Economics
22. Law and Legal Studies
23. English Language and Literature/Letters
24. Liberal Arts and Sciences, General Studies and Humanities
25. Library Science
26. Biological Sciences/Life Sciences
27. Mathematics
28. Reserve Officers' Training Corps (ROTC)
29. Military Technologies
30. Multi/interdisciplinary Studies
31. Parks, Recreation, Leisure and Fitness Studies
38. Philosophy and Religion
39. Theological Studies and Religious Vocations
40. Physical Sciences
41. Science Technologies
42. Psychology
43. Protective Services
44. Public Administration and Services
45. Social Sciences and History
46. Construction Trades
47. Mechanics and Repairers
48. Precision Production Trades
49. Transportation and Materials Moving
50. Visual and Performing Arts
51. Health Professions and Related Sciences
52. Business Management and Administrative Services

U.S. Department of Education is useful in this regard. The taxonomy was developed to support a study of high school subjects taught by teachers. Although it was not created to assist in describing jobs, it does fit the needs of O*NET particularly well as it is

- applicable to the general education settings of high school and college
- consistent with existing conceptions of the domain

While this coursework taxonomy has some desirable characteristics, it is incomplete in that it does not include subjects taught in colleges and other post-secondary institutions. Therefore, we supplemented this taxonomy with subjects that we found listed in course catalogs for these types of institutions. In consideration of the space available in an occupational questionnaire and the rather general needs of users for this type of information, we decided to use a short list of 15 subject matter areas. The revised taxonomy is listed in Figure 5-2.

Examination of how educational data are gathered in large organizations. We examined what large organizations do in terms of gathering educational data in job analysis surveys. We discovered that the data gathered in large organizations tend to:

- focus on deriving educational criteria from job tasks and KSAs (Gael, 1988)
- include "demographic-like items" on how much and generally what type of education or training is possessed by the respondent
- gather instructional program type through the use of a checklist or look-up table

Some of these approaches provided some useful suggestions for how we might design the data collection instruments supporting O*NET. The first approach is a logical one, since job task and KSA data are the foundations of carefully developed training programs (Gael, 1988). These types of data will be gathered for a variety of purposes at various levels of detail for the new Occupational Information System. One potential application of these data is to determine the level and type of education needed in a job.

Demographically-oriented items, such as those asking incumbents to "check your highest level of education", are commonly used to acquire educational information. This method is direct and inexpensive (only a few items need to be asked to cover the area). Therefore, we decided to gather education-level data using this method.

Subject Area	Definition: Courses focus on ...	Examples of Courses
Technical Vocational	non-business specific technical skills	Agriculture; Industrial Arts; Auto-Shop; Electronics
Business Vocational	basic business skills	Word Processing; Filing; Book Keeping/Basic Accounting;
English/language Arts	primarily on reading, interpretation, and writing	Reading; Literature; Composition; Journalism; Creative Writing
Oral Communication	primarily on oral communication	Oral Communication; Speech; Interpersonal Communication
Languages	reading, writing, and/or speaking languages other than English	French; Chinese; German; Japanese; Latin; Russian; Spanish;
Basic Math	basic and applied math	General Math; Business Math
Advanced Math	advanced topics in math	Algebra; Geometry; Calculus; Statistics
Physical Science	the study of matter and or energy	Physics, Chemistry, Astronomy
Computer Science	computers and their uses	Programming, Information Systems Management, Software Applications
Biological Science	the study of life and living beings	Life Science; Biology; Anatomy; Physiology
Applied Science	the application of science	Engineering; Health; Medicine
Social Science	the behavioral sciences	Social Studies; Economics; History; Psychology; Sociology
Arts	visual and performing arts	Arts & Crafts; Music; Painting; Sculpture; Theater; Voice
Humanities	cultural and philosophical aspects of humans	Minority Studies; Philosophy; Religion
Physical Education	physical fitness and sports	Aerobics; Jogging; Weight Lifting; Specific Sports

Figure 5-2
Revised Subject Area Taxonomy

Use of a checklist to gather information about type of instructional program has several advantages. Responses to the checklist are closed-ended, so that no coding of responses is necessary. In addition, respondents may be the best judge of which titles of course majors map most closely on their own major.

Considering all of these issues, we decided to gather instructional program data by having respondents check the most relevant instructional program from a list based on the CIP taxonomy. Respondents will:

- check the level of education that is required for the job
- check the instructional program that is relevant
- indicate the highest level at which education in certain subjects is required for the job

These items, tapping educational requirements, are included in the Training, Education, Licensure, and Experience Questionnaire, which is included in this report as Appendix C in Volume II.

References

Bloom, B. S. (1956). *Taxonomy of educational objectives:. Cognitive domain, psychomotor domain, affective domain.* New York: David McKay.

Campion, M., Gowing, M., Lancaster, A., & Pearlman, K. (1994). *United States Department of Labor Database of Occupational Titles reinvention project: DOT transition team final report.* Washington, DC: United States Office of Personnel Management.

Commission on the Skills of the American Workforce. (1990). *America's choice: High skills or low wages.* Rochester, NY: National Center on Education and the Economy.

Commission on Workforce Quality and Labor Market Efficiency. (1989) *Investing in people: A strategy to address America's workforce crisis.* Washington, DC: U.S. Department of Labor.

Dye, D.A., & Reck, M. (1988). *A literature review and meta-analysis of education as a predictor of job performance.* Washington, DC: U.S. Office of Personnel Management, OPRD-88-9.

Fullerton, H.N., Jr. (1985). The 1995 labor force: BLS' latest projections. *Monthly Labor Review, 117,* 17-25.

Gael. S. (1988). *Job analysis handbook.* New York: Wiley.

Gagne R. (1985). *Conditions of learning.* New York: Holt, Rinehart, and Winston.

Goldstein, I.L., & Gilliam, P. (1990). Training system issues in the year 2000. *American Psychologist, 45,* 134-143.

Halpern, D. (1994). *A national assessment of critical thinking skills in adults: Taking steps towards the goal.* Washington, DC: National Center for Educational Statistics.

Monahan, C.J., & Muchinsky, P.M. (1983). Three decades of personnel selection research: A state-of-the-art analysis and evaluation. *Journal of Occupational Psychology, 56,* 215-225.

Secretary's Commission on Achieving Necessary Skills. (1992). *Learning a living: A blueprint for high performance.* Washington, DC: U.S. Department of Labor.

Secretary's Commission on Achieving Necessary Skills. (1991). What work requires of schools. Washington, DC: U.S. Department of Labor.

Snow, R.E., & Swanson, J. (1992). Instructional psychology, aptitude, adaptation, and assessment. *Annual Review of Psychology, 43,* 583-626.

U.S. Department of Education (1990). *Classification of instructional programs.* U.S. Department of Education (1993)

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington DC: Author.

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

Ward, S.L., Byrnes, J.P., & Oventon, W.F. (1990). Organization of knowledges and conditional reasoning. *Journal of Educational Psychology, 82,* 832-837.

Westat (1993). *DOT user survey: A report and analysis.* Rockville, MD: Westat, Inc.

SECTION II

OCCUPATIONAL REQUIREMENTS

Section II
Occupational Requirements

When data are obtained about jobs and occupations, it is widely recognized that information should be collected about the requirements that establish expected behaviors for individuals who perform the activities associated with their work (Bemis, Belenky, and Soder, 1983; Gael, 1983; McCormick, 1979). This section describes the design of the occupational information system components that will obtain the relevant data about job requirements across the domain of work.

This section will be broken into three distinct chapters. The first chapter, on generalized work activities, provides a taxonomic system that might be used to describe the work people do on their jobs. Essentially, these generalized work activities are intended to provide a broader cross-job framework which will account for the more specific kinds of task activity statements that are commonly used to describe people's jobs.

It is not enough simply to describe the nature of the activities people must perform on their jobs. A complete description of people's activities on their jobs must also consider the environmental variables or those factors shaping the conditions of task performance. In the second chapter, on work context, we will examine these kinds of immediate environmental influences on people's job performance.

The immediate conditions under which a task is performed are not the only kind of environmental influences that affect how people go about completing their assigned activities. As noted in our overview of the content model, various features of the organizational structure also can affect how people go about doing their work. Thus, in the third, and final, chapter of this section, we will examine organizational context factors that shape the nature of people's work.

References

Bemis, S.E., Belenky, A.H., & Soder, D.A. (1983). *Job analysis: An effective management tool.* Washington, DC: The Bureau of National Affairs.

Gael, S. (1983). *Job analysis: A guide to assessing work activities.* San Francisco: Jossey-Bass.

McCormick, E.J. (1979). *Job analysis: Methods and applications.* New York: AMACOM.

Chapter 6
Generalized Work Activities
Table of Contents

Figures

Appendix

Chapter 6
Generalized Work Activities

P. Richard Jeanneret
Jeanneret & Associates, Inc.
Walter C. Borman
Personnel Decisions Research Institute, Inc.

Introduction

The nature of work and the content of jobs are changing, especially if one attempts to document and measure worker functions in terms of discrete tasks. The changes are expected to be reflected by increased skill requirements of jobs (i.e., the Workforce 2000 report) and, perhaps more importantly, by the way that work is structured. In response to the anticipated changes in work content as well as in consideration of the emerging body of research strongly indicating that work activities can be measured at more broadly defined levels with meaningful utility, the new occupational information system includes a data-gathering component we call the Generalized Work Activities Questionnaire. In designing this Questionnaire, we have heavily relied on job analysis research efforts that have studied occupations from a taxonomic perspective.

This chapter first reviews previously developed dimension systems in the area of generalized work behaviors or activities (GWAs). The review reveals several useful GWA taxonomies, and these taxonomies are integrated to form a 42-construct system that we believe provides a framework for evaluating the job activity requirements for all or the vast majority of occupations in the world of work. The GWA taxonomy is intended to be comprehensive in the sense that every task or duty from these occupations should be subsumed by one or more GWAs in the system. It is designed to be efficient so that a reasonably small number of constructs can effectively differentiate between occupations. Finally, the taxonomy is hierarchical; the 42-construct system collapses into nine constructs which in turn can be collapsed into four constructs. This feature will allow different users to obtain information about occupations at different levels of specificity, depending on their reason for using the O*Net.

The chapter is comprised of three main sections. The first section describes the theoretical background and taxonomic models that guided development of the content materials for the Generalized Work Activity component of the O*NET. The second section addresses the definition of specific GWAs broad, worker-oriented constructs that characterize the behaviors required for jobs. The third section describes possible applications of this part of the content model. The GWAs themselves within the O*Net system should be very useful for several applications, including occupational counseling, development of job families, and job evaluation. The GWAs, will also be useful when linked to knowledge, skills, abilities, and work styles, in providing strong guidance during the process of matching people with jobs.

Definition of a Generalized Work Activity

Although there has been considerable research associated with the identification and use of generalized work activities, the term itself has not acquired an explicit definition that is widely acknowledged. McCormick, Cunningham, and Gordon (1967) initially coined the term "job dimension" and described the dimensions of work as combinations of worker-oriented elements. In follow-on research, Jeanneret (1969) investigated the hypothesis that "there is some structure underlying the domain of human work, and that this structure can be identified in terms of one or more sets of job dimensions" (p. viii). Again, these dimensions were characterized as composites of worker-oriented job analysis elements that applied to a wide range of work activities, generally established using factor analytic techniques. Furthermore, it was reasoned that if jobs were characterized by these dimensions, "they would be of considerable importance to both the theoretical and practical developments of the study of the world of work" (Jeanneret, 1969, p. 2).

Cunningham (1971) had a similar perspective. His vision was expressed by the term "ergometrics," the integration of principles from the study of human behavior with the rigor of psychometrics and job analysis procedures. Further, Cunningham (1971) viewed the use of a structured job analysis process that was not task-specific as being a nomothetic (as opposed to an ideographic) methodology, "an approach emphasizing the common dimensions rather than the unique characteristics of tasks, jobs, and occupations" (p. 8).

More recently, Harvey (1991) has concluded that the principal proposition of research focused on worker-oriented job analysis is to describe the general dimensions (found through factor analytic procedures) that underlie all jobs. Harvey (1991) states that, "the issue of defining the dimensionality of work centers on the question of identifying general job behavior constructs" (p. 146).

Thus, research that has focused on identifying the dimensionality or structure of work using behavioral elements is viewed as a fundamental approach to defining GWAs. Further, within the content model, GWAs represent a crucial component needed to develop a comprehensive framework for describing the similarities and differences between jobs. Any job description must consider the work to be done and the tasks people do. However, specific job tasks lack the generality needed to formulate a viable set of cross-job descriptors. GWAs, therefore, provide a plausible basis for describing work activities in a way that promotes cross-job comparisons. Using this perspective as a framework, the criteria for determining what construct would qualify as a GWA includes

- being broad in scope and having applicability to a wide range of occupations
- being based on job analytic research
- being characteristic of the underlying structure of work.

A simple definition has evolved from these criteria.

> A Generalized Work Activity (GWA) is an aggregation of similar job activities/ behaviors that underlie the accomplishment of major work functions.

This definition is consistent with the concept set forth by Outerbridge (1981) who identified "Generalized Work Behaviors" (GWBs) by examining cluster analysis results for a set of job analyses. In effect, her operational definition of a GWB was a final cluster that had "sufficient homogeneity to be descriptive of work behaviors yet possess enough heterogeneity to cover more than occupation-specific duties" (p. 7).

Finally, it should be noted that during the last 20 years, many researchers have identified sets of generalized work activities. Some of their analyses have been based on behaviorally oriented job analysis data, and other analyses have been based on task-oriented job information. (See McCormick, 1979, or Harvey, 1991, for a discussion of these two types of job analysis data). A review of these research efforts will be presented in subsequent subsections of this chapter, because they have been influential in the final selection and definition of the GWAs proposed for the O*NET

Origin of the Generalized Work Activity concept. A review of the literature focused on identifying GWAs clearly indicated that the intention of several researchers was to identify constructs to support the synthetic validation of job requirement predictors. Jeanneret (1992) and Mossholder and Arvey (1984) have traced the history of synthetic validation, and Lawshe (1952) and Lawshe and Steinberg (1955), as well as Balma (1959) and McCormick (1959), discussed how results from empirical validation studies could be generalized to situations where sample sizes were small or other validation strategies were not feasible. McCormick's research went further. He and several associates documented how GWAs (job dimensions) could serve as the linking pins between those jobs for which there was empirical validity evidence for a particular predictor and other jobs for which validity evidence could not be obtained but were otherwise similar (on the basis of their job dimensions) to the jobs with the necessary validation support (Cunningham & McCormick, 1964a; Gordon, 1963; Gordon & McCormick, 1963; Jeanneret & McCormick, 1969; Marquardt & McCormick, 1974; McCormick, DeNisi & Shaw, 1979; McCormick & Jeanneret, 1988; McCormick, Jeanneret & Mecham, 1972; McCormick, Mecham & Jeanneret, 1989; Mecham, 1985; Mecham & McCormick, 1969a; Sparrow, Patrick, Spurgeon & Barwell, 1982).

The primary requirement of the synthetic validity concept is the analysis of job information according to a set of common dimensions that classify jobs into groups or families on the basis of their overall similarities. Then it may be possible to infer that a predictor which has been validated for certain jobs within a particular family (i.e., having a certain profile on a specified set of job dimensions) would be valid for other jobs in the same family (i.e., having the same profile on the same specified set of job dimensions). The job dimensions themselves were also found to be specifically related to certain basic aptitude measures (such as those included in the General Aptitude Test Battery [GATB]) as reported by Cunningham (1964), Jeanneret (1972, 1985), and McCormick et al. (1972).

Outerbridge (1981) had a similar perspective when she examined the viability of using GWBs in a modified application of Primoff's J-coefficient technique (Primoff, 1955a, 1955b). This modification, according to Outerbridge, was proposed by Trattner in an unpublished and undated manuscript and served as another model of synthetic validation. Specifically, Outerbridge proposed that GWBs would be the performance elements (appropriately weighted for importance) in a synthetic validation study.

A somewhat related reason for identifying GWBs was described by O'Leary, Rheinstein, and McCauley (1989), who argued that a work behavior taxonomy allows for grouping together (using cluster analysis) job duties across positions, a large number of federal government professional and administrative positions in their case. Such an argument is very reasonable in light of the prior research efforts on the development of job families using job dimensions from various job analysis questionnaires. Success in defining families on the basis of similarity in job dimensions, for example, has been reported by Cornelius, Carron, and Collins (1979); Sackett, Cornelius, and Carron (1981); DeNisi and McCormick (1974); McCormick, DeNisi and Shaw (1977); and Pass and Cunningham (1975). In some instances, the specific purpose for forming families has been to support validity generalization efforts (Colbert & Taylor, 1978; Taylor, 1978; and Taylor & Colbert, 1978) or the transport of validity (Hoffman & Lamartine, 1995). In other instances, the examination has focused on other personnel-related issues, such as classification, job evaluation, occupational guidance, or performance appraisal (see, for example, Ballentine, Cunningham & Wimpee, 1992; Champagne & McCormick, 1964; Cornelius, Carron & Collins, 1979; Cunningham & Scott, 1988; Dickinson, 1977; Harvey, Friedman, Hakel & Cornelius, 1988; Jeanneret, 1988; McCormick, DeNisi & Marquardt, 1974; McCormick & Jeanneret, 1988; Mecham & McCormick, 1969b; Pass & Cunningham, 1975; Scott, Cunningham & Pass, 1989; Talbert, Carroll & Ronan, 1976).

The GWA taxonomic structure. The taxonomic paradigm that underlies the structure of the GWA constructs is rooted in the primary foundation of modern psychology. As postulated by Watson (1913, 1919, 1925), behavior in any setting is a function of Stimuli (S) and Responses (R). Subsequently, both Hull (1943) and Skinner (1938) argued that the S-R formula was also the foundation for understanding all forms of learning, including the type of "learning" that takes place as an individual performs some activity in a work setting. The S-R theorem has been expanded in the applications of psychology to include the Organism

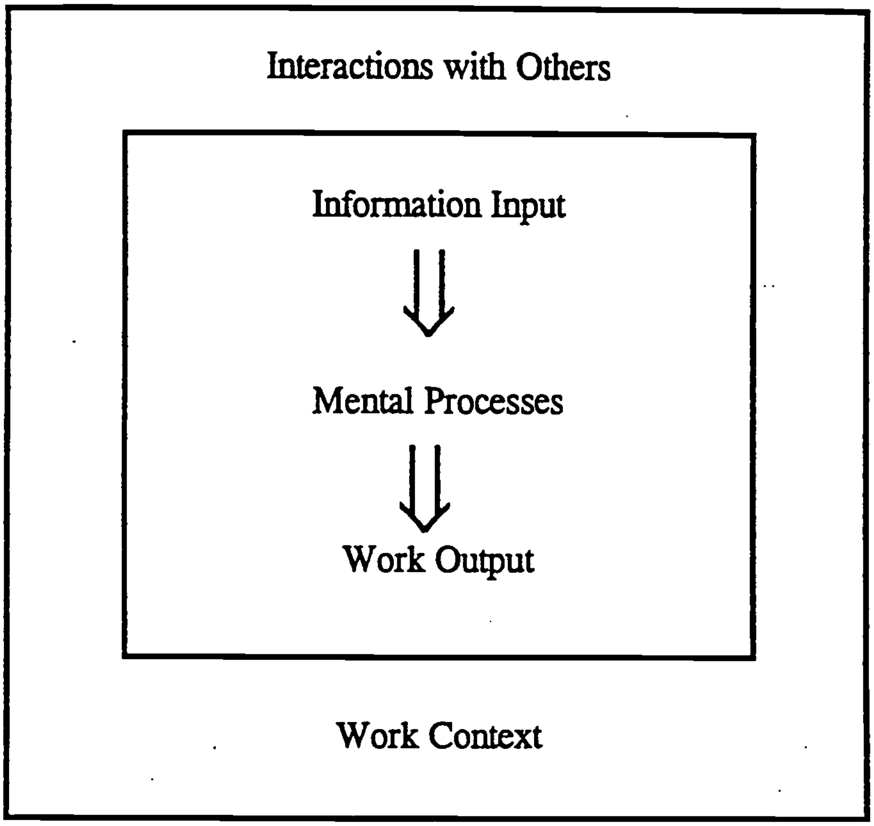


Figure 6-1
Highest Order GWA Taxonomy

Information Input
Where and how are the information and data gained that are needed to perform this job

- Looking For and Receiving Job-Related Information: How is the information obtained to perform this job?

- Identifying/Evaluating Job-Relevant Information: How is information interpreted to perform this job?

Mental Processes
What processing, planning, problem-solving, decision-making, and innovating activities are performed with job-relevant information?

- Information/Data Processing: How is information processed to perform this job?

- Reasoning/Decision Making: What decisions are made and problems solved in performing this job?

Work Output
What physical activities are performed, what equipment and vehicles are operated/controlled, and what complex/technical activities are accomplished as job outputs?

- Performing Physical and Manual Work Activities: What activities using the body and hands are done to perform this job?

- Performing Complex/Technical Activities: What skilled activities using coordinated movements are done to perform this job?

Interacting with Others
What interactions with other persons or supervisory activities occur while performing this job?

- Communicating/Interacting: What interactions with other people occur while performing this job?

- Coordinating/Developing/Managing/Advising Others: What coordinating, managerial, or advisory activities are done while performing this job?

- Administering: What administrative, staffing, monitoring, or controlling activities are done while performing this job?

Figure 6-2
Second Order GWA Taxonomy Embedded in Highest Order Taxonomy

(O). In the case of analyzing the behavior of individuals at work, the O represents the worker who is the receptor of the Stimuli (S) and, after processing of those Stimuli, provides one or more Responses (R). Miller (1953) was the first to apply the S-O-R model to the study of work, and did so in performing what he referred to as a Task-Equipment Analysis (TEA). With the emergence of the cognitive paradigm, these operations-oriented variables have become even more important.

McCormick (1964), in developing the Worker Activity Profile, and McCormick, Jeanneret, and Mecham (1969), in designing the Position Analysis Questionnaire (PAQ), used the S-O-R paradigm in an information theory context to organize their structured worker-oriented job analysis questionnaires. In this context, the S-O-R model is directly representative of three primary components of work behavior:

S	—	represents the information that is received by the worker (i.e., the stimulus)
O	—	represents the mediation process as performed by the worker
R	—	represents the action performed by the worker in response to the "processed stimulus"

Additional support for the above model comes from Berliner, Angell, and Shearer (1964), who proposed a taxonomy to classify the behavior of the "universal operator." The model postulated four primary operator "processes": Perceptual; Mediational; Communication; and Motor.

McCormick, Jeanneret, and Mecham (1969, 1972) reasoned that the S-O-R model was limited when describing behavior in a work setting since it omitted two important considerations: (a) work behavior typically involves interactions and relationships with individuals; and (b) work behavior occurs within a physical and social context that typically is described in terms of working conditions, interpersonal relationships, and structured job characteristics. Interactions with others, such as communications and supervision, are included within the development of our GWAs, while the environmental influences will be considered in greater detail in a Chapter 7 on work context.

The highest order GWA taxonomy is presented in the form of a diagrammatic model in Figure 6-1. The intent of this model is to communicate that the interactive components (i.e., the S-O-R), or information input, mental processes, and work output components occur: (a) while interactions with other people take place and (b) within a worker's and an organization's work context. This is not a level, however, at which occupations, jobs, or work functions could be meaningfully described for analytical purposes. At this level, the model simply states that the accomplishment of any form of work activity requires the worker to receive some information, process that information, and then make some response. There is little meaningful differentiation that can be made among jobs at such a broadly defined level of description.

A second-order taxonomy was also identified for the GWA constructs and is presented in Figure 6-2. Brief definitions of the constructs set forth in this second-order taxonomy (Figure 6-2) delineate the relationships between the highest order and second-order dimensions. This taxonomy was derived primarily on a rational rather than an empirical basis after examining all of the constructs that were considered relevant for the GWA domain. This is not to say, however, that there is not some precedent and even empirical evidence to support a second-order taxonomic structure. We now review that evidence.

Factor analytic research relevant to the higher order structure. First, the factor analysis research of Cunningham et al. (1990) using the Generalized Work Inventory (GWI) resulted in a further analysis of the 55 GWI first-order factors and yielded 15 second-order factors. Because of the nature of Cunningham's GWI and the job database, the composition of some second-order factors was very specific to an occupational domain (i.e., performing arts activities and working with plant life or animals). However, other factors were very generic and are reflected in the taxonomy presented in Figure 6-2 (i.e., information compiling activities; human development and interaction). Harvey et al.'s (1988) work with the Job Element Inventory (JEI) also led them to develop a second-order factor solution. These second-order factors were labeled as follows:

- Input from Work Environment
- Decision/Communication/General Responsibility
- Physical Activities/Related Environment
- Skilled Activities
- Equipment Operation/Related Environment

- Job Demands/Autonomy
- Care Provision

Of course, the research with the JEI included the environmental, social, and related contextual aspects of the work environment which have been purposely excluded from the GWA domain as prepared for the O*NET. Instead, these characteristics of jobs are measured by other components of the O*NET.

Berliner et al. (1964) also proposed a second-order taxonomy for the universal operator on a rational basis, and it was comprised of the six "activities" listed below:

- Perceptual Processes
  1 Searching for and receiving information
  2 Identifying objects, actions, events

- Mediation Processes
  3 Information processing
  4 Problem solving and decision making

- Communication Processes
  5 Simple/discrete
  6 Complex/continuous

When comparing the Berliner et al. (1964) structure (which primarily takes a human factors approach to the operator job) to the second-order taxonomy presented in Figure 6-2, one will find considerable overlap, recognizing that neither structure has been developed from a comprehensive empirical study.

While both Jeanneret (1987) and McCormick et al. (1972; 1977) did not conduct second-order factor analyses, they did look for what the authors labelled overall dimensions that appear to have the qualities of second-order factors. Examples of McCormick et al.'s (1972; 1977) overall dimensions that have some similarity to the GWI second-order taxonomic factors include:

- Being Aware of Work Environment
- Performing Clerical/Related Activities
- Having Decision, Communications, and General Responsibilities
- Engaging in Physical Activities
- Performing Technical/Related Activities
- Public/Customer/Related Contacts
- Supervisory/Directing/Estimating

Also, it should be noted that using a cluster-analytic technique, Cunningham and Scott (1988) found what would be equivalent to second-order factors for job information collected with the Occupational Analysis Inventory (OAI). These clusters were labelled as follows:

- Figural Activities
- Cognitive Activities
- Clerical Activities
- Demanding Physical Activities
- Skilled Motor Activities
- Skilled Social Activities
- Managerial Activities

Conceptually, these clusters and the Berliner et al. (1964) rational factors probably are the closest match to the second-order factors for the GWAs as presented in Figure 6-2.

Two other relevant studies that relied upon factor analytic techniques to identify the taxonomy of job requirements used the worker trait ratings of the U.S. Employment Service (as reported in the *Dictionary of Occupational Titles*; U.S. Department of Labor, 1991) as the primary database representative of 4,000 jobs. In a study by McCormick, Finn, and Scheips (1957), seven factors were found. Subsequently, Barker (1969) conducted a similar analysis and found factors with a substantial degree of correspondence to the McCormick et al. (1957) findings. Barker's factors were labelled as follows:

- Technical
- Clerical
- Manipulative
- Persuasive
- Color Discrimination
- Administrative
- Scientific
- Social Service
- Agility

Because the structured interpersonal, social, physical, and environmental contexts of work (i.e., the components of the Work Context dimensions set forth in Figure 6-1) are themselves extensive and comprehensive in scope, a decision was made at the outset to analyze these work characteristics separately from all other GWAs that fall within the taxonomic model expressed in Figure 6-1. Accordingly, Chapters 7 and 8 of this report are devoted to work context and organizational characteristics which are measured in a manner that is different from the measurement of the GWAs.

Research Relevant to the Lower Order GWAs

In the preceding section we proposed a broad, general structure, based on a "S-O-R" model for organizing any structuring dimensions describing generalized work activities. This broad organizing structure clearly finds some support in the literature. By the same token, however, the broad, higher order dimensions lack the specificity needed to describe the similarities and differences among jobs and structure more specific tasks.

This observation, in turn, poses a new question. How might one go about identifying a set of lower order, more narrowly focused generalized work activities? Because a number of earlier factor analytic studies have sought to identify dimensions of people's work activities at this level, these studies might provide a useful starting point for the development of this taxonomy. In the following section of this chapter we will briefly review this literature.

Three primary sources were examined to identify and define the GWAs selected for inclusion in the O*NET:

- One source is the factor analytic results derived from the application of nomothetic job analysis inventories that contain general descriptors of work activity and have been applied to a wide range of jobs.

- A second source is supervisory or management taxonomies intended to describe the dimensions underlying managerial work.

- The third source results from factor or cluster analyses of widely relevant behavioral dimensions or from models of generalized activities that cut across all or at least several types of jobs.

Nomothetic job analysis inventories. The nomothetic questionnaires that have been used to collect and measure the content of a wide spectrum of jobs across the domain of work include: the *Position Analysis Questionnaire* (*PAQ*; McCormick, Jeanneret & Mecham, 1969, 1972); the *Occupation Analysis Inventory* (*OAI*; Cunningham, 1988); the *Generalized Work Inventory* (*GWI*; Cunningham, Wimpee & Ballentine, 1990); and the *Job Element Inventory* (*JEI*; Cornelius, Hakel & Sackett, 1979).

The PAQ. McCormick (1959) was the first to clarify the distinction between job-oriented and worker-oriented job analysis approaches from a theoretical perspective. Furthermore, with students at the Occupational Research Center of Purdue University, McCormick was able to establish: (a) that job analysis terminology could be classified as either "worker-oriented" or "job-oriented," and (b) that the use of worker-oriented variables led to the identification of the structure underlying the domain of work. (See the research of: Chalupsky, 1962; Cunningham, 1964; Cunningham and McCormick, 1964a, 1964b; Gordon, 1963; Gordon and McCormick, 1963; McCormick, Cunningham and Gordon, 1967; Palmer and McCormick, 1961; and Peters and McCormick, 1962). The ideas and early work of McCormick and his students came to fruition with the publication of the *Position Analysis Questionnaire Form A* (McCormick, Jeanneret & Mecham, 1967) and then Forms B and C (McCormick et al., 1989).

The OAI and GWI. These two questionnaires are interrelated in that the GWI (Cunningham & Ballentine, 1982) is a 268-item questionnaire derived from the longer (617 items) OAI (Cunningham, 1988). Furthermore, the GWI is considered to be a less technically difficult questionnaire and is based on certain factors derived from the OAI and modifications to some of the OAI items (Cunningham, Wimpee, & Ballentine, 1990). Neither questionnaire is "pure" in the sense that they contain both worker-oriented and job-oriented items; however, the GWI is considered to be more worker-oriented (Cunningham et al., 1990).

The JEI. This questionnaire was developed by Cornelius and Hakel (1978) by editing the PAQ to make it easier to read and more meaningful to Coast Guard incumbents. The result was a 153-item questionnaire that used only one rating scale (a six-point relative time spent scale) for all items. The JEI retained the same divisional format for the revised items as is found in the PAQ, and the underlying content of the JEI items is the same as the corresponding items in the PAQ.

In summary, several worker-oriented questionnaires have been designed to measure job content, and it is possible to examine the research that has been completed using the data from nomothetic worker-oriented questionnaires to evaluate their scientific and practical contributions to understanding work. Further, it was concluded that the factors (dimensions) that have been derived from applications of these questionnaires would provide considerable guidance in selecting meaningful GWAs that have a solid foundation in job analytic research.

The structure of work — A worker-oriented perspective. As previously mentioned, an initial important theoretical basis for examining the content of jobs from a worker-oriented perspective, was to examine the hypothesis that there is a definitive structure to the domain of human work, that the dimensions or components of that structure can be measured, and that jobs can be characterized in terms of those dimensions. In effect, the development of a behavioral taxonomy of worker-oriented activities would provide a common ground for research in much the same way as Fleishman's (1972, 1975) work contributed a framework for understanding the conceptual and practical aspects of task performance typically obtained through job-oriented job analysis.

Thus, while work may be categorized into occupations and job titles that evolve and change with technology and societal needs, human workers are only capable of performing certain functions (or within a range of activities), and such work behaviors have defined limits. Examples of the consequences of such limitations are readily found in the workplace; the physical capabilities of workers have been supplemented with machinery, and the information processing abilities of humans have been expanded by computers, as the range of psychomotor and cognitive job requirements have necessarily remained consistent with the boundaries of human functioning.

Historical perspective on the development of the structure of work. One model describing the structure of work, when analyzed from the worker-oriented perspective, was presented over 20 years ago using data obtained with the PAQ (Jeanneret, 1969). PAQ item responses were factor analyzed by the principal components method and factors were rotated to an orthogonal varimax criterion of simple structure (Kaiser, 1958). Thirty-two components were interpreted, including five overall dimensions (based on factor analysis of 150 PAQ items) and 27 divisional dimensions (derived from the separate factor analysis of items from each of the six divisions of the PAQ). The sample of jobs (N=536)[1] in this first study was admittedly small and did not proportionally represent the U.S. labor force, but a confirmation of the structure was accomplished using a subsample of jobs selected to proportionally represent the number of distinguishable jobs in each occupational category reported in the *Dictionary of Occupational Titles* for 1965. This world of work sample was subjected to the same factor analytic procedures to examine the structure of the items in each division of the PAQ, and only two dimensions of the Output Division of the PAQ were not replicated. Harvey (1987) reanalyzed the Jeanneret PAQ data using a common factor analysis model and an oblique Harris-Kaiser rotation. While Harvey interpreted more overall factors, there was a good match to the factors derived by both Jeanneret (1969) and McCormick et al. (1977). Harvey

[1]In order to examine the stability of the factor structure, the job sample was randomly split in two halves (N=268), factor analyzed, and the resulting dimensions were compared with Tucker's (1951) coefficient of congruence. The average coefficient was .958, which indicates excellent congruence.

also completed a second-order factor analysis of the 19 first-order factors and interpreted three second-order factors labelled as follows:

- Working with People and Data
- Working with Things
- Physical Work Environment

Interestingly, these second-order factors are similar to the highest-order taxonomic model guiding the development of the GWAs as well as Fine's Functional Job Analysis components, which are discussed in the next section of this chapter.

Marquardt and McCormick (1973) examined the structure of the PAQ by factor analyzing the PAQ elements that had been rated in terms of attribute requirements in an earlier research project (Marquardt & McCormick, 1972). Thus, for each PAQ element, there is a rating of the relevance of each one of 71 attributes of a cognitive, perceptual, psychomotor, temperament, or interest nature. These ratings in effect represent individual job requirements, given that the PAQ element is applicable in a specific job. The results of the factor-analytic work produced findings that often were very similar to those found for actual job data. This finding supported the concept that the domain of work could be characterized in terms of worker behaviors or worker requirements (attributes), and the underlying structure was essentially the same. Further, the similarity in the two structures seemed responsive to the vision articulated by Dunnette (1976), in that there was some common ground to link a taxonomy of job information with a taxonomy of worker attributes (requirements). In 1974, Marquardt and McCormick, using a sample of 3,700 PAQ analyses stratified according to the U.S. work force, replicated the initial research of Jeanneret (1969) and identified 31 divisional and 14 overall job dimensions. Again, in 1976, another database of jobs (N=2,200) representative of the 1970 labor force was subjected to the same factor analytic procedures (McCormick, Mecham, & Jeanneret, 1977, 1989). A very similar, but somewhat more definitive, structure was documented, known as PAQ System II. Thirteen overall and 32 divisional job dimensions were interpreted. Finally, Jeanneret (1987, 1990) compiled an even larger set of data (N=30,000+ job analysis samples drawn from the master PAQ database and categorized in terms of 405 U.S. Bureau of Census occupational codes per the 1980 census[2]); then these data were analyzed in a manner consistent with previous factor analytic studies that led to the derivation of PAQ System I and System II job dimensions.

The resulting factor structures have been compared to their respective counterparts as they currently comprise PAQ System II. Comparison procedures followed those used by Eberhardt and Muchinsky (1982) who recommended the use of an overlap statistic. The overlap formula (using PAQ-relevant notations) was as follows:

$$\frac{N_C}{\frac{N_7+N_8}{2}}$$

where: N_c = number of PAQ items in common to a principal component,

N_7 = the number of PAQ items found in the 1976 PAQ System II component (the 1970 workforce), and

N_8 = the number of items found in the dimension from the present analysis that is representative of the 1980 workforce.

Eberhardt and Muchinsky (1982) recommended a critical value of 60 percent as indicating "substantial overlap." Twenty-two of the 31 dimensions (71%) met this criterion, which is quite reassuring given the great diversity in the scope of the two databases. Also reassuring is that the two databases considered for the overlap analysis (i.e., 1976 and 1987) are each representative of the labor force composition as determined by the 1970 and 1980 census.

Two factor analytic studies of the JEI, following procedures similar to those applied to the PAQ, led another group of researchers to conclude that there were consistent subjective and quantitative similarities in the structures identified by the two questionnaires applied to very different samples of jobs (Harvey, Friedman, Hakel, & Cornelius, 1988). They also argued that correlations ranging from the .80s and .90s between PAQ and JEI factors when the data

[2]There were 504 job categories published by the Census Bureau for 1980. The PAQ data are represented in all codes that have an equivalent *Dictionary of Occupational Titles* code. The 99 codes not represented include specialized engineers, certain scientists, medical specialists, college professors, clergy, athletes, private household workers, farmers, hunters, and individuals engaged in fishing. It is estimated that the 405 codes analyzed represent the jobs held by more than 90 percent of the work force and encompass the complete occupational structure from entry-level to executive, unskilled to professional in both private and public sector organizations.

were collected under very different administrative circumstances "makes a strong statement regarding the robustness of the job dimensions measured by these instruments" (Harvey et al., p. 646). Finally, these researchers pointed out that such a finding is "consistent with the basic worker-oriented premise that there is an underlying structure of work that can be assessed through standardized job analysis methods (Jeanneret, 1969; McCormick, 1959)" (Harvey et al., 1988, p. 646).

A parallel research program to the one focused on the PAQ was followed by Cunningham and his associates beginning in the early 1970s. Data collected with both the OAI and its companion, the GWI, have been analyzed with similar factor analytic procedures as described above, and similar results have been observed. Boese and Cunningham (1975) conducted the first major factor analyses of the 602 work elements of the OAI. They followed the procedures established by Jeanneret (1969) by conducting separate analyses within each of the eight sections of the OAI. They factor analyzed data obtained for 1,414 jobs distributed in accordance with the prevalence of workers in five occupational categories (Professional, Technical and Managerial; Clerical and Sales; Service; Farming, Fishing, Forestry, and Related; Operative, Skilled Trades and Related). The analyses produced 132 first-order factors and 28 higher order dimensions that were found to be highly stable using a split sample congruence technique followed by Jeanneret (1969). Next, Cunningham and Scott (1988) subjected the worker-oriented variables of the OAI to factor and cluster analytic procedures (N=1,343 job analyses) and found 47 "sectional" factors that grouped into 11 clusters. Many of these clusters are comparable to the "overall" dimensions of the PAQ database. Interestingly, Cunningham and Scott (1988) also analyzed 34 of the U.S. Employment Service (USES) Worker Functions and Characteristics (excluding the 12 interest variables and seven environmental conditions) ratings for 12,375 jobs, and then used a multi-trait multi-method analysis to relate the USES clusters to those of the OAI across 1,034 jobs that had been rated with both procedures. The researchers concluded that they successfully identified seven general factors underlying the USES and OAI worker-oriented variables. These factors were discussed previously in the description of the GWA second-order taxonomic structure. Conceptually, these OAI general factors match many of the overall PAQ dimensions.

The GWI was used to obtain data on 164 U.S. Air Force enlisted specialties, and a factor analysis of these data resulted in 62 first-order factors which were subjected to higher order factor analysis (Cunningham et al., 1990). Fourteen of fifteen second-order factors were interpreted, although because of the nature of the sample of jobs analyzed, the factors are much more specific than those previously identified for the PAQ and OAI.

Summary of taxonomic research using nomothetic questionnaires. Clearly the factor analysis of data collected with worker-oriented job analysis questionnaires has provided considerable insight as to the structure that underlies the domain of human work. Because the worker-oriented approach is not specific to technology or tasks, it permits an understanding of the general, cross-job structure that is not possible with a job-oriented job analysis methodology. Furthermore, the stability of the factor structure found using a worker-oriented questionnaire when the databases change, is satisfying evidence that the worker-oriented approach can withstand the changes of time as the mechanics and tasks of jobs evolve with technology and innovation. And finally, the fact that there is a degree of convergence, albeit subjectively assessed, across the various factor structures that have been obtained using different worker-oriented questionnaires and very diverse samples of jobs is sufficient to encourage the use of Generalized Work Activities based on such research to study jobs in the future.

The structure of work — A task-oriented perspective. The preceding discussion has focused on the dimensionality of work as determined by the analyses of jobs using worker-oriented techniques. Although not as extensive, factor analytic research has also searched for common work dimensions using task- or job-oriented data. Initially, such research was guided by the work of Sidney Fine, who, on a theoretical basis, argued that all tasks could be analyzed in terms of three fundamental functions: Data, Things, and People (Fine, 1989). In this regard, Fine's Data function is comparable to the "O" — Mental Processes component of our highest-order taxonomic model; similarly, Things is comparable to "R" — the Output component, and Fine's People function is equivalent to our Interaction with Others component. An attempt to confirm the hierarchical structure proposed by Fine within the People function met with limited success (McCulloch & Francis, 1989). Also, Harvey, Wilson, and Blunt (1989) factor analyzed a comprehensive task inventory and failed to find interpretable general dimensions of work such as those proposed by Fine. Additionally, Harvey and Hayes (1988) found little convergence between task-oriented factors and worker-oriented factors (PAQ dimensions) derived for the same set of jobs. Rather, the factors were technologically specific. In fact, Harvey (1991) has concluded that factor analysis of task-oriented job analysis inventories will not result in general dimensions of work activity. Because Fine's Functional Job Analysis hierarchical components are theoretical and not research-based, they were not used in developing the GWAs.

The structure of work — Managerial taxonomies. Much of the foregoing discussion has focused on taxonomies of generalized work activities derived using global task questionnaires. One characteristic of many of these questionnaires is that the tasks under consideration are somewhat loaded on direct, production jobs. Thus, in developing a truly general, cross-job taxonomy, it would seem desirable to consider the results obtained in efforts intended to capture the dimensions that are useful in summarizing managerial, in addition to production, work.

The following empirically derived managerial taxonomies were used to guide selection of dimensions for the supervisory portion of the GWA descriptors: Flanagan's (1951) summary dimensions from his critical incident study of Air Force officers; Williams' (1956) taxonomy of executive performance, also derived from critical incident research; Hemphill's (1960) executive job dimensions, derived from a factor analysis of responses to a job analysis questionnaire; the Tornow and Pinto (1976) managerial taxonomy, also based on factor analyses of responses to a job analysis questionnaire; Mitchell's (1978) dimension system for professional and managerial jobs resulting from factor analyses of responses to the Professional and Managerial Position Questionnaire (PMPQ); Yukl's (1987) integrating taxonomy of managerial behavior; and the Borman and Brush (1993) taxonomy of managerial "mega-dimensions" developed by summarizing all of the above dimensions, as well as other empirically derived dimensions, using an empirical clustering of expert judgments of the structure of these dimensions.

A brief review of the above-cited research efforts is presented below:

Flanagan (1951) gathered more than 3000 critical incidents of effective or ineffective Air Force officer performance. A content analysis of these incidents suggested a 6-dimension system of officer performance requirements. These dimensions were labeled: Handling Administrative Detail; Supervising Personnel; Planning and Directing Action; Accepting Organizational Responsibility; Accepting Personal Responsibility; and Proficiency in Specialty.

Williams (1956) likewise used the critical incident technique to build a managerial taxonomy. He interviewed 742 executives from several manufacturing companies, and asked them to provide incidents contrasting effective and ineffective performance. More than 1,800 incidents were generated in the interviews, and a sorting of the incidents led to six general requirement categories, in turn subdivided into a total of 82 specific performance dimensions. The general categories were named: Planning, Organizing, and Execution of Policy; Relations with Associates; Technical Competence; Coordination and Integration of Activities; Work Habits; and Adjustment to the Job.

The goal of Hemphill's (1960) research was to identify "concepts" useful for describing executive positions. He developed a job analysis questionnaire consisting of 575 "position elements," statements descriptive of executive positions. Ninety-three executives in five industrial companies completed the questionnaire, and a factor analysis of their responses yielded a 10-factor solution. The factors were titled: Providing Staff Service; Supervision of Work; Internal Business Control; Technical Performance; Human, Community, and Social Affairs; Long-Range Planning; Exercise of Broad Power and Authority; Business Reputation; Personal Demands; and Preservation of Assets.

Tornow and Pinto (1976) conducted research similar to Hemphill's. They developed a structured job analysis questionnaire containing 197 items, administered the questionnaire to approximately 500 managers in six organizations and factor analyzed the item responses. Thirteen orthogonal factors emerged from this analysis: Product, Marketing, and Financial Strategy Planning; Coordination; Internal Business Control; Products and Services Responsibility; Public and Customer Relations; Advanced Consulting; Autonomy of Action; Approval of Financial Commitments; Staff Service; Supervision; Complexity; Advanced Financial Responsibility; and Broad Personal Responsibility.

Mitchell's (1978) dissertation research involved developing a generalized job analysis questionnaire; the managerial and professional analog to the PAQ. The resulting *Professional and Managerial Position Questionnaire (PMPQ)* had 93 items. He administered the PMPQ to 249 managers and other professional job incumbents from 45 organizations. A factor analysis of their responses yielded a 10-factor solution, nine of which pertained to job activities. The factor labels were: Personal Development; Planning and Scheduling; Decision Making/

Problem Solving; Technical Activities; Processing of Information and Data; Interpersonal Activities; Communicating/Instructing; Responsibility; and Personal Qualities.

Yukl (1987) has also developed what he calls an integrating taxonomy of managerial behavior dimensions. Combining results from his own analytic studies of manager behavior and a number of other taxonomies, Yukl listed 13 "mid-range" dimensions that he argues integrate his and others' theoretical and empirical contributions. His dimensions are: Supporting; Consulting and Delegating; Motivating Task Commitment; Recognizing and Rewarding; Harmonizing and Team Building; Planning and Organizing; Problem Solving; Informing; Clarifying Roles and Objectives; Developing; Monitoring Operations; Representing; and Interfacing.

Finally, a study in the managerial performance literature by Borman and Brush (1993) also seemed appropriate in guiding selection of dimensions for the supervisory portion of the generalized work activities. In this study, empirically derived dimension sets and their definitions were first sought from I/O psychologists working in or consulting with private, public, or educational organizations. A total of 19 dimension sets and 192 dimensions in all were contributed from unpublished critical incident studies or similar empirical research focused on supervisors or managers. In addition, seven more dimension sets, each with definitions, emerged from published literature (54 additional managerial dimensions, including the dimensions from the taxonomies just discussed). After eliminating the multidimensional dimensions and the few that were not understandable, 187 defined dimensions remained.

Next, 25 I/O psychologists independently sorted the 187 dimensions into 9-26 mega-dimensions according to similarity in content. Borman and Brush then used the Rosenberg and Sedlak (1972) procedure to pool these 25 "solutions" into a single 187 x 187 correlation matrix. The matrix was factor analyzed and a very interpretable 18-factor solution emerged. The dimension labels are as follows: Planning and Organizing; Guiding, Directing, and Motivating Subordinates; Training, Coaching, and Developing Subordinates; Communicating and Keeping Others Informed; Representing the Organization to Customers and the Public; Technical Proficiency; Administration; Maintaining Good Working Relationships; Coordinating Subordinates and Other Resources; Decision Making; Problem Solving; Staffing; Persisting to Reach Goals; Handling Crises and Stress; Organizational Commitment;

Monitoring and Controlling Resources; Delegating; Selling/Influencing; and Collecting and Interpreting Data.

All of these dimension systems and taxonomies were seen as very useful in contributing to the supervisory/managerial part of the GWAs. The Borman and Brush dimension system was especially appealing as a source of GWAs because it represents a summary of all of the other managerial taxonomies in addition to other empirical studies of managerial performance across a variety of managerial levels and types of organizations.

Other job analysis taxonomies of performance. The following additional dimension sets were reviewed as potential sources of GWAs: The Dowell and Wexley (1978) taxonomy of first-line supervisor job attributes; Outerbridge's (1981) summary clusters of activities related to professional level government employees; O'Leary, Rheinstein, and McCauley's (1989) updated listing of these professional jobs' activity dimensions; the Campbell, McCloy, Oppler, and Sager (1993) categories from their comprehensive model of job performance; a summary dimension list from a study intended to identify and summarize general performance requirements for all non-managerial jobs in the U.S. economy (Borman, Ackerman, Kubisiak, & Quigley, 1994); competency dimension systems developed by the U.S. Office of Personnel Management (1991) for managerial, professional, and administrative occupations; activities from the National Job Analysis survey (American College Testing, 1993); and work on SCANS (Peterson, 1994), an effort to summarize job activities across a wide variety of jobs in the U.S.

Dowell and Wexley (1978) administered a 100 work activity survey (the Supervisor Task Description Questionnaire) to 251 supervisors who were responsible for such functions as production, maintenance, shipping, and housekeeping in 40 plants. Factor analyses of the survey responses yielded seven dimensions: Working with Subordinates; Organizing Work of Subordinates; Work Planning and Scheduling; Maintaining Efficient/Quality Production; Maintaining Safe/Clean Work Areas; Maintaining Equipment and Machinery; and Compiling Records and Reports.

Outerbridge (1981) extracted from the DOT 223 duty statements that were relevant to 24 populous Federal professional and administrative occupations. She had psychologists and occupational analysts sort the statements into categories according to similarity of content.

Outerbridge summarized all of these sorting solutions, resulting in a 32-cluster system. A few examples from the system are: Prepares budget; Purchases or contracts for services or supplies; and Conducts interviews to screen persons.

O'Leary, Rheinstein, and McCauley (1989) provided an update to Outerbridge's work. They first reviewed the Office of Personnel Management's Classification and Qualification Standards for each of 113 professional and administrative occupations and identified the 10-15 major duty statements for each. Then four psychologists independently sorted the 1,400 or so duty statements into Outerbridge's 32 clusters. For many of the statements, there was good agreement about where in the 32-cluster system the statements belonged. However, a total of 25 additional generalized activities were identified by these sorters, so the final O'Leary et al. system contained 57 activity dimensions.

Both the Outerbridge (1981) and O'Leary et al. (1989) dimension sets are at a high level of specificity, more specific than what was intended for the GWA taxonomy. Nonetheless, these were seen as good sources for ensuring that all of the activities represented in these systems were reflected somewhere in the final GWA set of constructs.

Campbell and his colleagues (Campbell, McCloy, Oppler, & Sager, 1993) developed a summary 8-dimension model intended to be comprehensive in the sense that the dimensions are appropriate for *all jobs*. More precisely, all performance requirements for any job should be represented in the eight (or a subset of the eight) dimensions. The performance model is derived in part from research in the U.S. Army's Project A (e.g., Campbell, 1990), where confirmatory factor analyses of performance data on a wide array of performance measures for a variety of Army jobs consistently suggested a 5-factor solution: Job-Specific Technical Proficiency; General Technical Proficiency; Effort; Personal Discipline; and Military Bearing. Campbell et al. dropped Military Bearing because of its narrow focus and added Communication; Facilitating Peer and Team Performance; Supervision/Leadership; and Management/Administration, resulting in the 8-dimension model.

Borman, Ackerman, Kubisiak, and Quigley (1994) conducted a study intended to develop performance rating scales that could be used to evaluate performance in any non-managerial job in the U.S. economy. Accordingly, the dimensions that they developed, by definition, were intended to be generalized work categories. To generate these dimensions, Borman et al.

conducted workshops with a total of 81 first line supervisors in a wide variety of industries and organizations. Workshop participants were asked to think about the performance behavior that separates effective from ineffective employees. They then recorded a dimension label and a definition for each dimension. They were instructed to identify dimensions that would be relevant not only to jobs they had supervised, but also to a wide variety of non-management jobs, preferably *any* non-management job in our economy. More than 500 dimensions were generated in these workshops. After eliminating redundancies and 30-40 dimensions Borman et al. could not understand, 176 dimensions were selected to be representative of the themes found in the content of the entire pool of dimensions.

The next step was to have 12 I/O psychologists independently sort the 187 dimensions into 8-13 mega-dimensions according to similarity in content, and then Borman et al. summarized these "solutions" using a pooling procedure that results in a single correlation matrix (Borman & Brush, 1993; Rosenberg & Sedlak, 1972). The matrix was factor analyzed and a highly interpretable 12-factor solution emerged. The dimensions are: Job Knowledge; Task Proficiency; Effort and Productivity; Judgment and Problem-Solving; Organization; Communication; Safety; Initiative; Adaptability; Dependability; Cooperation; and Integrity/Professionalism.

It should be observed that the Campbell et al. and Borman et al. taxonomies are not necessarily intended to reflect GWAs. They represent *performance requirements*, dimensions that should differentiate between effective and ineffective performance. Accordingly, some of these dimensions are not appropriate for a GWA taxonomy (e.g., Initiative, Cooperation). Nevertheless, some of the other dimensions in these systems were thought to be more useful for a GWA taxonomy (e.g., Communication, Organization, and Judgment/Problem Solving).

Three other major job analysis data collection efforts were reviewed for purposes of identifying constructs that should be included in the GWA framework. One source was the Multipurpose Occupational Systems Analysis Inventory—Close Ended (MOSAIC) prepared by the U.S. Office of Personnel Management (1991). This questionnaire was administered to managerial, professional, and administrative employees who work in the Federal government. The second source was the National Job Analysis Study Work Activities Survey, developed by American College Testing (1993) as part of an overall program to develop an understanding of workplace skills common across a wide spectrum of occupations, and to use that understanding in building content-valid assessment questionnaires of those skills. Finally, we reviewed the skills taxonomy proposed by the Secretary's Commission for Assessing Necessary Skills (SCANS), which seeks to describe jobs in terms of skills, or person requirements. Skills, of course, develop, in part, as a function of the kind of work activities people are asked to perform. As a result, the linkages, or relationships, observed between a proposed set of generalized work activities and these skills might provide some additional evidence for the meaningfulness of the generalized work activities identified through our synthesis of prior factor analytic studies. The SCANS work also, of course, contributed to the specification of cross-functional skill requirements discussed in Chapter 3.

The Lower Order GWA Taxonomic Structure

In the next section of this chapter, a complete description of each GWA and its development is provided so that the reader will have a comprehensive understanding of how the GWAs were identified and defined. However, in advance of the descriptive information, we present the taxonomic model that integrates the final set of 42 GWAs. The taxonomies are presented in Figures 6-3 through 6-12. Figure 6-3 presents the higher order structure of the GWAs including the highest level of four S-O-R components and the nine higher order GWAs that were derived from them. Figures 6-4 through 6-12 expand upon each of the higher order GWAs, revealing their lower order constituent GWAs. Considered collectively, this set of figures defines the hierarchical GWA model we are proposing.

We believe that our selection of the lower order GWA taxonomic structure as a guide to the development of the GWA questionnaire is consistent with the principles expressed by Cappelli (1995) in his discussion of the conceptual issues underlying a system for classifying occupations. Cappelli states that the choice of a classification scheme should consider the number and importance of propositions that can be made. We believe our system will be especially responsive and we discuss the various potential propositions in the last section of this chapter. Cappelli also contends that the classification system selected should reflect some underlying theory and demonstrate stability and robustness. We have carefully reviewed the theoretical and taxonomic arguments set forth by the prominent job analysis researchers of the last three decades and have extensively relied upon their findings to create our GWAs. A comprehensive discussion of the research findings and interpretations underlying our GWAs is presented in the section that follows. In addition, the figure in Appendix 6-A provides a cross-walk portraying the relationship between our 42-dimension taxonomy and each of the other taxonomic systems just discussed. Each "X" in the figure indicates a match between our GWA and the other system according to the judgments of the chapter authors.

Overview of GWA development strategy. In the preceding sections we have reviewed a variety of taxonomies of generalized work activities. Some of these taxonomies represent rather broad organizing frameworks, as in the higher order taxonomies. Others represent more narrow, but nonetheless cross-job variables, that might be used to describe people's work activities. The question that arises at this juncture is rather straightforward. How might we synthesize these dimensions to create a comprehensive taxonomy of people's work activities? In this section extant literature will be used to develop such a taxonomy and link the resulting lower order generalized work activities to a broader set of higher order variables.

As indicated previously, a number of taxonomic structures and job analysis research efforts were examined to develop both a model for the GWA constructs as well as the definitions and rating scale levels for each individual GWA to be included in the O*NET. The researchers began by selecting the GWA constructs using several criteria:

- The construct should have a foundation in one or more research efforts
- The construct should have definitive underlying content that, for GWAs derived from factor analyses of job analysis data, was determined by examining the content of individual items with significant factor loadings on the factor of interest
- The constructs as a set should be comprehensive, as much as possible reflecting work activities of all jobs in the U.S. economy
- The constructs provide unique descriptive information.

By following such a strategy, we also addressed the matter of specificity. The taxonomic structures presented earlier indicate that GWAs could be expressed at a very broad level of generality or at successively narrower levels across the specificity-generality continuum. Clearly, the analysis of work at a more specific level will yield occupational information at a finer level of differentiation. Because we believe the GWAs can act as stand-alone sources of occupational information that can be used to derive meaningful outputs for human resource management, we have selected a level of specificity that is consistent with the research findings for comparable sets of GWAs.

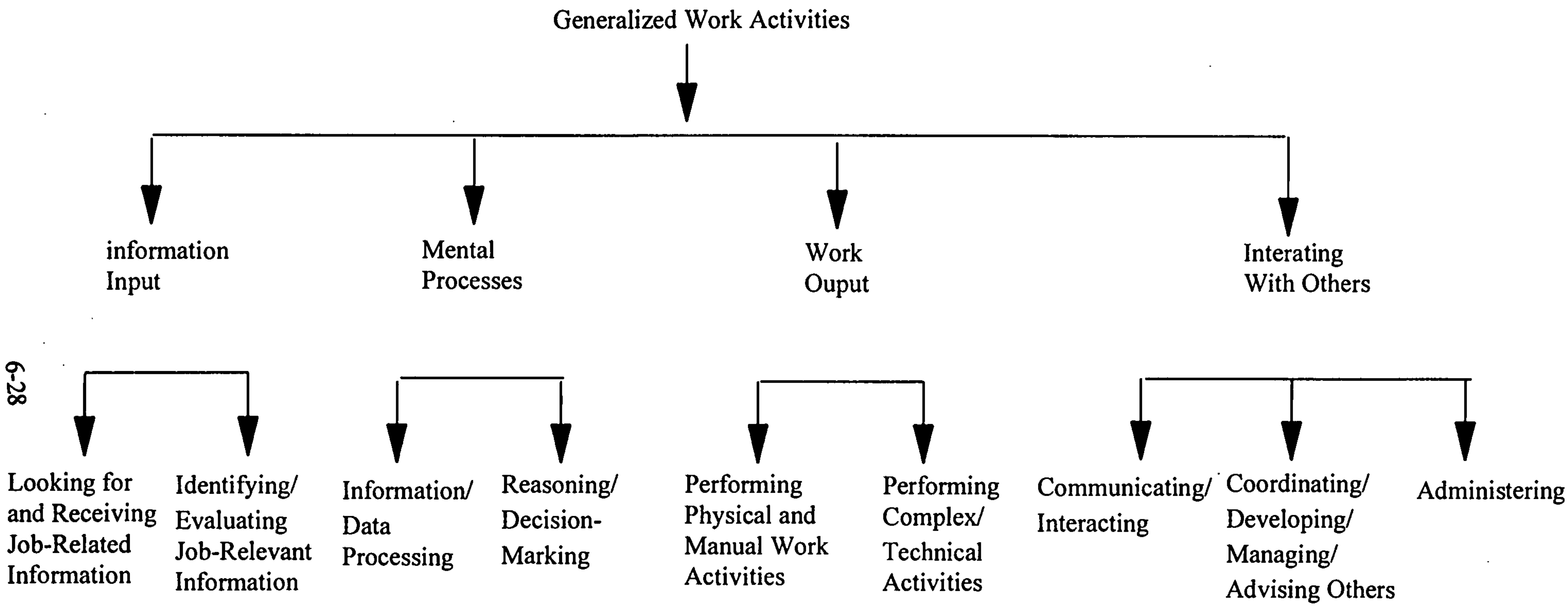


Figure 6-3

Higher Order Generalized Work Activities Hierarchy

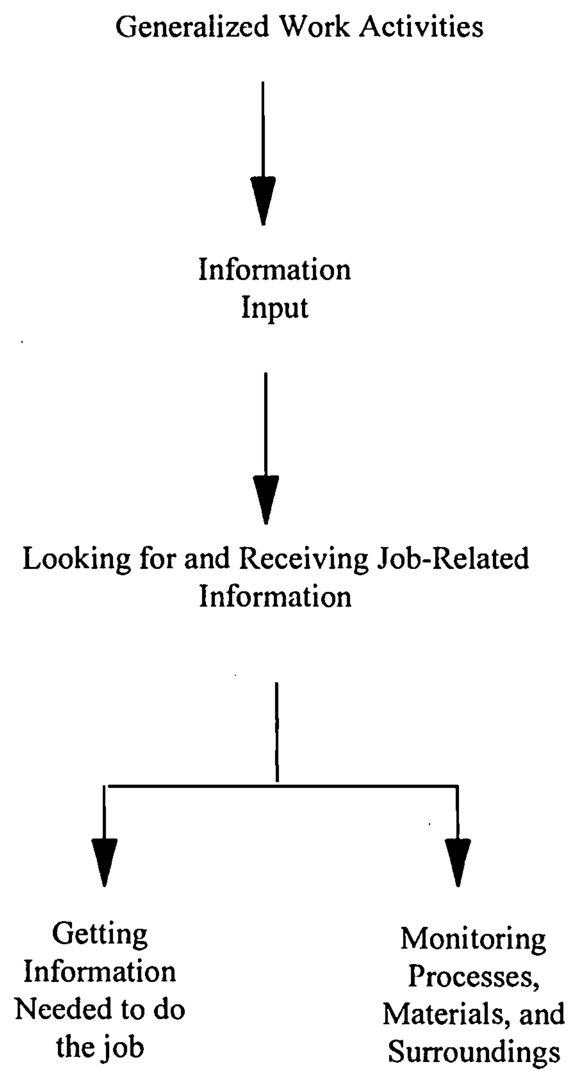


Figure 6-4
Looking for and Receiving Job-Related Information Hierarchy

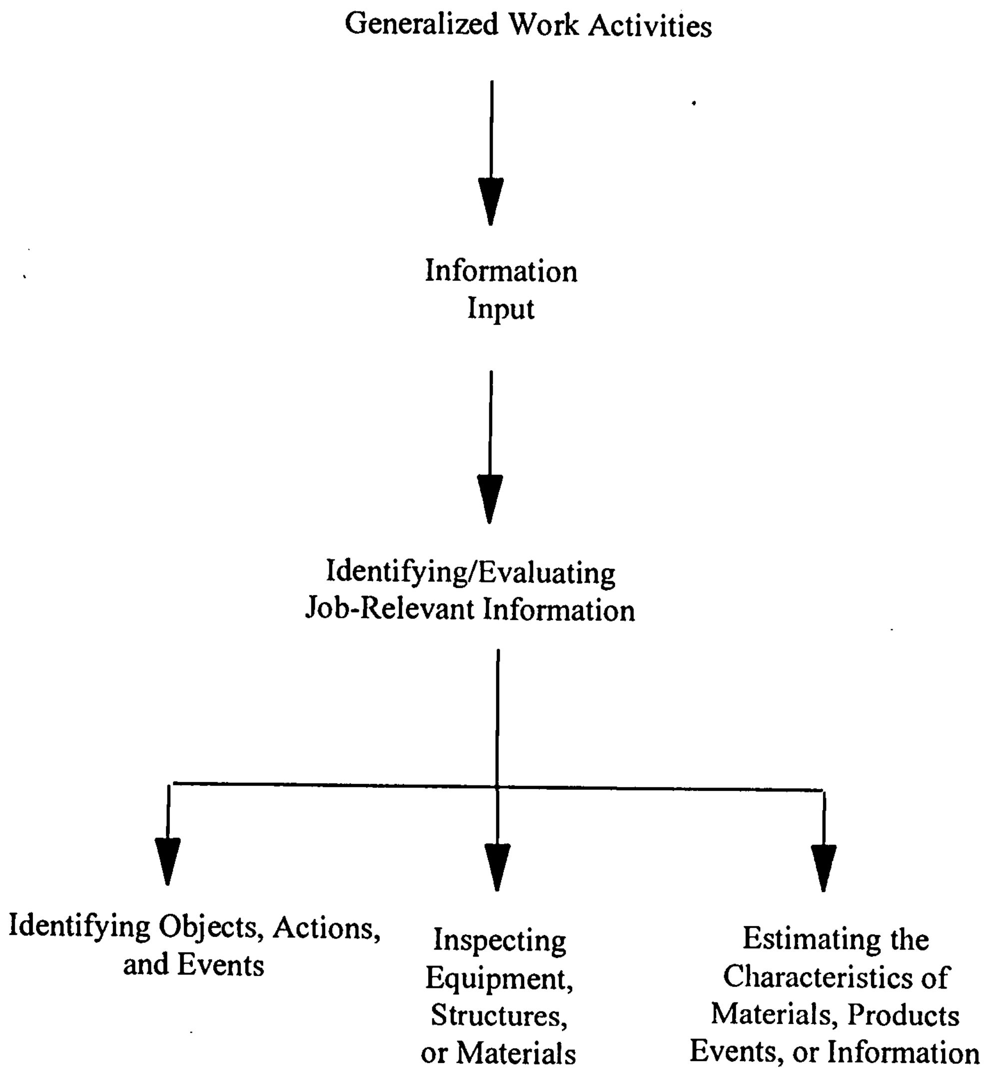
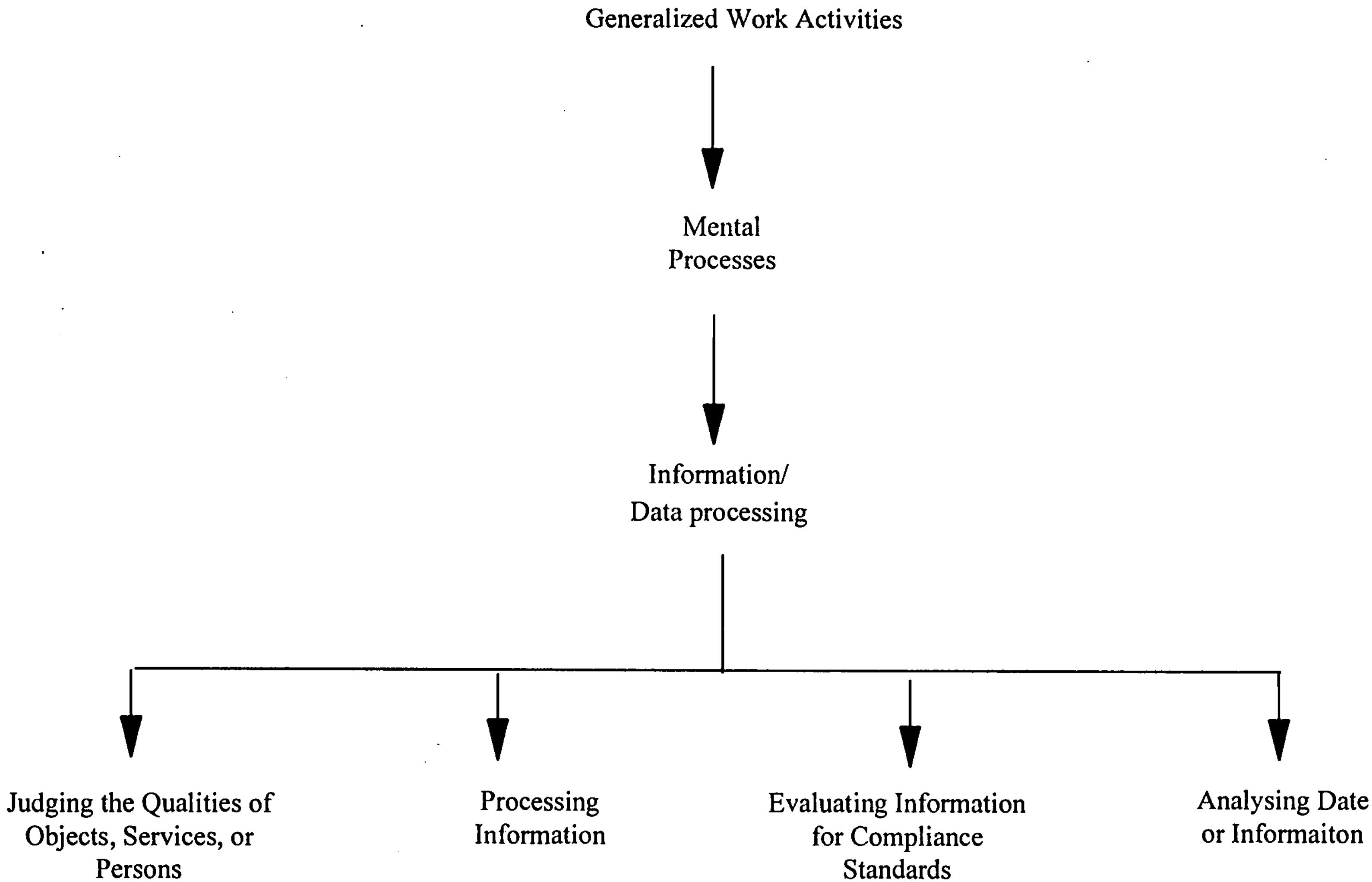


Figure 6-5
Identifying/Evaluating Job-Relevant Information Hierarchy



292

291

Figure 6-6
Information/Data Processing Hierachy

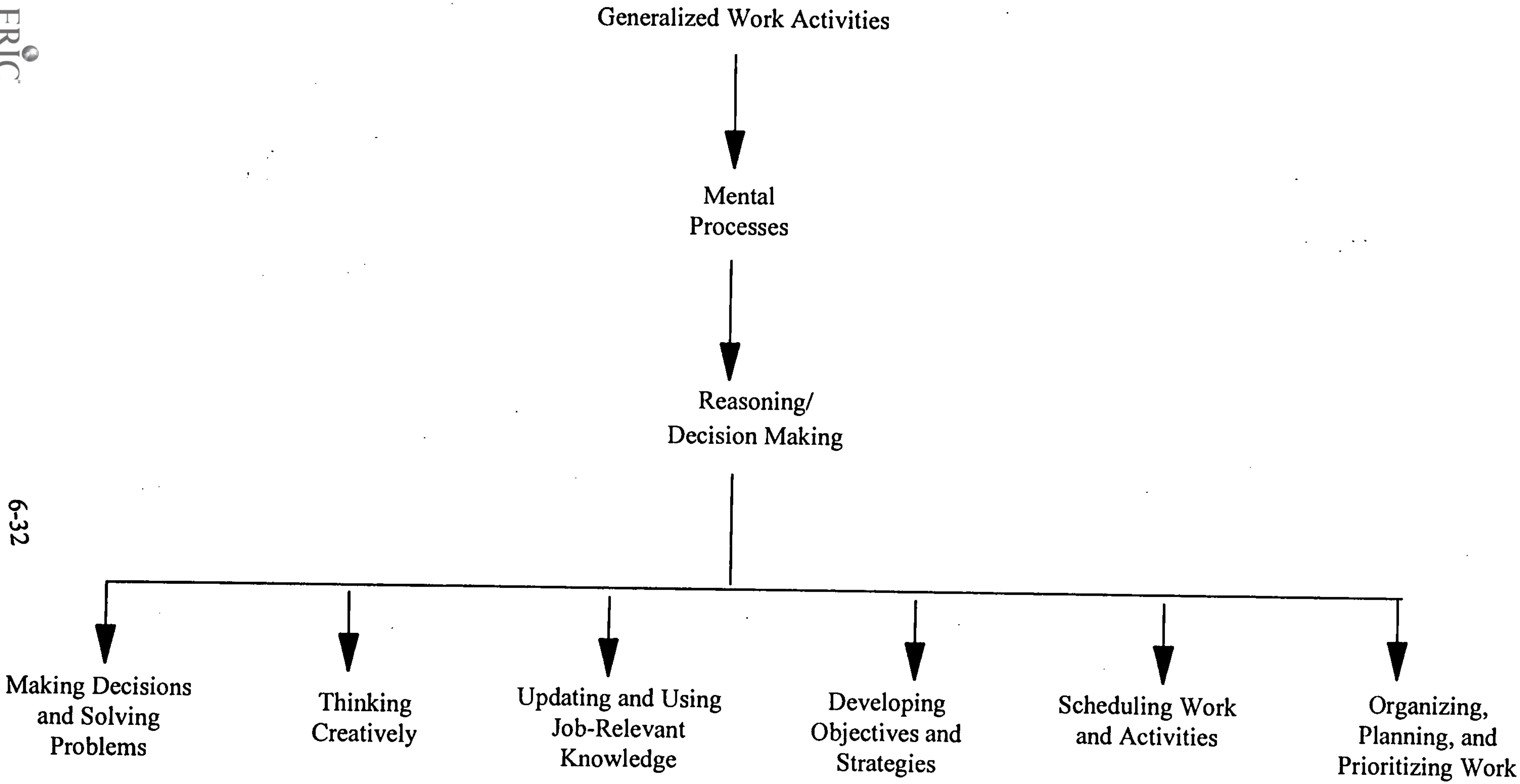


Figure 6-7
Reasoning/Decision-Making Hierarchy

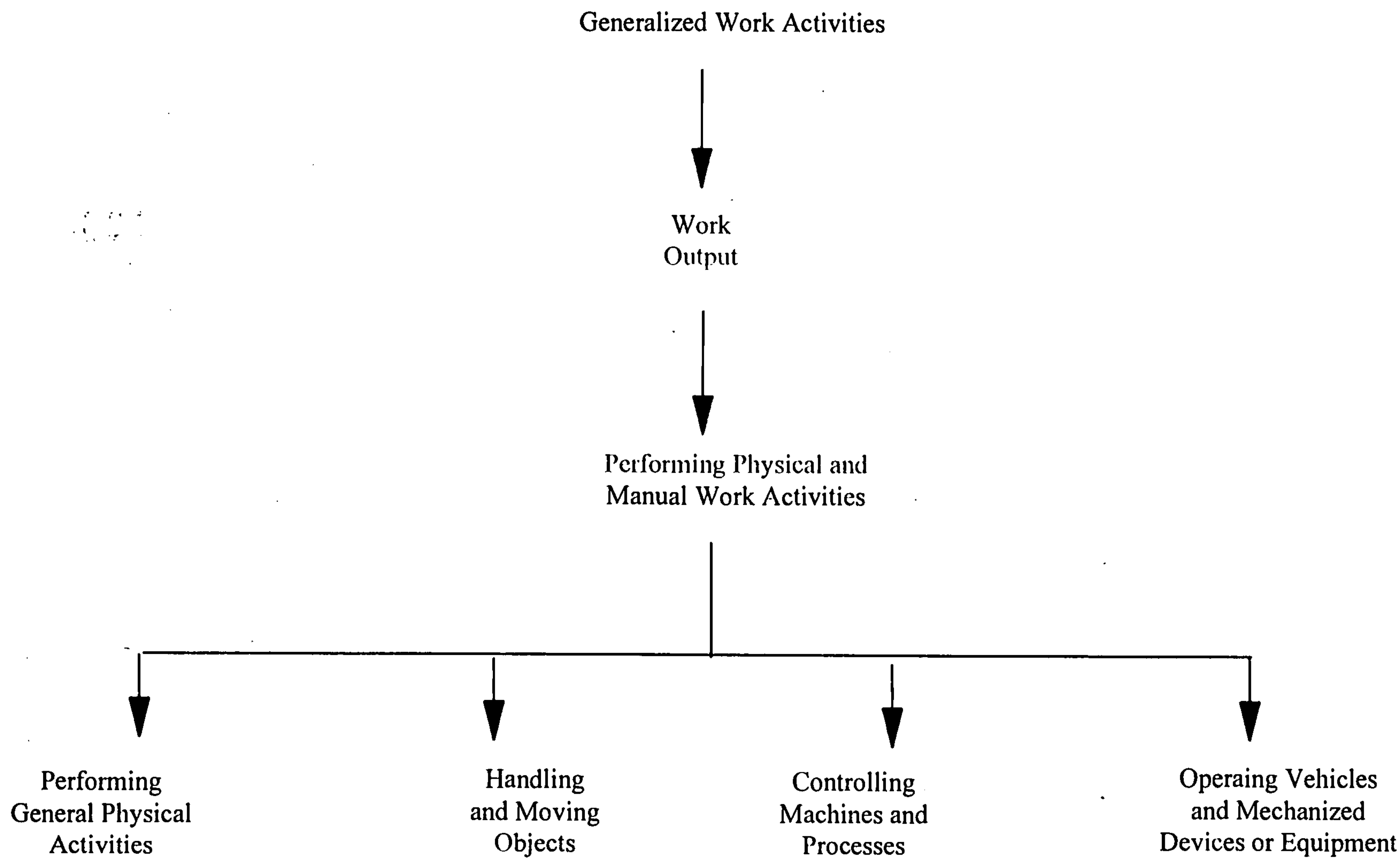


Figure 6-8
Performing Physical and Manual Work Activities Hierarchy

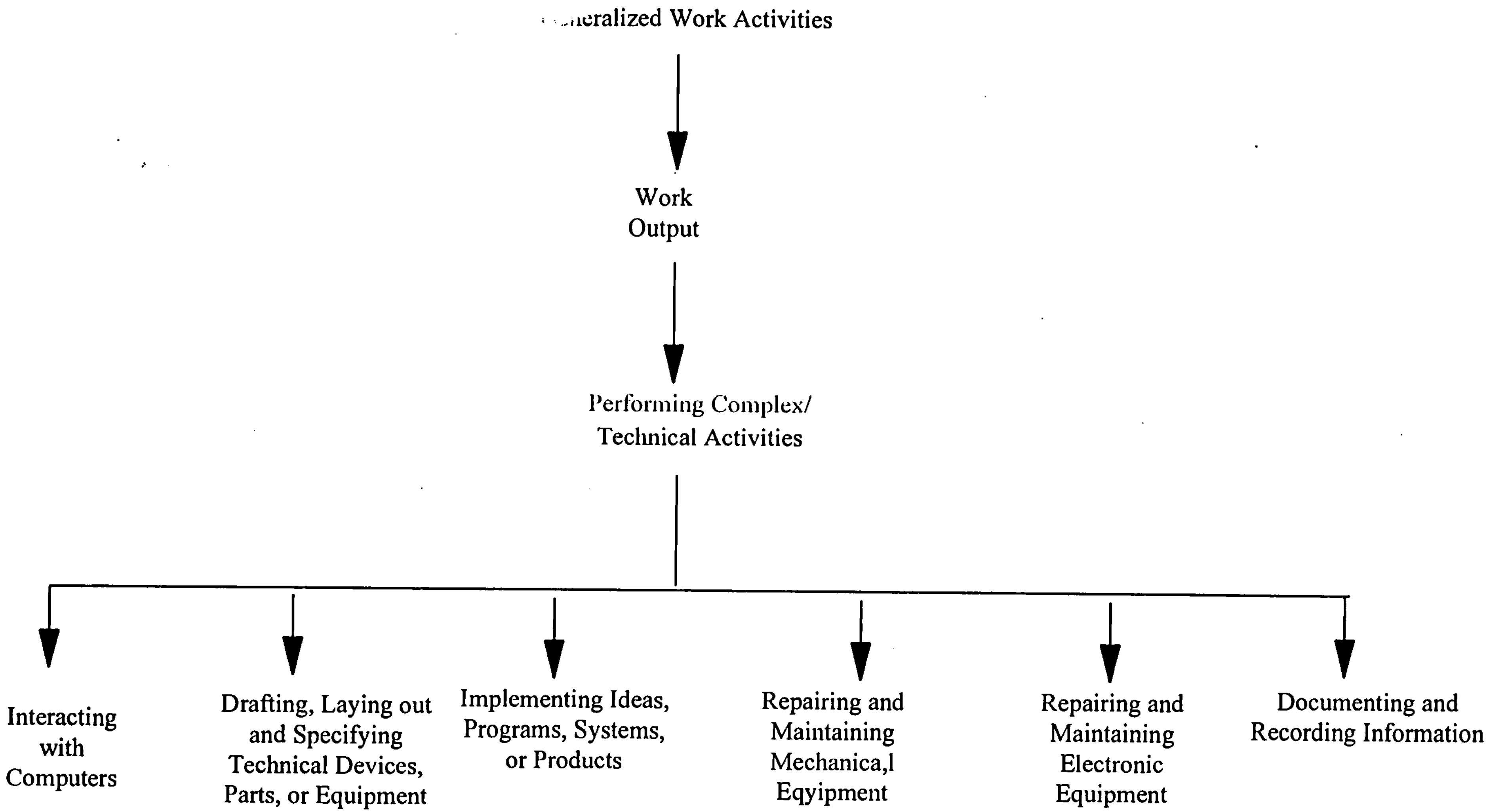
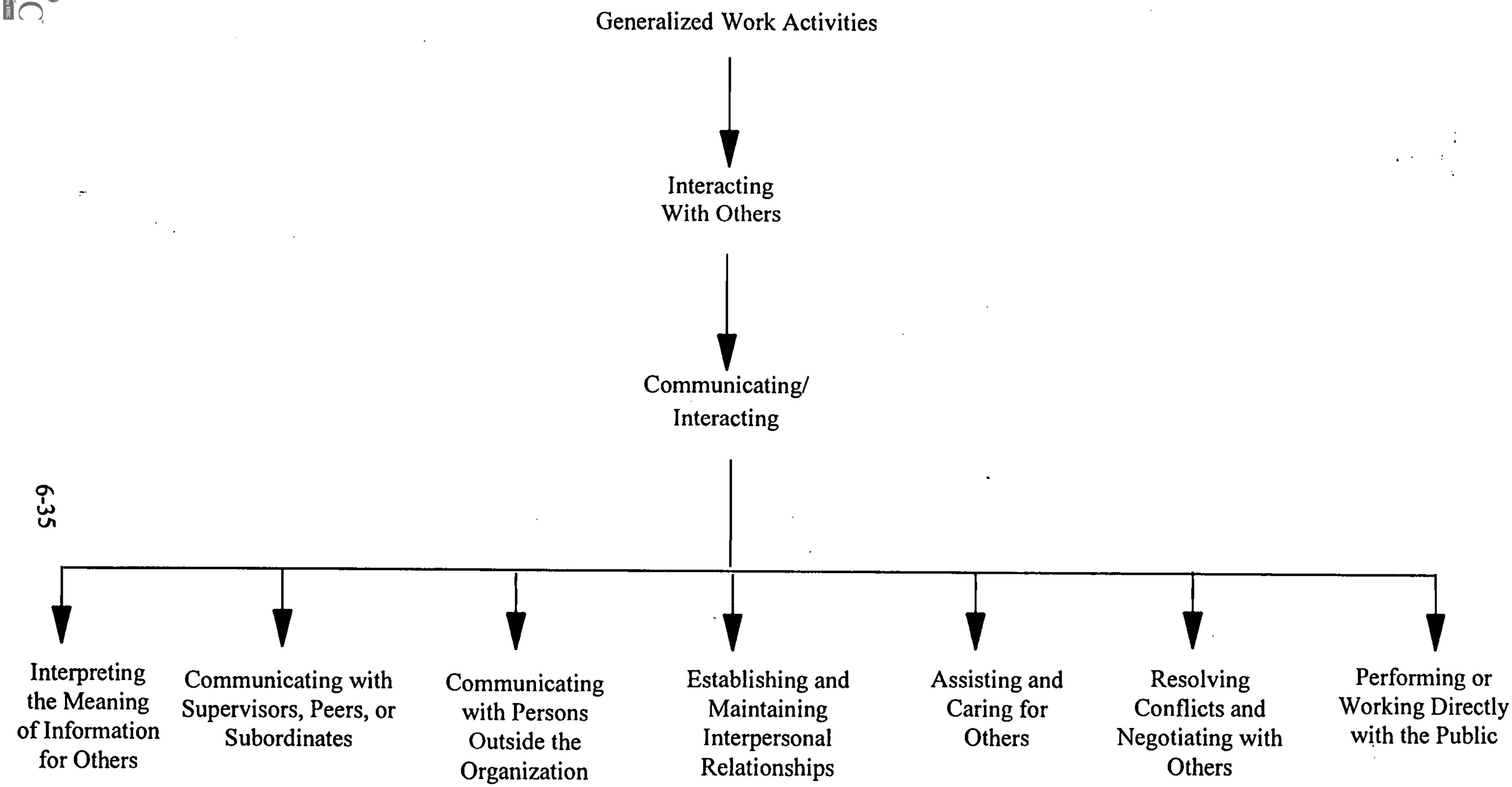


Figure 6-9
Performing Complex/Technical Activities Hierarchy



299

300

Figure 6-10

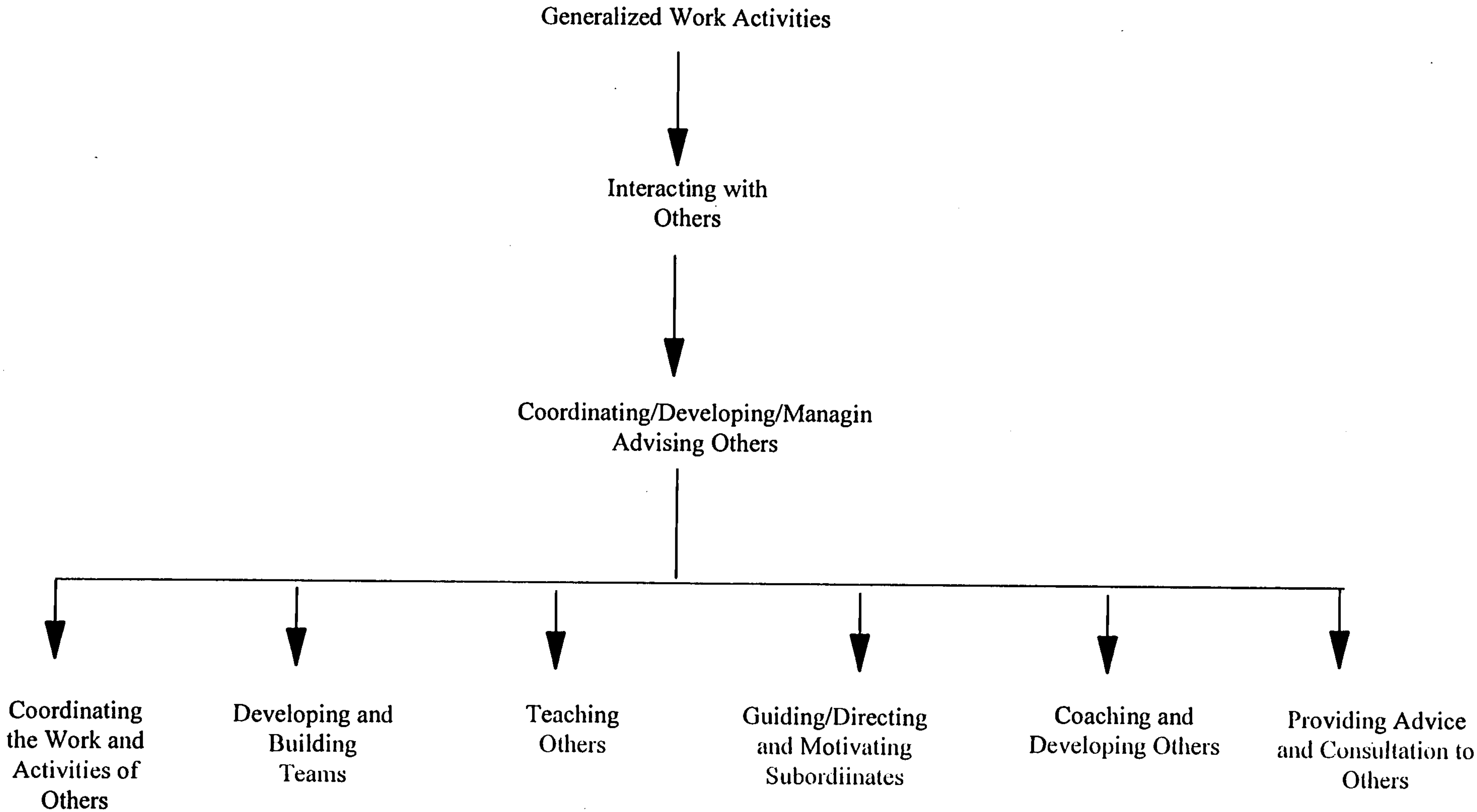


Figure 6-11
Coordinating/Developing/Managing/Advising Hierarchy

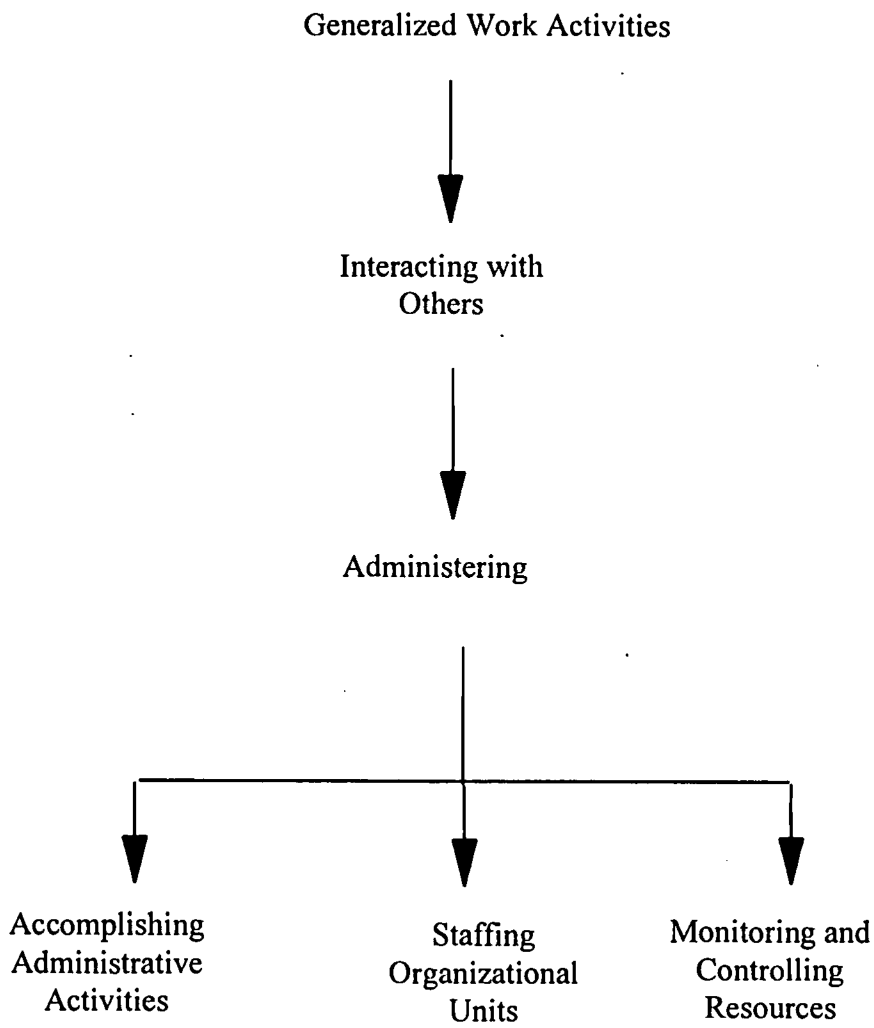


Figure 6-12
Administering Hierarchy

Once an initial set of GWAs was developed, we expanded our search to be sure that we had captured constructs that were included in other job analysis systems, or ones that we believed would be relevant to understanding work as it evolves in the next century. Consequently, there are a few GWAs that are not well grounded in past research, but seem to have strong likelihood for measuring work content that is more often found in high performance organizations or will become more prevalent in the future.

The following procedures were used to complete the definitions and rating scales for the GWAs. Initially, item working definitions were prepared by the researchers and, after refinement, these became the technical definitions that are provided for each GWA construct in the materials that follow. ***[Please note that the technical definition is <u>not</u> the same as the working definition ultimately created for each GWA, but rather is the researchers' full explanation of the content of the GWA.]*** A GWA's definition evolved from the titles and definitions given to the factors or dimensions by their original researchers/authors. Further, the content of the factors/dimensions was considered by examining the items with high factor loadings, when factor analysis data were available, to give further clarity to the definition. Finally, after a pilot trial of the GWAs, the construct labels and definitions were simplified so that they could be understood by most job incumbents throughout the world of work. The GWAs in terms of their final content are presented in Appendix D in Volume II.

The rating scales and their anchors also were based on information contained in the research studies relied upon for identification of the GWA constructs. The first scale selected to use in rating the GWAs was that of complexity. As pointed out by Cain and Treiman (1981), as well as Hunter (1983, 1986), complexity is a major influence on job performance and clearly delineates one type of job from another within the same occupational domain. In many instances, the research studies consulted reported on specific jobs that were high, medium, or low with respect to the degree of complexity of that construct or the extent to which the construct was required of job incumbents. In most cases, the intent has been to demonstrate the complexity of a GWA as it occurs *across* the domain of work. Hence, the level scale is a rating that reflects "across-jobs" rather than "within-a-job" complexity. The major work activities associated with those jobs identified in research studies as being representative of the GWA construct of interest were incorporated into the level anchors. In instances where such research information was not available, the developers relied upon their considerable job analysis experience to create the level definitions and representative job activities.

We also determined that it would be especially meaningful if the importance of each GWA were documented as part of the job analysis process. The importance scale is a "within-job" rating and does not attempt to compare the importance of the GWA relative to the GWAs of other jobs across the occupational domain. Finally, the frequency with which a GWA is performed has often been used as an indicator in job analysis and was incorporated as a separate rating scale. From a data analysis perspective, the most meaningful index is an absolute rather than relative frequency scale, and therefore the scale selected employs a variant of Harvey's (1991) modified absolute time spent scale.

Description of the GWAs. Presented below is a description of the 42 GWAs selected for inclusion in the prototype O*NET. For each GWA relevant research literature is cited and a technical definition is given that summarizes the meaning of the construct.

1. Getting information needed to do the job. The primary origin of this GWA is from the equivalent job dimensions associated with the PAQ and the JEI. Research by Harvey et al. (1988), Marquardt and McCormick (1973), McCormick et al. (1977), and Jeanneret (1987) found that the principal sources of information to a worker (i.e., verbal, quantitative, pictorial, and the observed behavior of others) formed a composite that consistently occurs across the domain of work. The dimension represents circumstances in which workers depend upon these various sources of information in the performance of their jobs. In the Harvey et al. (1988), Jeanneret (1987), and McCormick et al. (1977) research, the dimension was labelled Using Various Sources of Information, while Marquardt and McCormick (1974) found a very similar dimension and named it Input from Representational Sources. Also, Marquardt and McCormick (1973) found a somewhat narrower dimension labelled Verbal/Auditory Input/Interpretation. However, as described previously, the 1973 Marquardt and McCormick study factor analyzed the attribute ratings assigned to PAQ elements and not job data. Consequently, some difference in the dimension structure (and hence the label assigned) is not unexpected from the analysis of this different database. Finally, several of the ACT items and certain SCANS skills, related to reading and otherwise gathering information, provide a good match with this GWA.

The technical definition prepared for this GWA is as follows:

> Observes, receives, and otherwise obtains information from written documents, numbers, displays, graphics, products, people, and other relevant sources.

2. Monitoring processes, materials, or surroundings. This GWA represents a combination of two job dimensions that have been identified in research with the PAQ and JEI. It also has some similarity to a factor labelled Electrical/Electronic, Mechanical, and Engineering Information derived by Cunningham et al. (1990) from their use of the GWI in analyzing U.S. Air Force enlisted occupations. Within the context of the PAQ and JEI, two dimensions have emerged: one has focused on visual input, specifically from a designated source (i.e., a device or machine); the second is more generic in scope and recognizes that workers must be aware of their environment. Harvey's 1987 reanalysis of the PAQ data found a combination of using the senses and gaining information from tools in the work place. In the Harvey et al. (1988) research, the two dimensions were labelled Visual Input and Environmental Awareness. Jeanneret (1987) and McCormick et al. (1977) labelled the dimensions Watching Devices/Materials for Information and Being Aware of Environmental Conditions. Marquardt and McCormick (1973, 1974) found the identical dimension when using either job or attribute data and labelled it Visual Input from Devices/Materials. Only when factor analyzing job data did Marquardt and McCormick (1974) find a dimension they labelled Environmental Awareness. In all of these research studies, as well as in the Dowell and Wexley (1978) research that emphasized maintaining quality production, the content of these dimensions seemed to imply observing or being alert to machines, tools, processes, and events that occur in the work place. Finally, several ACT monitoring items share this GWA's content as does one of the SCANS skills.

The technical definition for this GWA is as follows:

> Monitors and reviews information from equipment, devices, finished materials and materials in process, events, and the relevant features of the environment. Often this is done to detect changes, to find out when things are finished, or to be aware of circumstances in the work environment.

3. Identifying objects, actions, and events. The primary origin of this GWA is identical to that of the Getting Information GWA, as described previously. McCormick et al. (1977) and PAQ Services (1990) noted that the dimension describes situations in which the worker typically identifies and interprets information that is received by the various sensory mechanisms, particularly vision, hearing, and touch. Marquardt and McCormick (1974) stated that this dimension made the distinction that the worker "evaluated" information, rather than just received it. They labelled the dimension Evaluation of Sensory Input. In earlier research, Marquardt and McCormick (1973) noted that the dimension, when derived from attribute ratings of PAQ elements, also required the worker to recognize and evaluate to some extent the information being received from various processes or events taking place in the work environment. This was a finding replicated by Harvey (1987) in his reanalysis of the original PAQ data and reporting of a factor he labelled Visual/Auditory/Sensing/Judging. In the Harvey et al. (1988), McCormick et al. (1977), and Jeanneret (1987) research, the dimension was labelled Interpreting What is Sensed; Marquardt and McCormick (1973) labelled the dimension Perceptual Input from Processes/Events. In the ACT questionnaire, at least two items reflect the content of this GWA, as does one of the SCANS skills.

The technical definition for this GWA is as follows:

> Locates, identifies, interprets, evaluates, or judges information about one's own work or the work of others. The source of this information could be materials, processes, events, or the actions of one or more persons. The interpretation of information seen, heard, or otherwise received may include making categorizations, recognizing differences or similarities, and understanding circumstances or events.

4. Inspecting equipment, structures, or materials. This GWA has its primary origin in the factor analytic research of Cunningham and his associates. In studies by Boese and Cunningham (1975) and Cunningham et al. (1990), they identified factors that were specific to obtaining information from Electrical, Electronic, and Mechanical Equipment and Devices. Further, the content of the factors focused on identifying malfunctions, interrelations or interconnections, obtaining readings from testing devices or indicators, and using information from technical drawings or documents. Also, Dowell and Wexley (1978) report on a machine maintenance dimension that emphasizes inspection. It is clear that a well-defined standard is in place for the worker to use in making an inspection. This is somewhat different from the

previous GWA in which monitoring is more of a general awareness or overview of a series of events rather than a specific inspection against a clear cut standard. Outerbridge (1981) was even more specific in her identification of an inspection construct and described the dimension as "....inspects persons, baggage, or other material. Inspection involves at least some physical action by the inspector." And, the ACT list has at least two inspecting items and SCANS describes a relevant skill.

The technical definition for this GWA is as follows:

> Inspects or diagnoses equipment, devices, structures, materials, etc., to identify the causes of errors or other problems or defects.

5. <u>Estimating the characteristics of materials, products, events, or information.</u> Once job-related information is received by a worker, that information is often evaluated by one or more types of estimating processes. The PAQ and JEI are the only nomothetic job analysis questionnaires that incorporate questions regarding estimation, although the ACT questionnaire contains a couple of similar estimation items. Specifically, PAQ and JEI items ask about estimating speeds of moving parts, objects, and processes, and estimating quantity, size, and time. These items, when factor-analyzed, load on one job dimension labelled Evaluating/Judging What Is Sensed (McCormick et al., 1977) or Interpreting.What Is Sensed (Harvey et al., 1988). Marquardt and McCormick (1974) found a similar dimension they labelled Evaluation of Sensory Input when analyzing job data, and a dimension they called Perceptual Input from Processes/Events after further analyzing attribute data (Marquardt & McCormick, 1973). Harvey (1987), in his reanalysis of the original PAQ data, confirmed this dimension and labelled it Estimating/Judging Physical Characteristics of Objects. Jeanneret's 1987 factor analytic study found the same dimension again and used the original label of McCormick et al. (1977). SCANS describes a skill, Acquires and Evaluates Information, that also seems tangentially related to this GWA.

The technical definition prepared for this GWA is as follows:

> Estimates size, distances, quantities, or time; determines the speed of parts, objects, or processes; or estimates the costs, resources, or materials needed to perform a work activity. These estimations do not involve direct measurement.

6. Judging the qualities of objects, services, or persons. This GWA is different from GWA 4 above (Inspecting) in that it is concerned with the appraisal or judgment of value rather than checking against some standard (inspection). Further, inspection is typically a more objective process, whereas appraisal is more subjective in nature, and there often are less measurable, formal, or verifiable criteria to guide the judgment.

This GWA has not appeared as a stand-alone dimension in any of the research reviewed for this study, although the ACT list has a few similar items and SCANS a similar skill. However, items descriptive of judging quality that are part of nomothetic job analysis questionnaires which have been the subject of factor-analytic research typically become associated with factors that include evaluations of sensory input. Further, such factors or dimensions are often very broad in nature and otherwise cannot be associated with specific categories or types of objects, situations, or persons. For example, consider Harvey's (1987) re-analysis of the PAQ and the Harvey, et al., factor analysis of the JEI. In the former research, a dimension labelled Visual/Auditory Sensing/Judging was identified, while in the latter study, two factors emerged that are at least tangentially relevant: Visual/Auditory Sensory Information Judging, and Taste/Odor/Touch Sensory Information Judging. In effect, the results of both studies indicate that the senses of vision, audition, gustation, olfaction, and touch are required to make judgments, but there is no indication as to the specific nature of these judgments or whether the judgments are being made about materials, behaviors (e.g., individuals, crowds, etc.), situations, or the environment (e.g., air quality).

The technical definition for this GWA is as follows:

> Judges condition or quality, or appraises the value of objects and persons.

7. Processing information. Almost every job analysis taxonomic structure includes a factor that describes the processing of job-related information in a wide variety of ways. Further, almost all of the researchers have labelled the dimension Information Processing (e.g., Berliner et al., 1964), or in the terminology of Jeanneret (1987), Marquardt and McCormick (1973; 1974), and McCormick et al. (1977), Processing Information. An overall PAQ dimension called Clerical Activities has also consistently been identified by several researchers (e.g., McCormick et al., 1972). Harvey (1987), after reanalysis of the PAQ data, labelled the dimension Clerical/Information Processing. The research of Cunningham et al.

(1990) identified several "processing" factors that were very job-specific (i.e., Stockkeeping and Bookkeeping; Health-related Information). Further, they found a higher order factor they called Information Compiling Activities. The factor analysis of data obtained with the OAI (Boese and Cunningham, 1975) yielded a divisional factor they named Routine Symbolic and Semantic Information Processing: Clerical Activities. Their factor analysis of the divisional factors resulted in a broader factor they also labelled Clerical Activities. Later research by Cunningham and Scott (1988) reported an overall OAI cluster they named Clerical Activities that included mostly information processing activities. The research of Harvey et al. (1988) with the JEI specified three factors that they associated with information processing: Clerical Equipment Usage; Routine Information Exchange; Processing Quantitative Information. Dowell and Wexley (1978) labelled the dimension Compiling Records and Reports. For managerial job analysis taxonomies, Mitchell and McCormick (1976) used the label Processing of Information and Data, while both Hemphill (1960) and Tornow and Pinto (1976) used a broader term--Staff Service--but the content was primarily information processing. The dimension also appears in SCANS as Prepares Information, in Outerbridge (1981) as Keeps Records and Compiles Statistical Reports, and in the ACT questionnaire.

The technical definition for the GWA Processing Information is as follows:

> Compiles, codes, categorizes, calculates, tabulates, audits, and processes information and data using standardized procedures or guidelines.

8. Evaluating information for compliance to standards. This dimension is likely to be important for some technical and clerical jobs, and for professional positions requiring incumbents to check and interpret completed forms or other more complex information against a set of standards, rules, or guidelines. At the high levels of this GWA, the information and the criteria for compliance may be complex, with substantial interpretation required in determining compliance or correctness.

Evidence for Evaluating Information for Compliance to Standards comes primarily from Outerbridge's (1981) and O'Leary et al.'s (1989) activity dimensions. Five or six of their generalized work behaviors cluster around the concept of compliance. These involve uncovering problems in standard operating procedures, authorizing payment of monies based on regulations and guidelines, reviewing documents for correctness and completeness of data, interpreting and explaining rules and procedures to individuals, and ensuring compliance with or enforcing agency regulations. Similarly, the ACT item set has items related to checking for accuracy.

The technical definition for this GWA is as follows:

> Evaluates information against a set of standards, verifies it is correct, or otherwise checks on its accuracy.

9. <u>Analyzing data or information.</u> Both the GWI and OAI factor analyses yielded factors that are descriptive of this GWA. Cunningham et al. (1990) found a divisional level factor named Numerical/Symbolic Thinking and an overall factor they called Working with Numerical/Symbolic Data. Analyses of the OAI yielded more definitive findings. At the division level, factor analyses yielded dimensions named Analyzing and Synthesizing Information, Semantic Operations, Figural Operations, and Symbolic Operations, and at the cluster level they found two relevant overall clusters: one was labelled Figural Activities and the second was called Cognitive Activities. The item content for all of these dimensions focused on mental processing activities to understand verbal, conceptual, or numerical information. The managerial job analysis of Mitchell and McCormick (1976) identified a somewhat broader factor they labelled Complex Analysis and Communication. Also, Borman and Brush (1993) had a Collecting and Interpreting Data factor. Within the SCANS program, this GWA is most closely associated with a reasoning competency skill. In the Outerbridge (1981) research, the work behavior was described as Analyzes Information and Makes Recommendations Based on Findings. And, the ACT questionnaire contains several analyzing data/information items.

The technical definition for this GWA is as follows:

> Identifies underlying principles, reasons, or facts by breaking down information or data into separate parts.

10. <u>Making decisions and solving problems.</u> This GWA is also reflected in many job analysis taxonomic structures. In the Harvey et al. (1988) research, they reported four categories of decision making in their analysis of U.S. Coast Guard jobs. These decisions

were about people, things, numbers, and medical matters. However, when the researchers examined whether the JEI elements would predict the PAQ decision-making dimension, the correlation was .84, indicating that one decision-making dimension was still able to explain most of the variance in the relevant JEI items. The PAQ-based research analyzing job data has always found a decision-making dimension (Harvey, 1987; Jeanneret, 1987; Marquardt, 1974; McCormick et al., 1977). Cunningham et al. (1990) described two factors derived from the GWI: Semantic Thinking and Object Problem Solving. The Borman et al. (1994) research found a similar construct; a combined Problem Solving/Decision Making dimension. Managerial job analysis taxonomies also have reported a dimension that involves making decisions and solving problems (Mitchell & McCormick, 1976; Baehr, 1988). The ACT list has at least two decision-making items. The SCANS research, along with OPM's work with MOSAIC, identified two separate competencies: Decision Making and Problem Solving. However, we believe there is sufficient research evidence to justify incorporating these two competencies into one GWA.

The technical definition prepared for this GWA is as follows:

> Combines and reasons with information and data to solve problems and make decisions. This involves deciding about the relative importance of information and choosing the best solutions.

11. Thinking creatively. This GWA is an expansion of the GWI factor labelled Aesthetic Thinking (Cunningham et al., 1990) and the factor labelled Aesthetic/Figural Creativity found by Cunningham and Scott (1988) in their factor analysis of the OAI. While creativity has also been part of other job analysis questionnaires (e.g., the PMPQ, ACT's list, and MOSAIC), it has typically been embedded in the information processing and problem solving dimensions rather than standing alone. It is also noted that creative thinking is one of the SCANS competencies.

The technical definition for this GWA is as follows:

> Originates, invents, designs, or creates new applications, ideas, relationships, systems, or products. Creative thinking includes artistic and aesthetic contributions.

12. <u>Updating and using job-relevant knowledge.</u> Virtually all jobs require some level of job knowledge. This GWA involves knowing one's own job duties, functions, and staying current with the job's technical requirements. Although this activity may be relevant to all jobs, the level of the dimension that is required will vary considerably across jobs. Relatively routine, non-technical jobs will not require a great deal of learning, updating, or mastering of information. More complex technical jobs, especially those with rapidly changing technologies, may on the other hand require almost continuous learning to keep sufficiently up-to-date to be able to perform effectively.

This GWA is part of several taxonomies reviewed previously. A PAQ-based dimension, derived from the Marquardt and McCormick (1973) factor analysis of attribute data, yielded a dimension they labelled Use of Job-Related Knowledge. Its content focused on the application of training and education to job accomplishment as well as the cognitive activities typically associated with the use of job knowledge (e.g., problem-solving, decision-making, etc.) Research with both the GWI and OAI yielded more specific rather than general job knowledge factors. For example, the Cunningham et al. (1990) study found 13 factors that were comprised of using information about specific knowledge areas (e.g., health-related, legal, business, plant life and animals, etc.). A similar outcome was reported by Boese and Cunningham (1975) who interpreted 15 such specific knowledge factors. Cluster analysis of the OAI factors (Cunningham & Scott, 1988) yielded a broad Cognitive Activities cluster.

Outerbridge (1981) and O'Leary et al. (1989) offer a related dimension involving gathering and organizing information to become knowledgeable about a technical area. Campbell et al. (1993) distinguish between job-specific and more general knowledge that employees must have to perform their jobs. Both of these dimensions are pertinent for this GWA. Borman et al. (1994) identified a job knowledge category involving knowledge of methods, procedures, and equipment as appropriate for successful job performance. The ACT questionnaire has a "keeping informed" item. Finally, the most closely related SCANS dimension is Understands How System Works. This concept is clearly related to the Updating and Using Job-Relevant Knowledge GWA.

The technical definition for this GWA is as follows:

> Keeps up-to-date technically and knows own job's and related jobs' functions.

13. Developing objectives and strategies. The Developing Objectives and Strategies GWA is different from GWA 15, Organizing, Planning, and Prioritizing Work, in that the present GWA has more to do with long-range and strategic planning, usually for an organization, whereas GWA 15 is focused on organizing and planning one's own work and activities.

This GWA is especially well represented in the managerial taxonomies. Flanagan's (1951) Planning and Directing Action dimension, Williams' (1956) Planning factor, Hemphill's (1960) Long-Range Planning dimension, the Tornow and Pinto (1976) Financial Strategy Planning factor, and Borman and Brush's (1993) Planning and Organizing factor all have components related to this GWA. The MOSAIC system's Planning and Evaluating competency and a setting goals item from the ACT questionnaire are likewise associated with this GWA.

The technical definition for this GWA is as follows:

> Establishes long-range objectives and specifies the strategies and actions to achieve these objectives.

14. Scheduling work and activities. This activity can be distinguished from the Organizing/Planning GWA in that, similar to the difference between GWAs 13 and 15, the latter pertains to organizing and planning one's own work, whereas this GWA has to do with scheduling events or other activities or scheduling the activities of others. In relation to other taxonomies, Outerbridge (1981) has a scheduling dimension in her system, Harvey's planning/scheduling dimension is similar to this GWA, and several ACT items center around scheduling and planning events and other persons' activities. SCANS also describes a skill entitled Allocates Time, that is primarily focused on scheduling work activity. Dowell and Wexley (1978) found that Work Planning and Scheduling was an important supervisor dimension. From the managerial taxonomies, Flanagan's (1951) Planning and Directing Activity, Williams' (1956) Planning, Organizing, and Execution of Policy, Hemphill's (1960) Providing Staff Service, Mitchell's (1978) Planning and Scheduling, and the Planning/Organizing dimensions of Yukl (1987) and Borman and Brush (1993) are relevant.

The technical definition for this GWA is as follows:

> Schedules events, programs, activities, as well as the work of others.

15. Organizing, planning, and prioritizing work. This is another GWA that is likely relevant at some level to virtually all jobs in the U.S. economy. The variation across jobs comes primarily in the level of this activity. Some positions have activities that are often planned and organized by the supervisor, and there may be little prioritizing of work left to the employee. In other positions, the prioritizing of tasks may be quite complex, with many variables entering into the organizing of work.

Sources for this GWA are numerous. Boese and Cunningham (1975), in their analysis of the OAI, described factors related to several types of planning and organizing (e.g., general worker activities, business functions, technical activities, etc.). The Borman et al. (1994) Organization dimension emphasizes prioritizing and personal time management. SCANS contains a Manages Time dimension and the Anticipates and Identifies Consequences dimension also is similar to our Organizing and Planning category. Finally, the managerial taxonomies all contain dimensions similar to organizing and planning (Borman & Brush, 1993; Flanagan, 1951; Hemphill, 1960; Mitchell, 1978; Tornow & Pinto, 1976; Williams, 1956; and Yukl, 1987), although some of these dimensions emphasize long-range planning or organizing others' work instead of or in addition to organizing and planning one's own work.

The technical definition for this GWA is as follows:

> Formulates work plans and objectives, and prioritizes and schedules own work.

16. Performing general physical activities. The JEI- and PAQ-based research is the primary origin of this GWA. Harvey et al. (1988) labelled the dimension General Physical Coordination; Jeanneret (1987) and McCormick et al. (1977) used the dimension title Performing Activities Requiring General Body Movements; Marquardt and McCormick (1973), after analyzing attribute data, called the dimension General Body/Handling Activities; then in 1974, these same authors factor analyzed job data and labelled an almost identical dimension as General Body Activity versus Sedentary Activities. Harvey (1987), after reanalyzing the PAQ, found two overall dimensions that he labelled Gross Body Movements While Stationary, and Gross Body Movements While Mobile. For all of these dimensions, the data describe the extent to which workers perform activities requiring general body movements. Further, these movements often require the action of the entire body, such as in

climbing and balancing and/or the use of major parts of the body (i.e., arms and legs). Finally, the ACT questionnaire contains an item reflecting this dimension.

The technical definition for this GWA is as follows:

> Requires workers to move their whole bodies, such as in climbing, lifting, balancing, moving, walking, or stooping. Oftentimes the activities also include considerable use of the arms and legs, such as in the physical movement of materials from one location to another.

<u>17.</u> <u>Handling and moving objects.</u> This GWA has been developed from the factor analysis results derived from all of the major generalized nomothetic job analysis questionnaires. The research of Harvey et al. (1988) with the JEI labelled the factor Handling/Related Activities. Jeanneret (1987), as well as McCormick et al. (1977), named the dimension Performing Handling/Related Manual Activities. Similarly, Marquardt and McCormick (1974) called the dimension Manipulating/Handling Activities, in part because a few more PAQ elements that reflected coordination of various bodily activities were found when compared to a similar dimension found in the earliest research with the PAQ (McCormick et al., 1972). The Cunningham et al. (1990) research with the GWI found a very broad dimension that they labelled General Physical Requirements, and then highly specific factors, such as Controlled Hand and Finger Activities that emphasized both coordination and strength required when working with one's hands and arms. A few of the ACT items relate to this GWA. In all of the factor analyses, the items that comprise this dimension involved use of the hands and often the arms in the manipulation or handling of materials or work-related things.

The technical definition for this GWA is as follows:

> Requires workers to use their hands and arms in handling and moving materials or in manipulating things. The worker could be relatively stationary or could be required to change location.

<u>18.</u> <u>Controlling machines and processes.</u> This GWA is also prevalent in most nomothetic job analysis taxonomic structures, although in some circumstances the control of machines is confounded with the operation of vehicles/equipment (the next GWA described below).

However, there is an identifiable distinction that can be made from an examination of the composition of the factors in terms of the factor loadings on the relevant job analysis elements. Those factors that are labelled as "controlling" a machine or process involve extensive use of hand- or foot-operated controls, often in a continuous manner, and frequently there is some product being produced by the machine. Harvey et al. (1988), as well as Jeanneret (1987) and McCormick et al. (1977), labelled the dimension Controlling Machines/Processes. In Harvey's (1987) reanalysis of the PAQ data, he labelled a comparable dimension as Operate Machines Requiring Continuous Attention to reflect the "hands-on" nature of this construct. Marquardt and McCormick (1974) called a similar factor Adjusting/Operating Machines/Equipment when the factor analysis was based on job data. For attribute data, the same authors found two factors: one was very general and labelled Control/Equipment Operation; the other was very specific and named Use of Foot Controls. In the Cunningham et al. (1990) work with the GWI, the researchers identified factors with more specificity (e.g., Material Forming and Shaping; Operating Office Equipment) than reported in research with other nomothetic questionnaires. Again, the ACT list has several items relevant to this GWA.

As implied by the label for this GWA, the activity described is associated with the control of machines, processes, and related operations. Further, the control is often executed by using various control mechanisms or by the direct physical "hands-on" operation of a device or some processing equipment.

The technical definition for this GWA is as follows:

> Uses either control mechanisms or direct physical movements of hands and arms (and possibly legs and feet) to operate machines or processes.

<u>19.</u> <u>Operating vehicles, mechanized devices, or equipment.</u> This GWA is derived primarily from research conducted with the OAI. Boese and Cunningham (1975) first reported a dimension labelled Driving/Operating Vehicles and Mechanized Equipment. Subsequently, in research by Cunningham et al. (1990), the specificity of the factor analyses yielded several factors that included vehicle/equipment operation: Working on Terrain Features (e.g., operating earth-moving equipment); Protecting/Enforcing (e.g., operating fire and police vehicles); and other unnamed factors that included operation of aircraft and rail

vehicles. Research with the PAQ and JEI has yielded factors labelled Use of Miscellaneous Equipment/Devices, which have reflected both vehicle operation (e.g., water vehicles and aircraft) as well as a variety of equipment (e.g., powered mobile equipment and remote-controlled equipment). When Marquardt and McCormick (1973) analyzed attribute ratings, a resulting factor, labelled Control/Equipment Operation, confounded the control of equipment with the operation of most types of vehicles (e.g., highway, rail, water, and air). Finally, the ACT questionnaire has one driving vehicles item.

The technical definition for this GWA is as follows:

> Runs, maneuvers, navigates, or drives vehicles and mechanized equipment such as forklifts, passenger vehicles, aircraft, or water craft.

20. Interacting with computers. This GWA was included because it reflects the realities and changes occurring in virtually every occupational domain. The computer-worker interface will continue to grow and, therefore, we believe should be part of any GWA system. The use of such a GWA was reflected in the following: The SCANS competencies (Uses Computers); research by Boese and Cunningham (1975) using the OAI yielded a representational factor they called Electronic Data Processing, which was separate from another factor entitled Using Keyboard and Other Office Equipment; the Cunningham et al. (1990) GWI factor labelled Operating Office Equipment; MOSAIC's competency of Applies Technology to Tasks; and several computer-oriented items from the ACT questionnaire.

The technical definition for this GWA is as follows:

> Controls computer operations by using programs, setting up functions, writing software, or otherwise communicating with computer systems.

21. Drafting, laying-out, and specifying technical devices, parts, and equipment. This GWA was primarily derived from research conducted with the OAI. Factor analyses by Boese and Cunningham (1975) indicated a separate first-order work output factor they called Drafting/Drawing. A second first-order factor was derived from the Work Goals section of the OAI, and it was labelled Technical Planning/Drawing Objectives. When the higher order factor analysis was completed, the factor was named Technical Planning and Drawing.

Outerbridge (1981) identified a somewhat related dimension she described as "Edits written materials and prepares materials for publication: The preparation involves selecting illustrations, laying out materials, recommending methods of reproduction and binding."

Research with the JEI and PAQ has identified broader constructs that encompass both technical preparation (e.g., drafting, etc.) as well as carrying out activities that evolve from that preparation (e.g., constructing, repairing, maintaining). These latter activities are found in the next two GWAs that are discussed below. The Harvey et al. (1988) research with the JEI identified a divisional dimension called Performing Skilled/Technical Activities. The same label was used for the PAQ divisional dimension reported by Marquardt and McCormick (1974) and McCormick et al. (1977). They also found an overall dimension titled Performing Technical/Related Activities. The focus of both the divisional and overall dimensions was the use of technical and measuring devices, drawings, specifications, etc., that is often associated with skilled craft and technician jobs. The Harvey (1987) study based on the PAQ did identify a dimension he labelled Graphic/Measurement/Technical, which does seem comparable to the above-cited Boese and Cunningham (1975) factor. The ACT list contains two items directly relevant to this GWA.

The technical definition for this GWA is as follows:

> Provides documentation, detailed instruction, drawings, and specifications to inform others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used.

<u>22.</u> <u>Implementing ideas, programs, systems, or products.</u> This GWA was created to include a broad range of factors that have been identified by a number of researchers who were analyzing occupations with structured job analysis questionnaires. Examples of the types of factors that were identified in the various research studies that lead to the development of this GWA are provided below:

Ballentine et al. (1992), in research of U.S. Air Force enlisted jobs using the GWI, identified job clusters they labelled Electronic Systems Installation; Structural Construction and Maintenance; Food Preparation; and Medical/Dental Services. While these are job clusters, it is interesting to note that many of these same constructs appear in Cunningham et al. (1990)

when they factor-analyzed the GWI across jobs. Examples of some of these GWI dimensions include: Protecting/Enforcing; Working with Animals; Health Care Activities; Material/Substance Preparation; and Food Preparation. Boese and Cunningham (1975) also found very similar types of dimensions in their research with the OAI. Examples of their dimensions include: Surface Finishing; Working on Buildings; Use and Handling Sporting Equipment; Use of Technical/Scientific Devices; and Health Treatment.

Baehr (1988) reported on finding such dimensions as Improving Work Procedures; Developing Technical Ideas; and Promoting Safety among samples of managerial jobs. Dowell and Wexley's (1978) factor-analytic study of supervisory jobs yielded two dimensions: Maintaining a Safe/Clean Work Area and Maintaining Efficient/Quality Production. In Outerbridge's (1981) study, she identified such behaviors as: "Purchases or Contracts for Services or Supplies" and "Performs Policy Functions." SCANS identified skills labelled Understands Systems, Selects Technology, Improves and Designs Systems, and Applies Technology to Tasks, which seem to relate to the implementation process. Finally, Mitchell and McCormick (1976) integrated a broad dimension of managerial and professional jobs they labelled Technical Activities, and the ACT questionnaire contains some construction and installation items that correspond to the Implementing GWA.

The technical definition for this GWA is as follows:

> Conducts, carries out, or implements work procedures and activities in accord with one's own ideas or information provided through directions/instructions for purposes of installing, modifying, preparing, delivering, constructing, integrating, finishing, or completing programs, systems, structures, or products.

23. Repairing and maintaining mechanical equipment. On an overall basis, the content of this GWA is embedded in the Skilled/Technical activities dimensions that have emerged from the PAQ and JEI as described above. For example, Harvey (1987) reported on a broad dimension that he labelled Operate/Adjust/Tend Machines/Tools/Equipment, but he categorized it as a dimension requiring considerable technical skill based on its item loadings. However, research with the OAI and GWI has consistently and strongly indicated that the repair and maintenance functions are separate for mechanical and electronic/electrical machines, devices, and equipment. The Boese and Cunningham (1975) research indicated

that even for information input, separate dimensions represented electrical versus mechanical information used by a worker. When considering the higher order factors of the OAI, they distinguished Mechanical Repair, Maintenance and Operation from Electrical or Electronic Repair Maintenance and Operation. The GWI research (Cunningham et al., 1990) led to the same conclusion. There were two separate factors: Mechanical Activities was one; Electrical/Electronic Activities was the other. When a higher order factor analysis of the first-order factors was completed, the two factors then came together. Dowell and Wexley (1978) describe a dimension for first line supervisors labelled Maintaining Equipment and Machinery. Finally, the SCANS system has a Maintains and Troubleshoots Technologies skill, which contains elements of this GWA and its electronic counterpart, and the ACT list has several repair and maintenance items focused on mechanical equipment. This list contains one general electronic repair item.

Given the strength and nature of the job analysis research by Cunningham and his associates, it was concluded that the mechanical repair and maintenance activities would be identified as a separate GWA from the electrical/electronic repair and maintenance activities.

The technical definition for this GWA is as follows:

> Uses appropriate tools and equipment, fixes, services, aligns, sets up, adjusts, and tests machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles.

24. Repairing and maintaining electronic equipment. The previous discussion has set forth the foundation for this GWA, which has an origin identical to the equivalent GWA focused on mechanical equipment, devices, and machinery.

The technical definition for this GWA is as follows:

> Uses appropriate tools and equipment, fixes, services, adjusts, regulates, calibrates, fine-tunes, or tests machines, devices, and equipment that operate primarily on the basis of electrical/electronic (not mechanical) principles.

25. Documenting and recording information. While this GWA might be considered very similar to the Processing Information GWA, it should be recognized that there are significant differences that are reflected in the taxonomic location of these two GWAs. Processing Information is a GWA within the Mental Processes taxonomic category; Documenting and Recording Information is an outcome and is included as part of the Work Output taxonomic structure.

The most direct identification of this GWA comes from the research of Boese and Cunningham (1975), who reported a representational work activity factor from analyses of the OAI they labelled Routine Recording. This factor was comprised of job activities the authors described as writing down information, such as weights of trucks or numbers of packages. In their analysis of supervisory jobs, Dowell and Wexley (1978) identified a factor they called Compiling Records and Reports, which was more of a documenting than processing (mental) activity. In the Outerbridge (1981) research, she defined a cluster of outputs as "writes reports of activities, findings, correspondence, memoranda, manuals, or technical reports." The ACT questionnaire has several recording information and maintaining records items.

The technical definition for this GWA is as follows:

> Enters, transcribes, records, stores, or maintains information or data in either written form or by electronic/magnetic recording.

26. Interpreting the meaning of information for others. Perhaps the most apparent type of work activity that is envisioned for this GWA would be the translation of information from one language to another. However, the construct is broader and includes such activities as interpreting the meaning of scientific information to a lay audience, describing the results of a series of medical tests, interpreting how a new technology could be applied to a company, or translating weather patterns for use by commercial aircraft pilots.

This GWA was identified by SCANS as Interprets and Communicates Information, a competency that would be important to the application of technology. Outerbridge (1981) also identified a comparable dimension she described as "Interprets and explains rules and procedures to individual members of the public."

The notion of interpreting information from one language to another is reflected in a few job analysis taxonomies. Mitchell (1978) defined a PMPQ dimension as Second Language Usage. Harvey (1991) in his taxonomy of general purpose and managerial dimensions listed Multiple Language Use, although he included it as an information processing rather than an interpersonal dimension. Finally, research with the GWI (Cunningham et al., 1990) reports on several factors that are associated with communications and have some potential requirements for the interpretation of the meaning of those communications. These factors include: Verbal Activities: Speaking and Writing; Information About People: Using/Producing; Performing Arts; Environmental and Physical Science/Technology Information: Using/Producing; and Construction/Engineering Information: Using/Producing. Clearly these latter factors span a variety of information that would need interpretation so that it could be used by others.

The technical definition for this GWA is as follows:

> Translating, clarifying, explaining or interpreting what information means and how it can be understood or used to support responses or feedback to others.

27. <u>Communicating with supervisors, peers, or subordinates.</u> Again, the vast majority of jobs in the U.S. require communicating with others in the organization. However, jobs will differ regarding the level of that communication. At the lower levels, workers may largely work alone. For the most part, they may not need to write as part of their job, or the written and oral communications required may be relatively simple and straightforward. At the higher levels, complex written and oral communication is required. Complicated and difficult report-writing assignments, important briefings to executives, or other complex written or oral communication may be necessary.

Several of the taxonomies previously discussed have communications as one of the activities represented. Sometimes communicating to persons outside the organization is not distinguished from within-organization communicating; in other cases, written and oral communication may be kept separate. [Note: In this context, "inside the organization" refers to communications by individuals who are employed by or are members of the organization in which the job occurs.] However, communication activities, in one form or another, are prominent in several of the general taxonomies and in all of the managerial dimension sets.

Research with the PAQ has consistently identified a dimension that involves communications within an organization. Marquardt and McCormick (1973, 1974) found a dimension labelled Interpersonal Communications after analyzing attribute data and three dimensions with job data (Interchange of Ideas/Judgments, Related Information; Communicating Instructions/Directions/ Related Job Information; and Job-Related Communications). McCormick et al. (1977) and Jeanneret (1987) identified three dimensions at the division level (Communicating Judgments/Related Information; Engaging in General Personal Contacts; and Exchanging Job-Related Information) and one overall dimension (Having Decision, Communication, and General Responsibilities). This same overall dimension was reported by Harvey (1987) in his reanalysis of PAQ data. Harvey et al. (1988), using the JEI, found an identical second-order factor to the PAQ overall dimension and labelled it Decision/Communication/General Responsibility; they also reported two first-order factors named Exchanging Job-Related Information and General Personal Contacts.

Review of the GWI research by Cunningham et al. (1990) indicated they found a relevant section dimension labelled Oral and Written Communication. Their dimension titled Management and Human Development Activities also encompassed items dealing with communicating. Analyses of the OAI by Boese and Cunningham (1975) found a communication dimension they named Obtaining and Giving Information; at the higher order level, the factor that emerged was called Verbal Communication.

Outerbridge (1981) and O'Leary et al. (1989) offer two activity clusters that tie in with part of this GWA. One relates to conferring with supervisors and the other is a report-writing dimension. Campbell et al. (1993) and Borman et al. (1994) have a general written and oral communication factor. MOSAIC keeps written and oral communications separate, and the ACT questionnaire contains several internal communication items. There are three SCANS skills that involve communications of some sort.

Regarding the managerial taxonomies, communication is reflected in every one, but kept separate only in the Borman and Brush (1993), Mitchell (1978), and Yukl (1987) systems. In the other taxonomies, communicating is part of coordinating or interacting with others.

The technical definition for this GWA is as follows:

Provides information to supervisors, fellow workers, or subordinates.

28. Communicating with persons outside the organization. This GWA is parallel to the other communication dimension, but the object of the communicating is external customers or others outside of the organization (i.e., they are not employed by or members of the organization in which the job of interest occurs). Thus, the level scale is very similar to that of the other communication dimension. The low end refers to jobs that require little contact with persons outside the organization. The high end is pertinent to jobs that require complex external communication such as presenting highly technical information to customers.

Evidence for this GWA can also be found in a number of taxonomies. All of the PAQ factor analytic studies have reported at least one dimension associated with communications external to the organization. Marquardt and McCormick (1974) labelled the dimension Public/Related Personal Contact, which is the same title used by Jeanneret (1987) and McCormick et al. (1977). The latter two research studies also identified an overall dimension called Public/Customer/Related Contacts. Harvey (1987) called the dimension Deals with Public. The JEI research of Harvey et al. (1988) labelled the dimension Public/Related Personal Contacts at the division level. Research with the OAI (Boese & Cunningham, 1975; Cunningham & Scott, 1988) has not yielded a dimension the researchers have called external communications, but they have consistently found a dimension or cluster they have named Entertaining/Socializing, which clearly has a flavor of external communications as well as selling/influencing, which is a separate GWA.

Outerbridge (1981) and O'Leary et al. (1989) have as part of their dimension sets three activities relevant to this GWA: preparing literature or oral presentations for public/clients, presenting information to individuals or groups in the community, and testifying in court or at other administrative proceedings. Again, the Campbell et al. (1993) and Borman et al. (1994) systems each have a general communication dimension covering both internal and external communication. The Serves Clients/Customers SCANS category has external communications as one of its elements. MOSAIC contains a dimension labelled Customer Service, part of which is communicating with customers. And finally, the ACT questionnaire has a few items related to providing information to persons outside the organization.

Among the managerial taxonomies, this GWA is explicitly recognized as representing the organization to customers and the public in the Borman and Brush (1993) and Yukl (1987) systems. In Tornow and Pinto (1976), a public and customer relations factor is very similar to this GWA. In each of the other managerial systems (with the exception of Flanagan's), the notion of external communications is embedded in a more general dimension.

The technical definition for this GWA is as follows:

> Communicates with persons outside the organization and/or represents the organization to customers, the public, government, or other external entity.

29. Establishing and maintaining interpersonal relationships. The sense of this GWA is that many jobs require working, often closely, with co-workers, supervisors, subordinates, customers, business associates, or others. This GWA area may require incumbents to develop good working relationships and over time to maintain cooperative and possibly collaborative relations with these other persons. This activity also is increasingly important with the emergence of a diverse work force and the growth of team-based work groups. At high levels, requirements for this GWA involve working smoothly with and gaining cooperation with others under difficult circumstances, such as when these persons have diverse backgrounds or are initially hostile or uncooperative.

The main support for this GWA comes from the MOSAIC taxonomy and from the managerial dimension systems. MOSAIC contains an Interpersonal Skills competency that aligns well with our GWA. The ACT list has several items at least tangentially related to this Interpersonal Relationships GWA. Every managerial taxonomy except Flanagan's (1951) has an interpersonal dimension. As examples, Williams (1956) has a dimension, Relations with Associates, Mitchell's (1978) system includes Interpersonal Activities, and Borman and Brush (1993) have a Maintaining Good Working Relationships dimension. SCANS includes Works with Cultural Diversity and Participates as a Member of a Team.

The technical description for this GWA is as follows:

> Develops constructive and cooperative working relationships with others.

30. Assisting and caring for others. This particular GWA has limited support from the taxonomies we have reviewed. Yet, we believe this dimension will be increasingly important as the number of health care jobs continues to rise dramatically, as child-care requirements for single-parent and dual career families greatly increase, and as our population demographics shift to contain a larger and larger percentage of older persons who will need care and assistance. Thus, the focus of this GWA is on providing personal care to others, but its scope is somewhat broader to include other kinds of helping and assistance.

The closest concepts in other taxonomies are the Client Orientation dimension in OPM's MOSAIC competency list and a couple of fairly specific dimensions from the GWI and OAI. The MOSAIC dimension has as part of its definition a commitment to provide quality service to others. Cunningham's dimensions that are relevant apply to health care and social workers, employment counselors, pharmacy and dietary workers, and associated para-professionals.

The technical definition for this GWA is as follows:

> Provides assistance or personal care to others.

31. Selling or influencing others. This GWA has to do with persuading or convincing others to buy products of some type or with otherwise influencing others to change their behavior. Management and supervisory jobs may often stand at the higher levels on this GWA, but not necessarily. Sales and marketing jobs will typically be described toward the high end of this GWA. Of course, many jobs require little selling or influencing of others to get the work accomplished, and these jobs will be described lower on the level scale. Thus, the high end of the level scale is characterized as requiring considerable persuasion, often of a difficult-to-convince audience, to get the job done. As mentioned, the lower end of this scale will describe jobs where little persuasion is required to get the job accomplished.

Evidence for this GWA comes from the OAI, O'Leary's activity clusters, and SCANS, as well as four of the managerial taxonomies. Boese and Cunningham (1975) report for the OAI a first-order factor they labelled Persuading and a second-order factor called Sales, Service, and Public Relations. As mentioned previously, Cunningham and Scott (1988) reported an OAI cluster they titled Entertaining/Socializing, which also has a selling and influencing component. The Entertaining/Socializing factor was also reported at the divisional factor analysis level by Cunningham et al. (1990). In the O'Leary et al. (1989) system, a selling property activity appears. SCANS has a directly relevant dimension labelled Influences an Individual or Group, MOSAIC contains an Influencing/Negotiating competency for professional occupations that in part reflects this GWA's content, and the ACT questionnaire has at least one selling/influencing item.

The concept of selling and influencing is recognized explicitly as a dimension in the Borman and Brush (1993) system. In Hemphill (1960) selling/influencing is an element of his Technical Aspects With Products and Markets; Williams (1956) has this dimension embedded in a general Relations With Associates category; with Tornow and Pinto (1976), it is part of their Public and Customer Relations factor; and Mitchell (1978) includes the concept in his Problem Solving dimension. In Harvey's (1987) reanalysis of PAQ data, he labelled the dimension Sales/Buyer Contacts.

The technical definition for this GWA is as follows:

> Persuades or convinces others to buy merchandise or goods, or otherwise change their minds or actions.

32. Resolving conflicts and negotiating. This GWA is seen as importantly different from the Selling or Influencing Others GWA. Negotiating involves handling complaints, arbitrating disputes, and resolving grievances. Standing at the lower levels of this GWA will be jobs that require no complaint-handling or negotiating, or, if they do require some of this activity, the negotiations will be in very easy-to-resolve situations. At the higher end of the level scale will be jobs that require complaint-handling and negotiating involving complex issues and with considerable conflict and pressure associated with the activity.

The negotiating concept appears as part of the OAI, and in O'Leary et al.'s activity clusters, SCANS, MOSAIC, and most of the managerial taxonomies, although in those taxonomies negotiating is consistently embedded in a broad supervision, coordination, or interpersonal relations dimension. Research with the OAI (Boese & Cunningham, 1975) reported a dimension they labelled Resolving Conflicts, which within the higher order analyses became part of Human Development, Assistance, and Conflict Resolution. In the O'Leary et al. (1989) system, Negotiating With Persons/Organizations With Differing Points of View is an activity cluster, and a dimension from SCANS is Negotiating to Arrive at a Decision. MOSAIC has both a Conflict Management and an Influencing/Negotiating dimension in its managerial competency list. Two or three resolving complaints/problems or negotiating items appear in the ACT questionnaire. Borman and Brush (1993), Williams (1956), Tornow and Pinto (1976), and Mitchell (1978) all have the concept of negotiating reflected in their category systems, but, as mentioned, as part of a broader managerial dimension.

The technical definition for this GWA is as follows:

> Handles complaints, arbitrates disputes, resolves grievances, or otherwise negotiates with others.

33. Performing or working directly with the public. It might be argued that this GWA overlaps substantially with the external communication and selling GWAs. We would not argue that this dimension is completely independent of those GWAs. However, when we considered such high population jobs as patrol officers, restaurant servers, and government employees directly interacting with the public, as well as acting, TV personality positions, and the like, the communication and selling GWAs did not appear to appropriately characterize their activities. Accordingly, this GWA involves performing in front of people or directly serving the public in some capacity. The level scale differentiates job requirements in this area primarily in terms of how challenging and difficult the interaction with the public is likely to be for the worker. Jobs at lower levels involve relatively brief and routine interactions with little or no complexity. Higher levels for this GWA require more challenging and complex interactions with the public.

Admittedly, there is little support for this GWA in the taxonomies we have reviewed. Outerbridge (1981) and O'Leary et al. (1989) have a dimension involving performing policing functions with the public, and the SCANS Serving Clients/Customers factor is in part related to this concept. Harvey's (1987) research with PAQ data did identify a dimension he labelled Deals with Public. Similarly, the PAQ research of McCormick et al. (1977) identified an overall dimension called Performing Service/Related Activities, in part a match with this GWA, and a few ACT questionnaire items are somewhat related to this concept. Despite limited support, for reasons provided above, we recommend including this dimension as a GWA.

The technical definition for this GWA is as follows:

> Performs in front of people or deals directly with the public, including serving persons in restaurants and stores, and receiving clients or guests.

34. Coordinating the work and activities of others. The Coordinating the Work and Activities of Others GWA is primarily a management activity. However, the GWA can be important for non-management positions if, for example, they require taking charge of tasks that temporarily involve coordinating other organization members, or they involve being part of a team where different members coordinate the others' activities depending on the task.

The lower levels on this GWA refer to jobs with very limited requirements to coordinate other organization members. At the higher levels, the job may require coordinating the tasks and activities of a large number of persons, where the sequencing of task steps is relatively complex.

Evidence for this GWA comes from the Outerbridge (1981) and O'Leary et al. (1989) taxonomies, from SCANS, and from all of the managerial dimension sets. Outerbridge and O'Leary identified a category that includes coordinating interrelated activities, and O'Leary et al. added a coordinating and performing liaison work with other units dimension. The broad SCANS category of Managing Human Resources includes the concept of coordinating others. PAQ-based research indicates that coordination is coupled with Supervision, and both Jeanneret (1987) and McCormick et al. (1977) labelled the dimension Performing Supervisory/Coordination/Related Activities. There are at least two items in the ACT questionnaire related to coordinating others.

Among the managerial taxonomies, Borman and Brush (1993) identified a dimension (Coordinating Subordinates and Other Resources) with almost exactly the same definition as this GWA. Yukl's (1987) Motivating Task Commitment dimension is likewise defined very similarly to the Coordinating Others GWA (although the label is quite different), and the Tornow and Pinto (1976) Coordination of Other Organizational Units and Personnel dimension is also quite similarly defined. In the Flanagan (1951), Williams (1956), and Mitchell (1978) systems, the concept is part of a broader managerial dimension.

The technical definition for this GWA is as follows:

> Coordinates members of a work group to accomplish tasks.

35. Developing and building teams. A major recent development in U.S. organizations is a movement from hierarchically organized units to team-based work units (e.g., Guzzo & Salas, 1995). A recent study (Gordon, 1992) showed that 35% of U.S. organizations were using teams. Almost certainly, that percentage is higher now. Accordingly, managing teams in organizations is becoming more and more important. Managers or supervisors are often expected to guide the work of teams, or in self-managed teams peers in a work group all may be involved in building and managing the team (e.g., Wellins, Byham, & Dixon, 1994). This GWA may overlap somewhat with some of the other supervisory GWAs (e.g., Guiding, Directing, and Motivating Subordinates), but it is included in the taxonomy to recognize the increasing emphasis in U.S. organizations on team-based structures.

Support for the GWA comes almost solely from OPM's MOSAIC competency list. Our GWA is modeled on their Team Building competency for managers. Yukl's (1987) Harmonizing and Team Building dimension is also similar to this GWA, and a few of the ACT items are somewhat related to the concept.

The technical definition for this GWA is as follows:

> Encourages and builds mutual trust, respect, and cooperation among team members.

36. Teaching others. This GWA involves both identifying educational needs and the actual development and delivery of training or instruction to improve trainee knowledge or skills. As with many other GWAs, the differentiation between jobs that require some training and teaching of others is in the complexity of that training effort. At the lower levels, jobs require very minimal, simple training, developing, or instructing of others. At higher levels, the activity requires both identifying ways to teach very difficult material and actually conducting training or instruction under these challenging and difficult circumstances. The GWA is intended to apply primarily to teachers or instructors in schools and trainers in businesses or public organization settings. The on-the-job training, coaching, and developing of subordinates is covered by GWA 38.

Support for this teaching/instructing others GWA comes from the OAI factor, Instruction (Boese & Cunningham, 1975). Outerbridge (1981) and O'Leary et al. (1989) also offer an activity cluster that aligns well with this GWA (Planning and Conducting Training Sessions). SCANS reports a separate skill labelled Teaching Others. Finally, two items from the ACT questionnaire reflect this GWA.

The technical definition for this GWA is as follows:

> Identifies educational needs, develops formal training programs or classes, and teaches or instructs others.

37. Guiding, directing, and motivating subordinates. This management dimension is defined as providing guidance and direction to subordinates. Included in this GWA is the concept of setting standards for performance and reviewing employee performance against those standards.

Jobs rated at lower levels of this GWA will include few management responsibilities or will be supervisory jobs where employees require very little guidance. The higher levels of the GWA are characterized by requiring the direction and motivation of several subordinates under organization conditions that are challenging, unpleasant, or otherwise difficult.

This GWA is part of many of the taxonomies previously reviewed, including the PAQ, the Campbell et al. system, SCANS, and all of the management dimension sets. In the PAQ, as previously mentioned, the dimension at the division level is called Performing Supervisory/Coordination/Related Activities from the research of Jeanneret (1987) and McCormick et al. (1977). Harvey (1987), after reanalyzing the PAQ data identified a dimension he labelled Direct Supervision of Others. Alternatively, Marquardt and McCormick (1974) found a dimension they called Supervisory/Staff Activities. These dimensions, based on the PAQ, are very similar to the JEI factor named Supervision/Judgment/Coordination reported by Harvey et al. (1988). The OAI study by Boese and Cunningham (1975) reported a divisional factor labelled Organizing and Supervising the Work of Others. This also became the title assigned to one of the higher order factors of the OAI. Dowell and Wexley (1978) labelled a dimension Working with Subordinates, but the emphasis is on direct supervision. Campbell et al.'s

Supervision/Leadership category is not congruent with but subsumes this GWA. The matches are not exact with SCANS, either, but the Monitoring and Correcting Performance dimension from SCANS includes this Guiding/Directing concept, as does the even broader Managing Human Resources SCANS category. Finally, the MOSAIC system's Leadership competency and part of the Managing Human Resources dimension align well with this GWA, and two or three ACT items are related to guiding or directing subordinates.

Regarding the management taxonomies, this GWA is closely aligned with the Borman and Brush (1993) dimension with the same title. Again, our motivation for configuring the management elements of the GWA with emphasis on the Borman and Brush taxonomy, including this and several of the other GWA managerial dimensions, is that this research summarizes and integrates much of the previous work on building empirical managerial performance dimension systems. The Guiding/Directing GWA also is very similar to Yukl's Recognizing and Rewarding dimension. With all of the other managerial taxonomies, the one-to-one matches are not evident, but this GWA is part of a broad, supervisory or "relations with subordinates" dimension.

The technical definition for this GWA is as follows:

> Provides guidance and direction to subordinates, including setting performance standards and monitoring their performance.

38. Coaching and developing others. As mentioned in the description of the Teaching Others GWA, this GWA is a management dimension, relevant to supervisory and managerial jobs that include the requirement to coach subordinates and otherwise support developmental opportunities for them.

Evidence for this GWA emerges from many sources. Marquardt and McCormick (1974) identified a dimension they called Communicating Instructions/Directions/Related Job Information. Research with the JEI (Harvey et al., 1988) yielded a dimension they labelled Supervision/Coaching. This GWA is also part of the composition of the GWI factor called Management and Human Development Activities (Cunningham et al., 1990). This concept is included in Dowell & Wexley's supervisory dimension they labelled Working With Subordinates. O'Leary et al. (1989) offer a counseling and advising individuals dimension that reflects part of our GWA. The Campbell et al. (1993) Supervision/Leadership dimension explicitly identifies the developing/coaching element as part of this category. SCANS has the general Manages Human Resources dimension that subsumes several of our GWA supervisory categories, including this one. As mentioned, the SCANS Monitors and Corrects Performance dimension contains elements of both this GWA and the Guiding/Directing GWA. Also, the MOSAIC competency list for professional and administrative occupations contains a Teaching Others dimension that has the same label as our GWA 36, but is defined very similarly to this GWA. The ACT questionnaire has about three items related to this activity dimension.

The GWA actually comes directly from the Borman and Brush (1993) dimension with a very similar label and definition. Its content is also evident, however, in Yukl's (1987) taxonomy (Developing), and is part of a broader supervision category in the Hemphill (1960), Flanagan (1951), Williams (1956), Tornow and Pinto (1976), and Mitchell (1978) systems.

The technical definition for this GWA is as follows:

> Identifies the developmental needs of others and coaches or otherwise helps them to improve their knowledge or skills.

39. Providing advice and consultation to others. This GWA involves the kind of work that is performed by consultants or advisors. The activity can refer to external consulting where advice from outside consultants is provided or to internal consulting where the advice is being given within the organization. The consultation might involve technical matters, or be systems or process related, as with management consulting.

Support for this GWA can be found in several of the taxonomies reviewed. First the Outerbridge (1981) and O'Leary et al. (1989) systems contain a consultation/advice-giving dimension. Also, the Tornow and Pinto (1976) taxonomy has a factor they labelled Advanced Consulting, referring to within-company, across-unit technical advising, and Yukl (1987) has a Consulting and Delegating factor, part of which involves content related to this GWA. Finally, MOSAIC contains a Technology Management competency that in part relates to consulting/advising, and many ACT questionnaire items involve consultation to some extent. Although there is not much mention of this activity area in other taxonomies, we believe this GWA will be increasingly important, as more technically complex advice and guidance are needed by organizations, and as management consultation, both internal and external, continues to grow significantly in popularity (see Howard, 1995, for discussion of these trends).

The technical definition for this GWA is as follows:

> Provides consultation and expert advice to management or other groups on technical, systems, or process related topics.

40. Accomplishing administrative activities. This GWA has to do with day-to-day administrative tasks. In jobs with a lower level requirement for this GWA, these tasks will involve routine paperwork; at higher levels the administrative procedure requirements will be more complex and difficult, perhaps requiring compliance with governmental regulations, federal laws, and state statutes.

Dimensions similar to this GWA appear in the following taxonomies. Outerbridge (1981) and O'Leary et al. (1989) have two such dimensions, Contracts for Services and Keeps Records and Compiles Statistical Reports. Dowell and Wexley (1978) have a dimension very similar to the latter one, Compiling Records and Reports. The administrative activities concept also appears as part of the Campbell et al. (1993) Management/Administration dimension. In the managerial taxonomies, the Borman and Brush (1993) Administration factor corresponds almost exactly to this GWA, and this construct is embedded in more general management categories for each of the other taxonomies except for Yukl's (1987). Finally, the MOSAIC competency, Planning and Evaluating, has this administration concept as one of its elements, and two items from the ACT questionnaire are closely aligned with this construct.

The technical definition for this GWA is as follows:

> Approves requests, handles paperwork, and performs day-to-day administrative tasks.

41. Staffing organizational units. This GWA involves the staffing sequence of recruiting, interviewing, selecting, and hiring persons for an organization. The activity may be a line management function, a staff function, or might be handled at least in part by external consultants. For jobs at high levels on this dimension, the requirement may include having

responsibility for a large and complex recruitment and selection program, being in charge of a sophisticated promotion system for managers, or similar functions.

Evidence for this GWA comes from several taxonomies. A staffing GWA appears in the Outerbridge (1981) and O'Leary et al. (1989) systems (Conducts Interviews to Screen Persons). The concept is one element in the broad MOSAIC competency called Managing Human Resources and in the Campbell et al. (1993) Management/Administration dimension. Four staffing items appear in the ACT questionnaire. Also, the Borman and Brush (1993) Staffing factor is very similar to this GWA, and the concept is included as a part of the Tornow & Pinto (1976: Staff Service), Hemphill (1960: Providing Staff Service), and Williams (1956: Planning, Organizing, and Execution of Policy) dimension systems.

The technical definition for this GWA is as follows:

> Recruits, interviews, selects, hires, and promotes persons for the organization.

<u>42.</u> <u>Monitoring and controlling resources.</u> This GWA involves the overseeing and controlling of non-personnel resources, including budgets, funds, materials, and similar assets. This activity will sometimes be carried out by management staff members, although line managers and others often perform the function. Clearly, many jobs in our economy do not require monitoring or controlling resources, or the activity is quite straightforward. These jobs will fall at the lower end of this GWA. At the higher levels, the amount and complexity of the resources to be monitored/controlled will be considerable, when measured in terms of dollar value or influence on an organization's asset base.

This GWA has a lot of support from the literature. The PAQ offers a Performing Supervisory/Coordination/Related Activities dimension that in part reflects this GWA (i.e., the "related activities"). The O'Leary et al. (1989) taxonomy has a Monitors Projects or Programs generalized work behavior that relates to elements of this GWA. MOSAIC has two competencies that are matched with this GWA (Financial Management and Internal Controls/Integrity), and many ACT questionnaire items relate to the construct.

Regarding the managerial taxonomies, the Borman and Brush (1993) dimension of the same name is also defined highly similarly to our GWA. In addition, Yukl (1987) has a dimension titled Monitoring Operations that is an excellent match with this GWA. The other managerial taxonomies (except Flanagan's and Mitchell's) also feature this construct, but it is part of a summary dimension, such as Internal Business Control (Hemphill, 1959; Tornow & Pinto, 1976) or Planning, Organizing, and Execution of Policy (Williams, 1956). The SCANS skills that are most relevant include Allocates Money and Allocates Material and Facility Resources.

The technical definition for this GWA is as follows:

> Monitors and controls resources and oversees the spending of money.

Evaluations and Applications

The prior description of the lower-order generalized work activities is noteworthy for a number of reasons. The description and justification provided for each GWA clearly indicate that virtually all of the proposed dimensions find support in earlier taxonomic efforts. These relationships, in turn, provide some crucial initial evidence for the meaningfulness or construct validity of the proposed taxonomy. A second piece of evidence bearing on the meaningfulness of this taxonomy may be found in the nature of the level rating scales, which indicate that each of these dimensions can indeed be linked to a specific set of job activities reflecting differences in the level of the dimension.

Aside from its potential meaningfulness, two other characteristics of this taxonomy should be noted. First, the proposed lower order dimensions can be organized according to a broader set of higher order dimensions, which in turn are derived from a "S-O-R" model. Second, because cross-functional skills develop, in part, as a function of job experience, these GWAs may provide a basis for linking job requirements to the kinds of person skill requirements described in earlier chapters. This linkage process has been termed the "job component" approach (Cunningham, Drewes, & Powell, 1995; Dunnette, 1976; McCormick et al., 1972).

Apart from the theoretical, psychometric, and content measurement evidence that has supported the inclusion of GWAs in development of the O*NET, it also is important to consider the potential applications that could evolve from having a job analysis database that includes GWA measurements. Mention has already been made of how the GWAs can support other components of the content model, such as the development of task lists, confirmation of cross-functional skills, or the linkage of job behaviors to knowledge, skills, abilities, and other requirements and characteristics of work . The final section of this chapter examines how GWA measurements might be directly used to support a number of different human resource management functions. Again, we have relied upon research literature to support the potential utility of GWA's in O*NET..

Contributions of GWAs to human resource management and occupational consulting. A review of the literature on applications of existing taxonomies having constructs similar to GWAs provides information on the value that GWAs might have for human resource management or occupational consultation purpososes. Our review identified five potential types of contributions:

- Estimation of Job Requirements
- Development of Job Families
- A Database for Occupational Interest Measurement
- Estimation of Job Values for Classification
- Estimation of Skills Gaps and Cross-Training Opportunities

A summary of research findings regarding each of these potential contributions is provided below.

Estimation of job requirements. Representative of the potential contributions that can be made by job analysis data collected at the GWA level are findings based on analyses of dimensions derived from the PAQ database. Analyses of PAQ data following the job component validity concept provided an opportunity to define job requirements in terms of the tests that comprise the General Aptitude Test Battery (GATB) of the United States Employment Service. The initial PAQ research effort was conducted on a sample of 90 jobs for which both PAQ analyses and GATB test data (mean scores, validity coefficients, cutting scores, etc.) were available (Mecham & McCormick, 1969a). The mean test scores for job incumbents working in the 90 jobs were used as a criterion of the "importance" of the various GATB tests for selecting personnel for the different jobs, predicated on the assumption that people tend to "gravitate" into those jobs that are commensurate with their own aptitudes. Thus, for a particular test, high mean test scores of people in certain jobs would imply that those jobs require high levels of the aptitude measured, and vice versa. Multiple correlations for the PAQ dimensions attempting to predict aptitude levels for the 90 jobs ranged from .59 to .80, and the median correlation coefficient was .71.

Several additional studies have replicated the initial job component validity research (Marquardt & McCormick, 1974; McCormick et al., 1977; McCormick et al., 1989). While the sample sizes have increased from the 1969 to the 1989 studies, the magnitudes of the relationships have remained remarkably similar. Also, it has always been true that the PAQ job dimensions are most effective in predicting cognitive abilities, followed by perceptual and then psychomotor abilities. In the most comprehensive analysis (N=460 validity studies of the GATB), the multiple correlation coefficients ranged from .75 to .78 for cognitive tests, .61 to .72 for perceptual tests, and .24 to .67 for psychomotor tests. The median of all coefficients was .69 (see McCormick et al, 1989). Further, it has been demonstrated that the validity of certain cognitive ability predictions is moderated by behavioral job characteristics measured with the PAQ (Gutenberg, Arvey, Osburn, & Jeanneret, 1983), and this research confirms the role job complexity plays in establishing the aptitude requirements of jobs.

Because the GATB tests are not available for use by private organizations, one study was carried out for incumbents in 202 jobs with data on a number of commercially available aptitude tests that were considered to "match" certain of the GATB tests (McCormick, etal, 1979). "Matching" was completed with commercially available tests for five of the GATB aptitudes, namely, G, V, N, S, and Q. The combination of job dimensions and their statistically determined weights for each of the five GATB aptitudes was used to derive predicted mean test scores for the jobs in the sample, which were correlated with actual mean test scores obtained for incumbents in the jobs. Across large numbers of subjects and jobs, it was found that there are relatively strong correlations between PAQ job dimensions and commercial tests designed to measure primary cognitive and perceptual abilities. These relationships are equivalent to those found for the GATB.

Cunningham and Scott (1988) have reported very similar results to those described above when OAI and USES job analysis data clusters were used to predict two GATB factor scores, a cognitive and a motor factor. For the OAI clusters using a data set for 282 jobs, the multiple correlations were .75 for the cognitive factor and .24 for the motor factor; in a comparable analysis with USES clusters for 434 jobs, the multiple correlations were .79 and

.31 for the cognition and motor GATB factors. These results are nearly identical to those previously reported for the PAQ.

Apart from examining predictions of aptitude test scores, it also is possible to identify job requirements directly from certain worker-oriented job dimensions. Such direct, one-to-one correspondence between a job analysis result and a job specification is another indicator of the value of GWAs in the overall job analysis process. Such a process was proposed by Cunningham et al. (1995) as well, who suggested a job's human attribute requirements could be estimated by having subject matter experts or knowledgeable respondents make such attribute requirement ratings. Further, Cunningham et al. (1995) also argued that the job component methodology would provide a rationale for each specific job requirement (content relevance) and a more reliable estimate of a job's requirements.

An example of how a GWA might provide direct input to the specification of job requirements can be found in Townsend, Prien, and Johnson (1974). They studied 23 different jobs and, based on the similarities of job dimension scores, found two clusters having similar job demands (requirements) on such dimensions as manual control/coordination activities, structural work, information from people, skilled technical activities, and decision making. While the researchers specifically were studying variables that would predict job success for mentally retarded workers, they recognized that job data on dimensions akin to generalized work activities could play a dominant role in identifying the most useful and valid predictors of performance. Another example of the value of generalized job dimensions for establishing job requirements is reported in a study of computer logic chip production operators. It was demonstrated that 10 PAQ dimensions were indicative of job specifications that could be used to make selection decisions (Jeanneret, 1988).

Development of job families. The development of job families, occupational clusters, or groups has had multiple purposes, but basically the attempt has been to guide predictions, facilitate communications, or impose a relational structure that provides more understanding of the world of work. Further, the ease with which such families may be formed and the nature of their composition is likely to vary depending on the type of data (e.g., task-oriented vs. worker-oriented) used and its degree of specificity (e.g., discrete task vs. universal attribute). The GWAs should provide a viable mechanism that, because of their lack of task specificity, their emphasis on behavioral content, and their generally broad applicability should facilitate the formation of job families irrespective of the purpose(s) for which they have been constructed. A review of research results regarding the formation of job families using indicators similar to our GWAs suggests the value the GWAs can have in future applications as part of the O*NET. A sampling of that research is described below.

Cornelius, Carron, and Collins (1979) examined the formation of job families for the same set of jobs (seven foremen in one plant) using an identical clustering procedure applied to three different job analysis data sets: task-oriented, abilities-oriented, and worker-oriented. Results indicated that the task-oriented data yielded either three or five families, the abilities-oriented data indicated three clusters (very different from the three-cluster solution using task data), and the worker-oriented (PAQ) data yielded one family. In a similar study, Sackett, Cornelius, and Carron (1981), analyzed eight foreman jobs in another plant on 237 task statements, and then using a cluster analytic routine, identified four families. Subsequently, the researchers found that a group of knowledgeable raters using global judgments identified the same four groups. However, it is by no means conclusive that rational clustering or the use of global job-content information is sufficient for most human resource management purposes. For example, Hartman and Kromm (1989) reported that empirically derived families had significantly greater internal and external validity relative to rationally developed families. Dowell and Wexley (1978) also found few differences across 251 supervisory positions when data from the Supervisory Task Description Questionnaire were factor analyzed and then examined for differences in dimension scores by production technology.

While the above research certainly is not definitive in terms of evaluating the effectiveness or utility of using various types or levels of job analysis data for the formation of job families, nor does it provide conclusive evidence that the time spent in more detailed job analyses is not worth the effort given the desired outcome, it does demonstrate that very different conclusions might be drawn about job family composition depending on the nature of the data and methods used in the analysis. A similar conclusion was reached by McNeil (1984), who used two different job analysis methods to identify job families within the job title of sales representative. Pearlman's (1980) review of the literature further concluded that job analysis procedures that focused on the human attribute requirements or broad content structure of jobs would provide more useful data for both the development of theory and the actual formation of job families for human resource management applications.

Job family formation using data from the PAQ. The procedures followed in the development of job families on the basis of PAQ data are predicated on the Ward and Hook (1963) hierarchical grouping procedure (based on a distance index), which can be applied to worker-oriented or job-oriented data. While there have been several research efforts to examine alternative methodologies and procedures for interpreting job similarities (Arvey, Maxwell, Gutenberg, & Camp, 1981; Arvey, Maxwell, & Mossholder, 1979; Arvey & Mossholder, 1977; Cornelius, 1981; DeNisi & McCormick, 1974; Hanser, Mendel, & Wolins, 1979; Lissitz, Mendoza, Huberty, & Markos, 1979; McIntyre & Farr, 1979; and Pearlman, 1980), the fundamental procedure of analyzing PAQ dimension scores using a distance index as the basis for profile comparisons has remained constant (McCormick & Jeanneret, 1988; McCormick et al., 1989).

The earliest published research on the use of PAQ data to form job families was conducted by DeNisi and McCormick (1974). In this study, 3,700 jobs were cluster analyzed on the basis of 14 overall job dimensions and 33 job families emerged with an overall average homogeneity index of .75. Because there is no single value for the index that indicates acceptability, other than a maximum value of 1.0, one must interpret the magnitude of the index relative to the nature and quality of the data used in the calculation. In this sense, an index of .75 indicates a reasonable degree of homogeneity. Additionally, a sample of 800 jobs was analyzed for 21 divisional dimensions with the Coordinated Occupational Data Analysis Program (CODAP) yielding 45 families with an average homogeneity of .45. The researchers concluded that the differences in homogeneity values may well have been a function of using different PAQ dimensions (overall vs. divisional). This initial work was followed by a replication that examined 746 jobs selected to be representative of the DOT categorization of job titles (McCormick, DeNisi, & Shaw, 1977). The researchers did not try to identify an optimum set of job groups, but rather specified a priori formation of 20, 40, and 60 families. These family configurations were then used to develop job component validity estimates in the same fashion as they are generated for individual PAQ analyses. The results were very comparable, indicating that a set of GATB-based job requirements could be established for a family of jobs in the same manner as they can be estimated for a single job analyzed with the PAQ.

Two somewhat different studies related to the formation of job families were conducted by Colbert and Taylor (1978), Taylor (1978), and Taylor and Colbert (1978). The analyses were performed within the insurance industry. Hierarchical grouping of 76 jobs yielded six job families in one study, and the grouping of 325 jobs yielded 13 families in a second study. The family structures had organizational meaning and were derived to be valuable for validity generalization purposes. Specifically, Colbert and Taylor (1978) reported that regression analyses yielded significant cross-validated multiple correlations within families and that different predictors were valid for different families.

Apart from using the job profile comparison methodology to form job families, the procedure has also been used to confirm the similarity of the behavioral content of jobs classified together in the same pay grade on the basis of their PAQ job evaluation points (Jeanneret, 1988). Thus, it is possible to consider the profile comparison methodology as a means of developing job families or as a basis for confirming the composition of classifications that have been formed using some other analytical procedure or data set.

<u>Job family formation using data from the GWI</u>. Cunningham et al. (1990) initiated research that examined the extent to which U.S. Air Force enlisted jobs analyzed with the GWI could be clustered together to form meaningful job classes. Their research found that 48 of the sectional GWI factors were most relevant and meaningful for identifying job similarities and differences when using a procedure for comparing job profiles based on the GWI that was developed by Hamer and Cunningham (1981). Follow-up research by Ballentine et al. (1992) documented that a hierarchical grouping of 155 jobs (90% of the total sample of jobs studied) resulted in 21 meaningful clusters. These clusters were then grouped to form various levels of job families. At the broadest level, the jobs were divided into two families: Electronic/Mechanical Maintenance, Construction, and Material Processing was the composite title of one family, and General Administration was the label assigned to the second family. The authors were also able to demonstrate substantial cluster replication and agreement between the job families and existing Air Force Career Field groups.

<u>Job family formation using data from the OAI</u>. One of the purposes for designing the OAI was to use it in support of occupational counseling. A study designed to determine the value of the OAI in such a context was completed by Pass and Cunningham (1975). The researchers developed two sets of clusters using the same data collected and factor analyzed by Boese and Cunningham (1975). A set of clusters (21 in number) was derived at the macro level; the second set (88 clusters) was narrower or at a more micro level; both clusters were

formed using the first-order dimensions of the OAI identified by Boese and Cunningham (1975). The macro clusters were very interpretable and typically reflected a broad occupational area (e.g., clerical; sales and customer service; protective service; health-related, etc.). Moreover, when the occupational structure based on the OAI clusters was compared to the 22 Dictionary of Occupational Titles (DOT) work areas derived from the 6-digit DOT code, the authors reported "reasonable relationships" in practically all cases. Apart from the significance of their findings with respect to the construct validity of an occupational taxonomy, the researchers also envisioned the use of the OAI elements or factors in the preparation of interest scales and an information system for occupational exploration and guidance.

Follow-up research by Scott, Cunningham, and Pass (1989) compared the OAI-based groupings to the job groups set forth in the Guide for Occupational Exploration (GOE) published by the U.S. Department of Labor (1979) using a statistical rather than rational comparison. The researchers concluded that there was substantial agreement between the two sets of job groups in terms of percent concordance, as well as convergent and discriminant validity analyses. Significant findings were found for all of the statistical analyses.

A database for occupational interest measurement. Cunningham (1971, 1988) has described occupational interests in the context of vocational counseling as tendencies or preferences to approach or avoid certain types of work activities. Further, Spetz and Cunningham (1989) demonstrated using factor analytic and multitrater-multimethod procedures that the interest scales developed by the USES (Droege and Hawk, 1977) clearly converged on Holland's (1985) work-related interests.

Holland, Viernstein, Kuo, Karweit, and Blum (1970) initially analyzed the relationships between Holland's (1985) six factors of vocational interest and the PAQ job dimensions with considerable success. Subsequently, Rounds, Shubsachs, Davis, and Lofquist (1978) were able to use the PAQ database as a means of deriving five (out of six) work environment factors patterned after the Holland vocational theory. Less success in discovering Holland's six-factor model using PAQ data was achieved by Hyland (1988), but she did report that confirmatory factor analysis provided some support for the Holland theory. A summary of exploratory research in the area, as well as further documentation of the relationships between interests and job dimensions, is reported by Hyland and Muchinsky (1991). They concluded that "this study provides corroborative evidence for the usefulness of employing job analysis data developed by the U.S. Employment Service for the classification of occupations in the DHOC" (p. 78). [Note: DHOC is the Dictionary of Holland Occupational Codes; Gottfredson, Holland, & Ogawa, 1982]. While these studies were designed to investigate the Holland model of vocational choice, it also is important to recognize that, independent of the model, the analysis of PAQ dimension data across a wide spectrum of occupations yields on its own significant conceptual clarity regarding the content of work. Conceptually, the GWAs might also support such understanding, especially when coupled with other components of the O*NET.

With respect to career guidance that might result from the use of occupational interest data directly linked to GWAs, Freudenberg (1995) has documented the development of such a methodology for an aerospace worker retraining and outplacement program, supported by a grant from the U.S. Department of Labor. The intent of the process is to align laid-off workers with demand occupations for which they have both an interest and transferable capabilities, and to identify specific skill gaps that could be closed through retraining. Using the Occupational Preference Inventory (an interest measure based on the PAQ) and demand occupational data described in terms of the PAQ, a job-matching procedure linked specific individuals to potential jobs that would be of interest to them and for which they would be reasonably well-qualified.

Estimation of job values for classification. Preliminary comments. For purposes of this discussion, a clear distinction is being drawn between the terms "job evaluation" and "job classification." Job evaluation is the process of determining the value or hierarchical order of jobs within an organization, typically by utilizing job analysis data. On the other hand, job classification is the arrangement of jobs into classes or grades according to the results of job evaluation. Usually, job evaluation and classification are accomplished for the specific purpose of developing a compensation structure and assigning jobs to pay levels within that structure, although in some organizational settings, classification can occur for some purposes other than pay determination.

When establishing value or worth, a critical issue relates to defining the standard or criterion of value to be applied to the evaluation of jobs. Although various criteria have been proposed, none has gained acceptance due to both theoretical and measurement problems, except for the traditional criterion of supply and demand, most frequently expressed in terms of dollar compensation. This issue has become a matter of national concern, in particular because of the differences in the pay of women relative to men. Nonetheless, by using a broad-based sampling of jobs that is not dominated by incumbents of one gender, it may be reasonable to use the labor market as an index of value for job component job evaluation with a generalized worker-oriented database.

Job evaluation research. The earliest study investigating the viability of using worker-oriented job analysis data to estimate job values was completed by Champagne and McCormick (1964). Using the Worker Activity Profile (WAP; the forerunner to the PAQ), they found a very modest cross-validated multiple correlation of .36 between WAP item ratings and rates of pay for a sample of 255 jobs. However, the research study using the PAQ was much more impressive. Mecham and McCormick (1969b) found cross-validated multiple correlation coefficients ranging from .83 to .89 when using either items or job dimensions as predictors and average wages as a criterion for samples of 165 and 175 jobs. In a follow-up study, McCormick, DeNisi, etal, (1974) found a cross-validated multiple correlation of .64, and concluded that their results were less impressive because of the volatile nature of the wage and salary data they had collected. More encouraging results were subsequently reported for a sample of 850 jobs representative of the U.S. labor force, when a shrunken multiple correlation of .85 was found between PAQ job dimensions and average earnings (McCormick et al., 1977). In all of these studies, data were obtained from a wide variety of industries and from different geographical areas. Consequently, these variables were uncontrolled sources of variance that would contribute to error in the regression analyses, and the observed correlations may well be underestimates of the true relationship between the PAQ data and job value.

Validation of the PAQ job evaluation estimates has been accomplished by correlating the PAQ points with salary questionnaire or organizational compensation data (Jeanneret, 1980). Within the insurance industry, Taylor (1978) reported a correlation of .93 between PAQ points and actual salary rates for 79 jobs. In a public sector study, Robinson, Wahlstrom, and Mecham (1974) found a correlation of .945 between PAQ points and median salaries for 19 benchmark municipal jobs. Thus, as reported in McCormick and Jeanneret (1988), the statistical weighting that underlies the PAQ dimensions "has been found to be stable, indicating that while technology has changed, the values of basic work behaviors have remained relatively constant" (p. 832).

To summarize, the PAQ dimensions provide a means to quantitatively measure generic worker-oriented job components. Replicated research studies have shown that these PAQ dimensions underlie a hierarchy of job worth or value. Consequently, it is reasonable to expect that GWAs will have a similar application.

Estimation of skills gaps and cross-training opportunities. Given the changes that are occurring in the demographics of the U.S. workforce, as well as the skill demands of work activities, there is a growing demand for organizations to evaluate the extent to which they face a skills gap. In what may be a first-of-a-kind study, Holden (1995) used data from the Dictionary of Occupational Titles and test predictions from the PAQ to assess job skill requirements for most of a company's non-management positions. Applicant and incumbent skill levels (based on selection test results) were compared to the job requirements across positions to measure the skills gap. The gap for applicants and incumbents combined ranged from 9% to 32% (an average of 22%) of the individuals who did not meet the minimum requirements, depending on the specific skill (aptitude) required. Cunningham et al. (1995) also have pointed out the utility of "inventorying human resource pools" using GWAs as the basis for determining which individuals were sufficiently trained for which activities. Clearly, gaps would indicate opportunities for education, training, and development.

Estimation of cross-training demands is also gaining increased importance with the changing nature of jobs and workforce demographics. In fact, one way for an organization to overcome a skills gap is to train capable employees in new and needed skills. In an exploratory study Lance, Mayfield, Foster, Stokes, and Mecham (1991) were able to calculate cross-training time estimates for 57 jobs on the basis of PAQ data. The estimates followed from the work of Sparrow (1989) who created cross-training indices for both the divisional and overall dimension scores using a measure of distance (Sd) between the profile of PAQ dimension scores for a current and a "retraining" job. In the Lance et al. study, scores for PAQ items rather than dimensions were used, but the Sparrow Sd algorithm was applied by comparing all jobs pairwise and summing differences in PAQ item data. Based on the results, Lance et al. believed that the estimation procedure could be useful for determining present training allocations, planning for the integration of new technologies, and providing vocational counseling to those contemplating a career change.

Summary

The O*NET provides for the collection and organization of a vast amount of occupationally related information. However, there will be many needs and applications identified that program administrators should be able to respond to by focusing on a limited amount of information. According to the research cited above, it is clear that the GWAs (alone or perhaps in combination with one or two other content areas) can be used to develop meaningful associations with human attributes, job requirements, job values, and job interests. Once these linkages are established, many needs and applications can be satisfied simply by analyzing the jobs or work functions in terms of GWAs. Thus, person-job matching, employment selection, skill development, wage and salary determination, career guidance, and other human resource management programs will be supported by the outputs that can be directly derived from the GWAs themselves.

References

American College Testing (1993, August). Performing a national job analysis study: Overview of methodology and procedures. *Work Activities Survey, Form A and Form B.* Iowa City, IA.

Arvey, R.D., Maxwell, S.E., Gutenberg, R.L., & Camp, C. (1981). Detecting job differences: A Monte Carlo study. *Personnel Psychology, 34,* 709-730.

Arvey, R.D., Maxwell, S.E., & Mossholder, K.M. (1979). Even more ideas about methodologies for determining job differences and similarities. *Personnel Psychology, 32,* 529-538.

Arvey, R.D., & Mossholder, K.M. (1977). A proposed methodology for determining similarities and differences among jobs. *Personnel Psychology, 30,* 363-373.

Baehr, M. (1988). The managerial and professional job functions inventory. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York: John Wiley & Sons.

Ballentine, R.D., Cunningham, J.W., & Wimpee, W.E. (1992). Air Force enlisted job clusters: *An exploration in numerical job classification. Military Psychology, 4,* 87-102.

Balma, M.J. (1959). The concept of synthetic validity. *Personnel Psychology, 12,* 395-396.

Barker, D.G. (1969). Factor analysis of worker trait requirements. *Journal of Employment Counseling,* 162-168.

Berliner, C.D., Angell, D., & Shearer, J.W. (1964, August). *Behaviors, measures, and instruments for performance evaluation in simulated environments.* Symposium and Workshop on the Quantification of Human Performance, Albuquerque, NM.

Boese, R.R., & Cunningham, J.W. (1975). Systematically derived dimensions of human work. Raleigh, NC: Center for Occupational Education, North Carolina State University. (*Ergometric Research and Development Series Report No. 14*).

Borman, W.C., Ackerman, L.D., Kubisiak, V.C., & Quigley, A.M. (1994). Development of a performance rating program in support of Department of Labor test validation research. *Department of Labor Technical Report, University of South Florida.*

Borman, W.C., & Brush, D.H. (1993). More progress toward a taxonomy of managerial performance requirements. *Human Performance, 6* , 1-21.

Cain, P.S., & Treiman, D.J. (1981). The Dictionary of Occupational Titles as a source of occupational data. *American Sociological Review, 46,* 253-278.

Campbell, J.P. (1990). An overview of the Army selection and classification project (Project A). *Personnel Psychology, 43,* 231-239.

Campbell, J.P., McCloy, R.A., Oppler, S.H., & Sager, C.E. (1993). *A theory of performance. In Schmitt, Borman, & Associates, Personnel selection in organizations.* San Francisco: Jossey-Bass, Inc.

Cappelli, P. (1995, March). *Conceptual issues in developing a system for classifying occupations.* Prepared for U.S. Department of Labor, Washington, D.C. Unpublished manuscript.

Chalupsky, A.B. (1962). Comparative factor analyses of clerical jobs. *Journal of Applied Psychology, 46,* 62-66.

Champagne, J.E., & McCormick, E.J. (1964). *An investigation of the use of worker-oriented job variables in job evaluation.* Lafayette, IN: Purdue University, Occupational Research Center. (Report No. 7).

Colbert, G.A., & Taylor, L.R. (1978). Empirically derived job families as a foundation for the study of validity generalization: Study III. Generalization of selection test validity. *Personnel Psychology, 31,* 355-364.

Cornelius, E.T. (1981, August). *The impact of statistical algorithms on the formation of job families.* Paper presented to 89th Annual meeting of the American Psychological Association, Los Angeles.

Cornelius, E.T., Carron, T.J., & Collins, M.N. (1979). Job analysis models and job classification. *Personnel Psychology, 32,* 693-708.

Cornelius, E.T. & Hakel, M.D. (1978). *A study to develop an improved enlisted performance evaluation system for the U.S. Coast Guard.* Washington, DC: Department of Transportation, United States Coast Guard.

Cornelius, E.T., Hakel, M.D., & Sackett, P.R. (1979). A methodological approach to job classification for performance appraisal purposes. *Personnel Psychology, 32,* 283-297.

Cunningham, J.W. (1964). *Worker-oriented job variables: Their factor structure and use in determining job requirements.* Unpublished doctoral thesis, Purdue University, Lafayette, IN.

Cunningham, J.W. (1971). "Ergonometrics": A systematic approach to some educational problems. Raleigh, NC: Center for Occupational Education, North Carolina State University. In *JSAS Catalog of Selected Documents in Psychology, 1974, 4,* 144-145.

Cunningham, J.W. (1988). Occupation analysis inventory. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 975-990). New York: Wiley.

Cunningham, J.W., & Ballentine, R.D. (1982). *The General Work Inventory.* Raleigh, NC: Authors.

Cunningham, J.W., Drewes, D.W., & Powell, T.E. (1995, April). *Framework for a revised Standard Occupational Classification (SOC).* Prepared for U.S. Department of Labor, Washington, DC. Unpublished manuscript.

Cunningham, J.W., & McCormick, E.J. (1964a). *Factor analyses of "worker-oriented" job variables. Lafayette, IN: Purdue University, Occupational Research Center.* (Prepared for Office of Naval Research under contract Nonr-1100 (19), Report No. 4).

Cunningham, J.W., & McCormick, E.J. (1964b). *The experimental use of worker-oriented job variables in determining job requirements.* Lafayette, IN: Purdue University, Occupational Research Center. (Prepared for Office of Naval Research under contract Nonr-1100 (19), Report No. 5).

Cunningham, J.W., & Scott, B.M. (1988, August). *The dimensionality of USES and OAI worker-oriented job variables.* Symposium: Occupational Analysis and the Dictionary of Occupational Titles. 96th Annual Convention of the American Psychological Association, Atlanta, GA.

Cunningham, J.W., Wimpee, W.E., & Ballentine, R.D. (1990). Some general dimensions of work among U.S. Air Force enlisted occupations. *Military Psychology, 2,* 33-45.

DeNisi, A.S., & McCormick, E.J. (1974). *The cluster analysis of jobs based on data from the Position Analysis Questionnaire* (PAQ). Lafayette, IN: Purdue University, Department of Psychological Sciences. (Technical Report No. TR-7).

Dickinson, A.M. (1977). *Development of a systematic procedure for the evaluation of employee job performance based on a structured job analysis questionnaire.* Unpublished master's thesis, Fanleigh University, Madison, NJ.

Dowell, B.E., & Wexley, K.N. (1978). Development of a work behavior taxonomy for first-line supervisors. *Journal of Applied Psychology,* 63, 563-572.

Droege, R.C. & Hawk, J. (1977). Development of a U.S. Employment Service interest inventory. *Journal of Employment Counseling*, 14, 65-71.

Dunnette, M.D. (1976). Aptitudes, abilities, and skills. In M.D. Dunnette (Ed.), *Handbook of industrial and organizational psychology*. Chicago: Rand McNally College Publishing Company.

Eberhardt, B.J., & Muchinsky, P.M. (1982). An empirical investigation of the factor stability of Owen's Biographical Questionnaire. *Journal of Applied Psychology, 67,* 138-145.

Fine, S.A. (1989). *Functional job analysis scales: A desk aid.* Milwaukee, WI: Sidney A. Fine.

Flanagan, J.C. (1951). Defining the requirements of the executive's job. *Personnel, 28,* 28-35.

Fleishman, E.A. (1972). On the relation between abilities, learning, and human performance. *American Psychologist*, November, 1017-1032.

Fleishman, E.A. (1975). Toward a taxonomy of human performance. *American Psychologist*, December, 1127-1149.

Freudenberg, R. (1995, May). *Use of the Position Analysis Questionnaire and the Occupational Preference Inventory in the redeployment of laid-off aerospace workers. Current Innovations in PAQ-Based Research and Practice*. Symposium presented at the Tenth Annual Conference of the Society for Industrial and Organizational Psychology, Inc., Orlando.

Gordon, G.G. (1963). *An investigation of the dimensionality of worker-oriented job variables*. Unpublished doctoral thesis, Purdue University, Lafayette, IN.

Gordon, G.G., & McCormick, E.J. (1963). *The identification, measurement, and factor analyses of "worker-oriented" job variables*. Lafayette, IN: Purdue University, Occupational Research Center. (Prepared for Office of Naval Research under contract Nonr-1100 (19), Report No. 3).

Gordon, J. (1992). Work teams: how far have they come? *Training, 29,* 59-65.

Gottfredson, G.D., Holland, J.L., & Ogawa, D.K. (1982). *Dictionary of Holland occupational codes.* Palo Alto, CA: Consulting Psychologists Press.

Gutenberg, R.L., Arvey, R.D., Osburn, H.G., & Jeanneret, P.R. (1983). The moderating effects of decision making/information processing job dimensions on test validities. *Journal of Applied Psychology, 68,* 602-608.

Guzzo, R. A., & Salas, E. (1995). *Team effectiveness and decision-making in organizations.* San Francisco: Jossey-Bass.

Hamer, R.M., & Cunningham, J.W. (1981). Cluster analyzing profile data confounded with interrater differences: A comparison of profile association measures. *Applied Psychological Measurement, 5,* 63-72.

Hanser, L.M., Mendel, R.M., & Wolins, L. (1979). Three flies in the ointment: A reply to Arvey and Mossholder. *Personnel Psychology, 32,* 511.

Hartman, E.A., & Kromm, G.M. (1989). *A comparison of rationally and empirically derived job families.* Presented to the Fourth Annual Meeting of the Society for Industrial and Organizational Psychology, Inc., Boston, MA.

Harvey, R.J. (1987, April). *Alternative factor structures for the Position Analysis Questionnaire* (PAQ). In M.D. Hakel (Chair), *The dimensionality of work: Future directions, applications, and instrumentation.* Symposium presented at the annual conference of the Society for Industrial and Organizational Psychology, Atlanta.

Harvey, R.J. (1991). Job analysis. In M.D. Dunnette & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology* (pp. 72-163). Palo Alto, CA: Consulting Psychologists Press.

Harvey, R.J., Friedman, L., Hakel, M.D., & Cornelius III, E.T. (1988). Dimensionality of the Job Element Inventory (JEI), a simplified worker-oriented job analysis questionnaire. *Journal of Applied Psychology, 73,* 639-646.

Harvey, R.J., & Hayes, T.L. (1988, March). *Task versus worker-oriented job analysis factors*. Paper presented at the meeting of the Southeastern Psychological Association, New Orleans.

Harvey, R.J., Wilson, M.A., & Blunt, J.H. (1989). *A comparison of rational versus empirical methods of deriving job analysis dimensions*. Manuscript under review.

Hemphill, J.K. (1960). *Dimensions of executive positions*. Columbus: Ohio State University, Bureau of Business Research.

Hoffman, C.C., & Lamartine, S.C. (1995, May). *Transporting physical ability test validity via the Position Analysis Questionnaire. Current innovations in PAQ-based research and practice*. Symposium presented at the Tenth Annual Conference of the Society for Industrial and Organizational Psychology, Inc., Orlando.

Holden, L.M. (1995, May). *Assessing the organizational skills gap: Using the Position Analysis Questionnaire as the bridge. Current innovations in PAQ-based research and practice*. Symposium presented at the Tenth Annual Conference of the Society for Industrial and Organizational Psychology, Inc., Orlando.

Holland, J.L. (1985). *Making vocational choices* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Holland, J.L., Viernstein, M.C., Kuo, H., Karweit, N.L., & Blum, Z.D. (1970). *A psychological classification of occupations.* Baltimore: The Johns Hopkins University, Center for the Study of Social Organization of Schools.

Howard, A. (Ed.) (1995). *The Changing Nature of Work.* San Francisco: Josey-Bass.

Hull, C.L. (1943). *Principles of behavior: An introduction to behavior theory.* New York: Appleton-Century.

Hunter, J.E. (1983). *The dimensionality of the General Aptitude Test Battery (GATB) and the dominance of general factors over specific factors in the prediction of job performance for the U.S. Employment Service* (USES Test Res. Rep. No. 44). Washington, DC: U.S. Department of Labor.

Hunter, J.E. (1986). Cognitive ability, cognitive aptitudes, job knowledge, and job performance. *Journal of Vocational Behavior, 29,* 340-362.

Hyland, A.M. (1988). The construct validation of Holland's model of vocational choice using PAQ job analytic information. *Dissertation Abstracts International, 49,* 4006-13.

Hyland, A.M., & Muchinsky, P.M. (1991). Assessment of the structural validity of Holland's model with job analysis (PAQ) information. *Journal of Applied Psychology, 76,* 75-80.

Jeanneret, P.R. (1969). A study of the job dimensions of "worker-oriented" job variables and of their attribute profiles. *Dissertation Abstracts International, 30,* 5273-5274.

Jeanneret, P.R. (1972, September). *Investigation of a worker-oriented approach to position analysis. Directions in Work Analysis.* American Psychological Association, Hawaii.

Jeanneret, P.R. (1980). Equitable job evaluation and classification with the Position Analysis Questionnaire. *Compensation Review, 12,* 32-42.

Jeanneret, P.R. (1985, August). Chair and Discussant, Symposium: *Job component validity: job requirements estimates and validity generalization comparisons*. American Psychological Association, Los Angeles.

Jeanneret, P.R. (1987). Presenter, Future directions in the application of job analysis data. Symposium: *The dimensionality of work: Future directions, applications, and instrumentation*. Second Annual Conference of the Society for Industrial and Organization Psychology, Inc., Atlanta.

Jeanneret, P.R. (1988). Computer logic chip production operators. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 1329-1345). New York: Wiley.

Jeanneret, P.R. (1990, August). Presenter, *The Position Analysis Questionnaire: Recent applications based on quantified job profiles*. Symposium: Quantitative job Description and Classification: *Nomothetic approaches and applications*. 38th Convention of the American Psychological Association, Boston.

Jeanneret, P.R. (1992). Applications of job component/synthetic validity to construct validity. *Human Performance, 5*, 81-96.

Jeanneret, P.R., & McCormick, E.J. (1969). *The job dimensions of "worker-oriented" job variables and of their attribute profiles as based on data from the Position Analysis Questionnaire*. Lafayette, IN: Purdue University, Occupational Research Center. (Technical Report No. 2).

Kaiser, H.F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika, 23*, 187-200.

Lance, C.E., Mayfield, D.L., Foster, M.R., Stokes, G.S., & Mecham, R.C. (1991). *Cross-job retraining time estimates based on the Position Analysis Questionnaire*. Presented to the Sixth Annual Meeting of SIOP, St. Louis, MO.

Lawshe, C.H. (1952). Employee selection. *Personnel Psychology, 5,* 31-34.

Lawshe, C.H., & Steinberg, V. (1955). Studies in synthetic validity: An exploratory investigation of clerical jobs. *Personnel Psychology, 8,* 281-301.

Lissitz, R.W., Mendoza, J.L., Huberty, C.J., & Markos, V.H. (1979). Some further ideas on a methodology for determining job similarities/differences. *Personnel Psychology, 32,* 517.

Marquardt, L.D., & McCormick, E.J. (1972). *Attribute ratings and profiles of the job elements of the Position Analysis Questionnaire (PAQ).* Lafayette, IN: Purdue University, Department of Psychological Sciences, Occupational Research Center. (Technical Report No. 1).

Marquardt, L.D., & McCormick, E.J. (1973). *Component analyses of the attribute data based on the Position Analysis Questionnaire (PAQ).* Lafayette, IN: Purdue University, Occupational Research Center. (Technical Report No. TR-2).

Marquardt, L.D., & McCormick, E.J. (1974). *The job dimensions underlying the job elements of the Position Analysis Questionnaire (PAQ Form B).* Lafayette, IN: Purdue University. (Technical Report No. 4).

McCormick, E.J. (1959). The development of processes for indirect or synthetic validity: III. Application of job analysis to indirect validity (A symposium). *Personnel Psychology, 12,* 402-413.

McCormick, E.J. (1964). *The development, analysis, and experimental application of worker-oriented job variables.* Lafayette, IN: Purdue University, Occupational Research Center. (Prepared for Office of Naval Research under Contract Nonr-1100, Final Report).

McCormick, E.J. (1979). *Job analysis: Methods and applications.* New York: AMACOM.

McCormick, E.J., Cunningham, J.W., & Gordon, G.G. (1967). Job dimensions based on factorial analyses of worker-oriented job variables. *Personnel Psychology, 20,* 417-430.

McCormick, E.J., DeNisi, A.S., & Marquardt, L.D. (1974). *The derivation of job compensation index values from the Position Analysis Questionnaire (PAQ).* Lafayette, IN: Purdue University, Department of Psychological Sciences, Occupational Research Center. (Technical Report No. TR-6).

McCormick, E.J., DeNisi, A.S., & Shaw, J.B. (1977). *Job-derived selection: Follow-up report.* Lafayette, IN: Purdue University, Department of Psychological Sciences. (Technical Report No. TR-4).

McCormick, E.J., DeNisi, A.S., & Shaw, J.B. (1979). Use of the Position Analysis Questionnaire for establishing the job component validity of tests. *Journal of Applied Psychology, 64,* 51-56.

McCormick, E.J., Finn, R.H., & Scheips, C.D. (1957). Patterns of job requirements. *Journal of Applied Psychology, 41,* 358-364.

McCormick, E.J., & Jeanneret, P.R. (1988). Position Analysis Questionnaire (PAQ). In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (Vol. II., pp. 825-842). New York: Wiley.

McCormick, E.J., Jeanneret, P.R., & Mecham, R.C. (1967). *Position Analysis Questionnaire (Form A).* Lafayette, IN: Purdue University, Department of Psychology, Occupational Research Center.

McCormick E.J., Jeanneret, P.R., & Mecham, R.C. (1969). *A study of job characteristics and job dimensions based on the Position Analysis Questionnaire.* Lafayette, IN: Purdue University, Occupational Research Center. (Technical Report No. 6).

McCormick, E.J., Jeanneret, P.R., & Mecham, R.C. (1972). A study of job characteristics and job dimensions as based on the Position Analysis Questionnaire (PAQ). *Journal of Applied Psychology Monograph, 56,* 347-368.

McCormick, E.J., Mecham, R.C., & Jeanneret, P.R. (1977). *Technical manual for the Position Analysis Questionnaire (PAQ).* Logan, UT: PAQ Services.

McCormick, E.J., Mecham, R.C., & Jeanneret, P.R. (1989). *Technical manual for the Position Analysis Questionnaire (PAQ) (2nd ed.).* Logan, UT: PAQ Services. (Available through Consulting Psychologists Press, Inc., Palo Alto, CA).

McCulloch, M.C., & Francis, D.J. (1989, August). *Analyzing the social content of jobs: Testing the social scale of Functional Job Analysis. In T.W. Mitchell (Chair), Theory, instrumentation applications, and consequences in recent job analysis research.* Symposium presented at the annual meeting of the American Psychological Association, New Orleans.

McIntyre, R.M., & Farr, J.L. (1979). Comments on Arvey and Mossholder's "A proposed methodology for determining similarities and differences among jobs." *Personnel Psychology, 32,* 507-510.

McNeil, R.C. (1984). A methodological approach to job family development. *Dissertation Abstracts International, 46.*

Mecham, R.C. (1985, August). *Comparative effectiveness of situational, generalized, and job component validation methods. In P.R. Jeanneret (Chair), Job component validity: Job requirements, estimates, and validity generalization comparisons.* Symposium conducted at the Annual Convention of the American Psychological Association, Los Angeles.

Mecham, R.C., & McCormick, E.J. (1969a). *The use of data based on the Position Analysis Questionnaire in developing synthetically derived attribute requirements of jobs.*

Lafayette, IN: Purdue University, Occupational Research Center. (Technical Report No. TR-4).

Mecham, R.C., & McCormick, E.J. (1969b). *The use in job evaluation of job elements and job dimensions based on the Position Analysis Questionnaire*. Lafayette, IN: Purdue University, Occupation Research Center. (Technical Report No. 3).

Miller, R.B. (1953). *A method for man-machine task analysis* (USAF, WADC, TR 53-137). Wright-Patterson AFB, Ohio.

Mitchell, J.L. (1978). *Structured job analysis of professional and managerial positions.* Unpublished doctoral dissertation. Purdue University, Lafayette, IN.

Mitchell, J.L., & McCormick, E.J. (1976). *Professional and Managerial Position Questionnaire (PMPQ)*. Lafayette, IN: Purdue University, Department of Psychological Sciences. (Published by Consulting Psychologists Press, Palo Alto, CA).

Mossholder, K.W., & Arvey, R.D. (1984). Synthetic validity: A conceptual and comparative view. *Journal of Applied Psychology, 69*, 322-333.

O'Leary, B.S., Rheinstein, J., McCauley, D.E. (1989). *Developing a taxonomy of generalized work behaviors*. Unpublished paper presented at the 31st annual conference of the Military Testing Association, San Antonio, TX.

Outerbridge, A.N. (1981). *The development of generalizable work behavior categories for a synthetic validity model.* Washington, DC: U.S. Office of Personnel Management, Personnel Research and Development Center.

PAQ Services, Inc. (1990). *User's manual for the Position Qualification System* (PQS). Logan, UT: Author.

Palmer, Jr., G.J., & McCormick, E.J. (1961). A factor analysis of job activities. *Journal of Applied Psychology, 45,* 289-294.

Pass, J.J., & Cunningham, J.W. (1975). *Occupational clusters based on systematically derived work dimensions: Final report.* Raleigh, NC: North Carolina State University, Center for Occupational Education.

Pearlman, K. (1980). Job families: A review and discussion of their implications for personnel selection. *Psychology Bulletin, 87,* 1-28.

Peters, D.L., & McCormick, E.J. (1962, November). *The experimental use of various types of scales in rating job activities.* Lafayette, IN: Purdue University, Occupational Research Center. (Prepared for Office of Naval Research under contract Nonr-1100, Report No. 2).

Peterson, N.G. (1994). *Methodology for identifying SCANS competencies and foundation skills.* Washington, DC: American Institutes for Research.

Primoff, E.S. (1955a, May). *Basic formulae for the J-coefficient to select tests by job analysis requirements.* Washington, DC: U.S. Civil Service Commission.

Primoff, E.S. (1955b). *Test selection by job analysis: The J-coefficient, what it is, how it works (Test Technical Series No. 20).* Washington, DC: U.S. Civil Service Commission.

Robinson, D.D., Wahlstrom, O.W., & Mecham, R.C. (1974). Comparison of job evaluation methods: A "policy-capturing" approach using the Position Analysis Questionnaire. *Journal of Applied Psychology, 59,* 633-637.

Rosenberg, S., & Sedlack, A. (1972). *Structural representations of perceived personality trait relationships. In A.K. Romney, R.N. Shepart, & S.B. Nerlove (Eds.), Multidimensional scaling* (pp. 134-162). New York: Seminar.

Rounds, J.B., Shubsachs, A.P., Davis, R.V., & Lofquist, L.H. (1978). A test of Holland's environment formulations. *Journal of Applied Psychology, 63,* 609-616.

Sackett, P.R., Cornelius, E.T., & Carron, T.J. (1981). A comparison of global judgment vs. task oriented approaches to job classification. *Personnel Psychology, 34,* 791-804.

Scott, B.M., Cunningham, J.W., & Pass, J.J. (1989). *A comparison of two job grouping systems: Research in numerical job taxonomy.* Presented to First Annual Convention of the American Psychological Society, Alexandria, VA.

Skinner, B.F. (1938). *The behavior of organisms: An experimental analysis.* New York: Appleton-Century.

Sparrow, J. (1989). The utility of PAQ in relating job behaviors to traits. *Journal of Occupational Psychology, 62, 151-162.*

Sparrow, J., Patrick, J., Spurgeon, P.C., & Barwell, F. (1982). The use of job component analysis and related aptitudes in personnel selection. *Journal of Occupational Psychology, 55,* 157-164.

Spetz, S.H., & Cunningham, J.W. (1989, June). *Worker-related interest factors among undergraduates.* Presented at the 1989 Convention of the American Psychological Society. Arlington, VA.

Talbert, T.L., Carroll, K.I., & Ronan, W.W. (1976). Measuring clerical job performance. *Personnel Journal, 55,* 573-575.

Taylor, L.R. (1978). Empirically derived job families as a foundation for the study of validity generalization: Study I. The construction of job families based on the component and overall dimensions of the PAQ. *Personnel Psychology, 31,* 325-340.

Taylor, L.R., & Colbert, G.A. (1978). Empirically derived job families as a foundation for the study of validity generalization: Study II. The construction of job families as a foundation for the study of validity generalization. *Personnel Psychology, 31,* 341-353.

Tornow, W.W., & Pinto, P.R. (1976). The development of a managerial job taxonomy: A system for describing, classifying, and evaluating executive positions. *Journal of Applied Psychology, 61,* 410-418.

Townsend, J.W., Prien, E.P., & Johnson, J.T. (1974). The use of the Position Analysis Questionnaire in selecting correlates of job performance among mentally retarded workers. *Journal of Vocational Behavior, 4,* 181-192.

Tucker, L.R. (1951). A method for synthesis of factor analysis studies. *Personnel Research Section Report No. 984.* Washington, DC: Department of the Army.

U.S. Department of Labor. (1979). *Guide for occupational exploration.* Washington, DC: U.S. Government Printing Office.

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington DC: Author.

U.S. Office of Personnel Management. (1991). *Leadership effectiveness survey for federal supervisors, managers, and executives.* Washington, DC: Author.

Ward, Jr., J.H., & Hook, M.E. (1963). Application of an hierarchial grouping procedure to a problem of grouping profiles. *Educational and Psychological Measurement, 23,* 69-81.

Watson, J.B. (1913). Psychology as the behaviorist views it. *Psychological Review, 20,* 158-177.

Watson, J.B. (1919). *Psychology from the standpoint of a behaviorist.* Philadelphia: Lippincott.

Watson, J.B. (1925). *Behaviorism*. New York: Norton.

Wellins, R. S., Byham, W. C., & Dixon G. R. (1994). *Inside teams*. San Francisco: Josey-Bass.

Williams, R.E. (1956). *A description of some executive abilities by means of the critical incident technique*. Unpublished doctoral dissertation, Columbia University, New York.

Yukl, G.A. (1987, October). *A new taxonomy for integrating diverse perspectives on managerial behavior*. Paper presented at the annual meeting of the American Psychological Association, New York.

Appendix 6-A

Cross-Walk Between the Jeanneret and Borman GWAs and 18 Other GWA Frameworks

GWA Dimension	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Information Input																		
Looking for and Receiving Job-Related Information																		
1. Getting information needed to do the job	X	X	X	X			X	X			X							
2. Monitoring processes, materials, and surroundings	X		X	X			X	X	X		X							
Identifying/Evaluating Job-Relevant Information																		
3. Identifying objects, activities, and events	X			X				X			X							
4. Inspecting equipment, structures, or materials		X	X					X	X		X							
5. Estimating the characteristics of materials, products, events, or information	X			X					X		X							
Mental Processes																		
Information/Data Processing																		
6. Judging the qualities of objects, services, or persons								X			X							
7. Processing information	X	X	X	X			X	X	X		X			X	X	X		
8. Evaluating information for compliance to standards		X	X								X	X				X		
9. Analyzing data or information			X				X	X			X							
Reasoning/Decision Making																		
10. Making decisions and solving problems	X			X	X		X	X		X	X					X		
11. Thinking creatively		X					X	X		X	X							
12. Updating and using job-relevant knowledge	X	X	X		X	X	X	X			X							
13. Developing objectives and strategies										X	X	X	X	X	X		X	
14. Scheduling work and activities			X	X				X	X		X	X	X		X	X	X	X
15. Organizing, planning, and prioritizing work		X			X			X		X	X	X	X	X	X	X	X	X
Work Output																		
Performing Physical and Manual Work Activities																		
16. Performing general physical activities	X			X							X							
17. Handling and moving objects	X	X		X			X				X							

GWA Dimension	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
18. Controlling machines and processes	X	X		X			X				X							
19. Operating vehicles and mechanized devices or equipment	X	X		X							X							
Performing Complex/Technical Activities																		
20. Interacting with computers		X					X	X		X	X							
21. Drafting, laying out, and specifying technical devices, parts, or equipment		X	X				X				X							
22. Implementing ideas, programs, systems, or products	X	X		X				X	X		X							
23. Repairing and maintaining mechanical equipment	X	X		X			X	X	X		X							
24. Repairing and maintaining electronic equipment	X	X		X			X	X	X		X							
25. Documenting and recording information		X	X						X		X							
Interacting with Others																		
Communicating/Interacting																		
26. Interpreting the meaning of information for others			X				X	X										
27. Communicating with supervisor, peers, or subordinates	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
28. Communicating with persons outside the organization	X	X	X	X	X	X		X		X	X	X		X	X	X	X	X
29. Establishing and maintaining interpersonal relationships								X		X	X	X		X	X	X		X
30. Assisting and caring for others		X					X			X								
31. Selling or influencing others	X	X	X				X	X		X	X	X		X	X	X	X	
32. Resolving conflicts and negotiating with others		X	X					X		X	X	X		X		X	X	
33. Performing or working directly with the public	X		X					X			X							
Coordinating/Developing/Managing/Advising Others																		
34. Coordinating the work and activities of others	X		X	X				X		X	X	X	X	X	X	X	X	X
35. Developing and building teams											X	X						X
36. Teaching others		X	X					X	X		X							

GWA Dimension	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
37. Guiding, directing, and motivating subordinates	X	X		X		X		X	X	X	X	X	X	X	X	X	X	X
38. Coaching and developing others	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
39. Providing advice and consultation to others			X							X	X			X				X
Administering																		
40. Accomplishing administrative activities			X			X			X	X	X			X				X
41. Staffing organizational units			X							X	X	X		X	X		X	
42. Monitoring and controlling resources			X						X	X	X	X		X	X		X	X

Taxonomies Represented

1. PAQ (McCormick et al., 1972)
2. OAI (Cunningham, 1988)
3. Outerbridge/O'Leary GWBs (Outerbridge, 1981; O'Leary et al., 1989)
4. JEI (Cornelius, Hakel, & Sackett, 1979)
5. Department of Labor Dimensions (Borman et al., 1994)
6. Campbell et al. (1993) Performance Model
7. GWI (Cunningham et al., 1990)
8. SCANS (Peterson, 1994)
9. First-Line Supervisor Taxonomy (Dowell & Wexley, 1978)
10. MOSAIC Competencies (Office of Personnel Management, 1991)
11. ACT GWB List (American College Testing, 1993)

Managerial Taxonomies

12. Borman and Brush (1993)
13. Flanagan (1951)
14. Tornow & Pinto (1976)
15. Hemphill (1960)
16. Mitchell (1978)
17. Williams (1956)
18. Yukl (1987)

Chapter 7
Work Context
Table of Contents

Tables

Figures

Appendix

Chapter 7
Work Context

S. Morton McPhail, Barry R. Blakley, Mark H. Strong,
Tonya J. Collings, P. Richard Jeanneret, & Laura Galarza
Jeanneret & Associates, Inc.

Introduction

The work environment is one of the most salient aspects of a person's job, and the study of this environment, or Work Context, is a vital component of job analysis. To fully understand how work actually gets accomplished, the environment in which the work occurs must be taken into consideration and examined for its moderating effects. The need for such study is widely recognized in the literature, and there are few job analysis questionnaires that do not measure some aspect of the context in which work takes place (Gael, 1988; Ghorpade, 1988). Although Work Context greatly influences how jobs are performed, there are few questionnaires specifically designed to document environmental or contextual variables. Perhaps one reason is that there is an extremely broad range of constructs that may be considered under the rubric of Work Context. From another perspective, there has been little consistency in linking these contextual factors to a theoretical structure. Consequently, the study of Work Context variables has been fragmented and often only is a supplemental component of job analysis procedures that are focused on specific work tasks or behaviors.

The purpose of this chapter is to provide information concerning the development of a taxonomic structure within O*NET that specifically addresses Work Context variables. Additionally, we have compiled and created job analytic measures of the elements of our taxonomy. This structure has not been designed as an exhaustive list of Work Context factors, but rather as a selection of variables judged to have potential for differentiating between jobs, explaining variations in performance, and providing utility from a job analytic perspective. We also anticipate that the variables we have selected will support the contention of Cappelli (1995) that a successful occupational classification system will need to focus on task, trait, ***and*** work context criteria.

The actual physical environment in which the job is performed is the most obvious Work Context dimension. Working conditions, such as temperature, heights, pollutants, and hazards, are very salient aspects of the work environment. However, Work Context includes many more variables than the physical nature of the environment. There is a social or interpersonal work context which can greatly affect workers. Factors such as communication and role relationships have been shown to affect a number of work outcomes. The structure of jobs also provides a context in which the work takes place. A position's criticality to the organization, its pace and scheduling, and other structural factors can influence worker demands, how the work is performed, and work outcomes. Accordingly, the taxonomy described herein includes variables from the physical, interpersonal, and structural work contexts.

Review of Previous Work Context Investigation

An extensive literature review was conducted to explore aspects of the psychosocial and physical environment of work. The body of literature examining Work Context, or the psychosocial aspects and physical conditions of work, is extensive and transcends many academic disciplines. For instance, medical research has examined occupational disease, injury, stress, and their precursors and outcomes; industrial engineering research has evaluated ergonomic factors in the workplace; psychologists have studied group dynamics and interpersonal relationships in organizations and their influences on performance of work; and workplace designers have attempted to determine the optimal physical arrangements which are technically efficient and socially facilitating.

These disciplines use different labels when discussing Work Context factors, and no well-defined area of study specifically addressing contextual factors has emerged. Factors which can be labeled contextual also may be examined as factors which predispose individuals to psychological disturbances, hamper productivity, affect satisfaction with work, predispose one to injury, or act as stressors within a wide range of disciplines. In order to develop a theoretical model of the psychosocial aspects of work, a review encompassing clinical, industrial/organizational, social, human factors, medical, and general stress literature was conducted.

In addition to reviewing the research literature concerning Work Context variables, existing and precursor job analysis questionnaires also were reviewed. Various factors which may be considered contextual aspects of jobs have been included in many well-known job analysis questionnaires and systems (e.g., Department of Labor's Revised Handbook for Analyzing Jobs [DOL], Occupational Analysis Inventory [OAI], Position Analysis Questionnaire [PAQ], etc.). Although Work Context facets have been included under various headings (such as physical characteristics of work, work structure, work conditions, job design characteristics, etc.), they describe aspects of the work environment which fall under our definition of the contextual dimensions of work discussed below.

Many of the variables in our proposed taxonomy have been assessed by these popular job analysis questionnaires or have been examined in other research forums. Even variables we have included to reflect current technology (such as the amount of e-mail a worker receives) have, in some cases, been assessed elsewhere. Thus, an objective was to integrate the existing body of research regarding contextual variables into an organized structure that included meaningful constructs differentiating between jobs.

Background of Work Context Assessment

The focus of most job analytic activities has been to identify and measure the tasks and activities performed by job incumbents, while efforts to examine the context in which the work occurs often have lacked consistency and theoretical structure. It is important to note, however, that Work Context can greatly affect the performance of various work activities, as well as workers' attitudes, behaviors, and health. Because environmental factors exert great influence on tasks or activities, it is not sufficient to provide merely an examination of work activities without also evaluating the context in which they occur. Accordingly, complete information about jobs must include contextual or environmental variables. Although many job analysis questionnaires include assessment of some aspects of the psychosocial and physical work environment, no single questionnaire captures the full range of Work Context factors or provides a theoretical framework for contextual job characteristics. The current taxonomy attempts to organize these factors into a coherent structure in order to account more fully for the variables in the analysis of jobs throughout the world of work.

Researchers familiar with job analysis and the nature of work have argued that individuals must adapt to the physical and social environment rather than simply respond to them (Cunningham, 1988; Frost, 1972; Kochhar & Armstrong, 1988; Lopez, 1988; McCormick, Jeanneret, & Mecham, 1969a, 1969b, 1972; Rohmert, 1983). This position suggests that Work Context may be conceptualized as a set of moderator variables affecting or altering worker behavior. This view requires that the physical and social contexts of work be subjected to thorough examination because they represent the pervading contexts in which the work stimulus impacts the worker and in which the worker responds (see Figure 7-1) (Boese & Cunningham, 1975). As we indicated in the preceding chapter, all generalized work activities occur within structural, physical, and social contexts involving interactions and relationships with other individuals and the work environment. These structural, social, and physical characteristics are addressed as contextual factors within this chapter.

Work Context and Safety

Work Context frequently has been included in job analyses as a means of identifying and eliminating unsafe work behaviors, unsafe physical conditions, and unsafe (or unpleasant) environmental conditions. In the 1940s, job analysis was viewed as a method to investigate accidents and as an approach to studying worker health and fatigue (Zerga, 1943). More recently, the use of job analysis information for safety considerations is a legal expectation of the Occupational Safety and Health Act (OSHA) of 1970 and other legal and professional guidelines. Some job analysis methods, such as the U.S. Department of Labor *Handbook for Analyzing Jobs* (1972, 1991), specifically considered physical demand factors and environmental conditions when the factors or conditions affected the safety of the worker or others, and when the factor or condition was sufficiently hazardous to lead to bodily injury or danger to health.

The study of environmental conditions and their impact on the worker is frequently recognized as an applied ergonomics or human factors approach to job analysis (Christensen, 1988). While humans are adaptable to a wide range of environmental conditions, there are

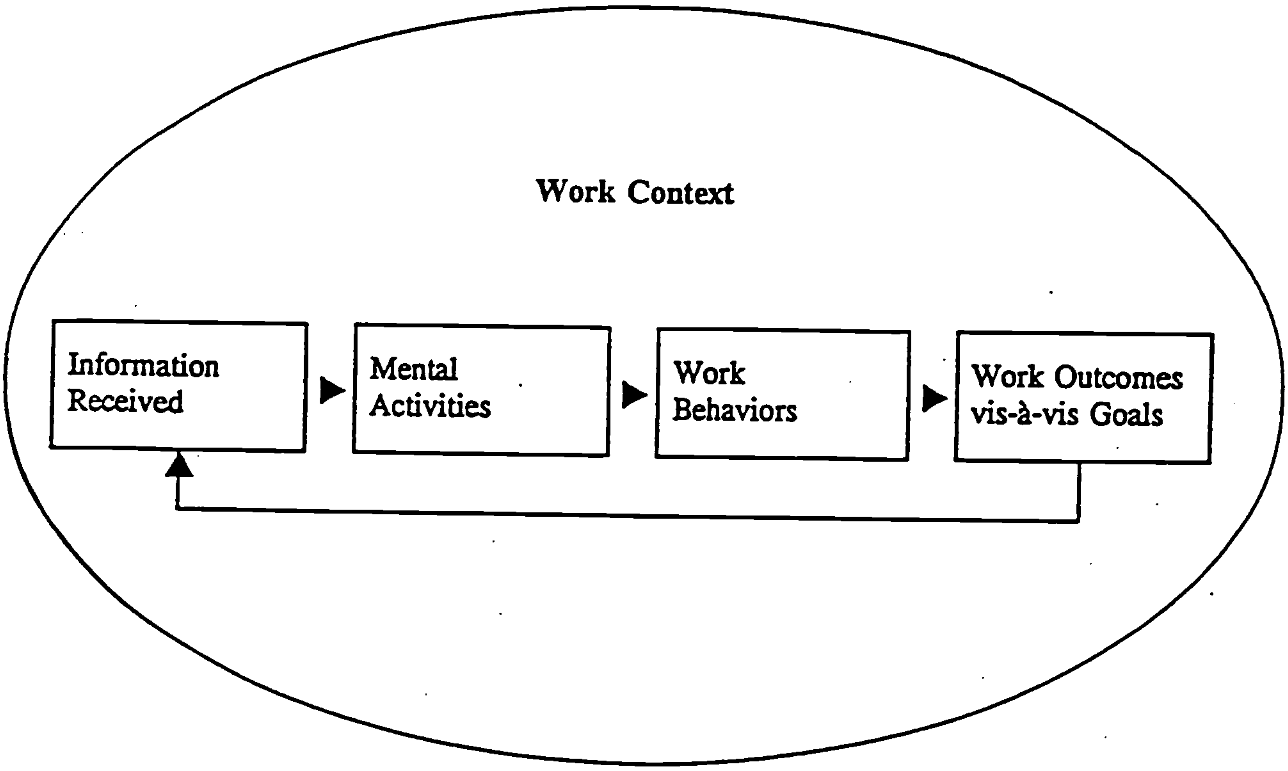


Figure 7-1
Work Context and Information Processing

many environmental parameters that are recognized as having consequential impact on worker performance (Parker & West, 1973; Poulton, 1970, 1978). In fact, many environmental factors even have standards or industrial recommendations, such as lighting (IES Industrial Lighting Committee, 1983), noise (Federal Register, 1983), and toxins (Federal Register, 1974).

Work Context and Worker Stress

Beyond the concern for worker safety, other job analysis approaches consider the environmental conditions of work that contribute to stress and strain on the worker (Rohmert, 1988). Kochhar and Armstrong (1988) examined the totality of the worker behaviors in an overall system and used a human engineering or systems approach to job analysis. Factors they examined in relation to worker stress included: (a) the goal or objective of work, (b) workplace attributes, (c) environmental attributes, (d) worker attributes, and (e) the interactions between the worker and the machinery or environment (Kochhar & Armstrong, 1988). Additionally, Payne (1980) found that interpersonal relationships and social support at work are related to important work outcomes and job stress. The link between various Work Context variables has been well established, and the literature includes psychosocial factors, such as group behaviors, communications, role relationships, and internal and external social relations, as well as other contextual factors, such as work hours, pace and schedule of work, and structure associated with work, as comprising the Work Context (Cooper, 1987; McGrath, 1976).

Work Context and Job Evaluation

The context of a job also is an important consideration for job evaluation purposes. In conducting job evaluations, it is common to analyze jobs, not necessarily in terms of specific observable behaviors, but in terms of compensable factors. Compensable factors may be defined as "paid-for, measurable qualities, features, requirements, or constructs that are common to different kinds of jobs" (Henderson, 1988, p. 94). Job evaluation methods have identified hundreds of compensable factors, which are frequently identified within the four general groupings of skill, effort, responsibility, and working conditions. In fact, these general groupings were given legal recognition in the Equal Pay Act of 1963. Many of the compensable factors pertaining to working conditions describe the physical and emotional demands placed upon the worker and the requirement to perform work in a given physical and social environment. Examples of job evaluation/job analysis methods that consider working conditions include the Position Analysis Questionnaire (PAQ; McCormick, Jeanneret, & Mecham, 1967; 1977), the Hay Plan (Hay & Purves, 1954), and the Factor Evaluation System (FES) used by the Office of Personnel Management.

Importance of Work Context

Work Context factors can have important effects on both the worker and work performance. It is well documented that working conditions can affect worker performance, contribute to occupational diseases or injuries (e.g., carpel tunnel syndrome, back injuries, etc.), and also influence various determinants of employee health, such as stress levels (Cooper & Payne, 1979; Parker & West, 1973; Poulton, 1970; Selye, 1980). In addition to having impact on physical health, many job components influence psychological well-being and work-related affect (Sundstrom & Sundstrom, 1986). Factors of Work Context, such as exposure to hazards, role relationships, and work schedules, also have been linked to a variety of work outcomes, including job performance, satisfaction, group formation, group cohesion, organizational effectiveness, and physical and psychological health (see Cooper, 1987; Evans, Johansson, & Carrere, 1994; Sundstrom & Sundstrom, 1986). The link between some Work Context variables, stress, and worker behavior has been well established (Ivancevich & Matteson, 1980; Kahn & Byosiere, 1992; Shaw & Riskind, 1983). A partial list of worker behavioral, physical, and psychological responses to stress from work context variables is presented in Table 7-1.

The examination of Work Context variables is important for other reasons as well. Evaluation of physical work conditions allows for the identification and correction of job hazards and the development of appropriate guidelines for worker safety. Information concerning the types of interpersonal relationships required by a job and the structure of the work can be beneficial when designing selection systems. Contextual factors are considered when designing compensation systems (e.g., workers may be paid at higher rates if the job requires working in hazardous conditions or if the worker is required to assume a high level of responsibility for the work or safety or others). Work Context information can be used by job designers for facilitating communication among workers and reducing hazards or work

Table 7-1
Worker Responses to Stress from Work Context Variables

• Reduced job performance	• Irritation
• Alienation from organization	• Resentment
• Turnover	• Lowered self-confidence
• Strikes	• Lowered self-esteem
• Anxiety	• Sexual maladjustment
• Boredom	• Somatic complaints
• Burnout	• Physical strain
• Reduced organizational commitment	• Tension
• Confusion	• Injuries
• Depersonalization	• Absence
• Depression	• Accidents
• Low job satisfaction	• Alcohol use on the job
• Reduced life satisfaction	• Caffeine intake
• Emotional arousal	• Spread of rumors
• Emotional exhaustion	• Lowered quality of work
• Fatigue	• Damage to property
• Poor mental health	• Poor interpersonal relationships
• Hostility	• Drug use on the job
• Illness	• Early retirement
• Physiological changes	• Increased smoking rate

interruptions. Further, job seekers can use such information to gain a better understanding of the work requirements through more comprehensive job previews.

Considerations in Developing the Work Context Taxonomy

The goal for the taxonomic structure is to provide a systematic approach to the study of Work Context variables that will provide valuable information and help differentiate jobs. This Work Context taxonomy is similar to McGrath's (1976) global division of organizational factors into tasks, roles, and settings. Work Context is defined here as *non-task-related factors of work which affect intrapersonal, interpersonal, or work outcomes*. Based on previous job analysis work, research literature, and earlier taxonomic efforts, Work Context has been divided into three higher order dimensions: (a) Interpersonal Relationships, (b) Physical Work Conditions, and (c) Structural Job Characteristics. That is, there are three

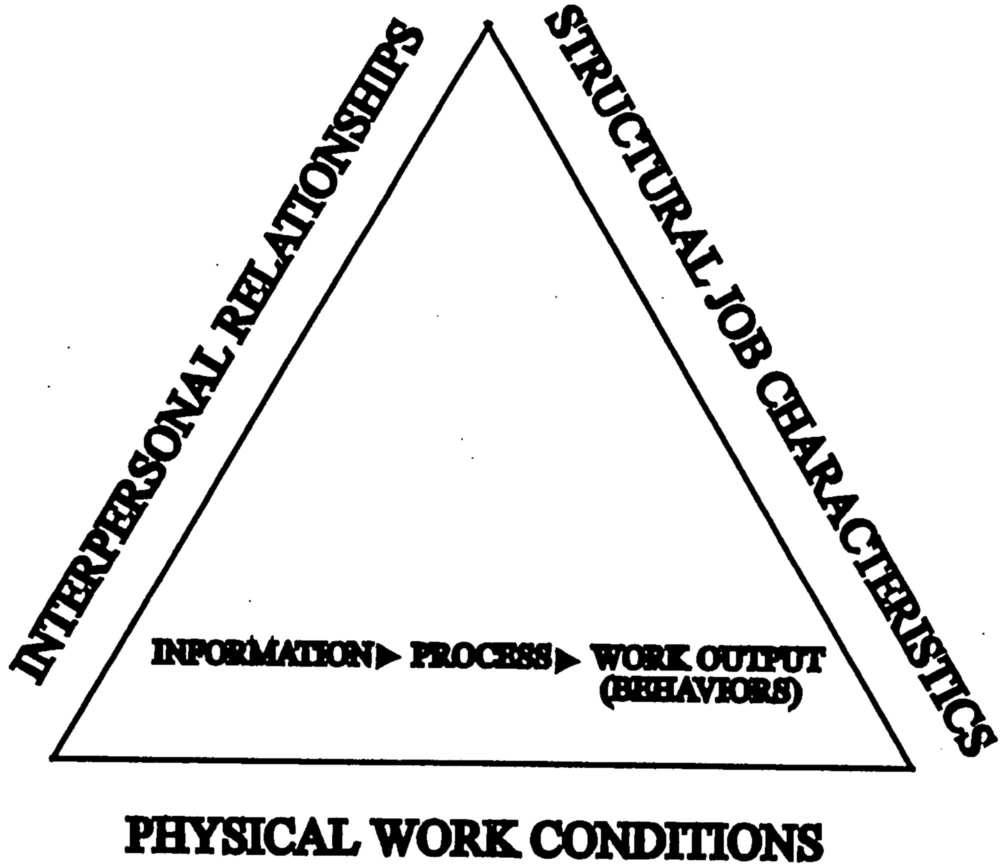


Figure 7-2
Work Context and Work Behavior

broad categories of variables that can be said to impinge on the worker in the immediate work environment: people, physical conditions, and the structure of the work, in addition to those variables mediated by the work activities and the organization. The Interpersonal Relationships dimension includes aspects of the work context such as communication, role relationships, and responsibility for others, which make up the social environment in which the work takes place. Physical Work Conditions are the actual environmental conditions in which the work is conducted (e.g., temperature, pollutants), the hazards associated with the job and possible injuries (e.g., exposure to electricity, heights), and the demands placed on the worker in terms of body positioning or required safety equipment. Structural Job Characteristics are based on the nature of the work or position and can greatly influence worker behavior. These factors include the criticality of the work, how routine the work is, and the pace and scheduling of work.

Information Processing Models

The constructs examined under the rubric of Work Context were created or compiled using an information processing or systems approach to jobs and work. The work elements were developed using an information processing paradigm in which inputs are transformed to outputs through workers' mental activities and behaviors. As depicted in Figure 7-2, this process occurs within a Work Context, here defined by the three higher order dimensions. This paradigm follows the concept of the worker as an agent who transforms materials or information into work outcomes, but it provides that the context in which the work occurs can influence various steps of the process. Using this information processing paradigm, constructs that may affect the worker or work performance were identified, including a number assessed in Cunningham's Occupational Analysis Inventory (OAI; Boese & Cunningham, 1975).

The information processing paradigm and the importance of work context variables also is evident in the organization of the Position Analysis Questionnaire (PAQ; McCormick, Mecham, & Jeanneret, 1972). The PAQ job elements are organized into six divisions: (1) Information Input, (2) Mental Processes, (3) Work Output, (4) Relationships with Others, (5) Job Context, and (6) Other Job Characteristics. The first three divisions encompass the information processing model of receiving information, performing mental processes, and producing an output or action, which occur in virtually all jobs (McCormick & Jeanneret, 1988). However, this input-process-output occurs within the framework of work relationships, job context (i.e., physical conditions), and other job characteristics. Job elements within these latter three divisions also were used as a source of constructs for the proposed Work Context taxonomy. On a conceptual level, our Interpersonal Relationships, Physical Work Conditions, and Structural Job Characteristics are closely related to divisions in the PAQ.

Psychosocial Models

Katz and Kahn (1978) view organizations as sets of subsystems and discuss integrating the technological and social subsystems in the workplace. As this systems approach is transferred to the job level, it can be seen that the social, structural, and technological elements of jobs are highly integrated. Both the social and technological subsystems involve constructs that may be labeled as Work Context. The social system includes contextual factors such as the roles that workers must assume. The technological subsystem includes many contextual factors, such as the use of computer communications, which can affect worker behavior. Constructs that correspond to these elements were developed for inclusion in the Work Context taxonomy with a focus on identifying contextual or environmental constructs that have been found to affect work behavior.

Psychosocial factors and physical work conditions have been referenced in the psychological and stress literature under various construct labels or categories, and numerous classification schemas have been used in the literature to organize the large number of work-related characteristics which affect performance, health, and well-being. Neff (1987) differentiates work behavior as the product of characteristics of the worker and characteristics of the work situation. Cooper (1987), in discussing sources of occupational stress, differentiated between six contextual aspects of the work environment: (a) factors intrinsic to the job, (b) role in the organization, (c) career development, (d) relationships at work, (e) organizational structure and climate, and (f) home-work interface.

McGrath (1976) conceptualized an organization as a combination of behavioral settings, tasks, and roles. McGrath also alluded to work context in his categorization of stressors into six types: (a) task-based stress, (b) role-based stress, (c) stress intrinsic to the behavioral setting, (d) stress arising from the physical environment, (e) stress arising from the social environment, and (f) stress the person brings to the environment. In a general sense, psychosocial characteristics might all be classified as stressors which fall into one of McGrath's categories. Origins of stress are important in understanding organizational behavior; however, individual characteristics such as social skills and organizational variables are beyond the scope of this chapter. They are treated in Chapters 3 and 8, respectively.

Another categorization of contextual factors and work outcomes has been provided by Evans and his colleagues (Evans et al., 1994). They have extensively discussed the psychosocial and physical factors in the workplace, classifying these characteristics as: structural, organizational, interpersonal, task parameters, ambient conditions, layout and arrangement of space, architectural design, and ergonomic factors. Excluding those variables that relate to the organization or external environment, the proposed Work Context taxonomy includes the aspects of the psychosocial and physical environment discussed by Evans.

Workplace Stress and Health

Some theoretical and research models address the effect of Work Context variables on stress, work outcomes, and consequences. Ivancevich and Matteson (1980) for example identify several Work Context outcomes that affect stress, which in turn affects the health, behavior, and job performance of workers. They divide Work Context into physical environment, individual level antecedents, group level antecedents, and organizational level antecedents. The physical environment variables in their model include light, noise, temperature, vibration and motion, and polluted air, among others. The individual level work context variables include work overload, role conflict, role ambiguity, and responsibility for people. The organizational level work context variables include technology, control systems, job design and job characteristics. These variables have been found to affect job, career, and life stress, leading to physiological and behavioral outcomes and consequences, such as changes in job, career and life satisfaction, changes in performance, absenteeism and turnover, coronary heart disease, ulcers, headaches, anxiety, depression, apathy, and nervous exhaustion.

Marshall and Cooper (1979) proposed and tested a model of stress which includes Work Context variables that affect workers' physical and mental health and job outcomes. Work Context variables of communication, work overload or underload, time pressures and deadlines, working conditions, technology, role ambiguity and conflict, and too much or too little responsibility were found to have an impact on stress. The effects of stress were manifested in increased pulse rate, high blood pressure, high cholesterol levels, smoking, ulcers, cardiovascular heart disease, and other physical symptoms. Excessive stress also resulted in poor mental health, low motivation, low self-esteem, job dissatisfaction, job-related tension, and escapist drinking.

Models such as the ISR Model of Social Environment and Mental Health (French & Kahn, 1962) emphasize the importance of measuring the objective industrial environment, which is hypothesized to affect the workers' physiological, behavioral, and affective responses and the mental and physical health and disease of incumbents. Kahn and Byosiere (1992) propose a model of stress in which they include the following antecedents to stress: work schedule, noise, light vibration, role ambiguity, role conflict, and role overload. They hypothesize that these Work Context variables result in cardiovascular, biochemical, gastrointestinal, musculoskeletal, and other physiological changes in the body. The antecedents of stress also are proposed to affect psychological variables, such as depression, anxiety, and job satisfaction, as well as worker behaviors such as turnover and absenteeism.

Researchers often have examined psychosocial characteristics and physical work conditions in order to differentiate between jobs. For instance, Bemis, Belenky, and Soder (1983) considered accountability, roles, the physical context, and personal and emotional demands as factors on which jobs differ. McCormick (1979) discussed job context in terms of physical working conditions, work schedule, organizational context, social context, and incentives. These dimensions commonly have been used to differentiate between jobs, and therefore are useful and necessary for a thorough and comprehensive analysis of work.

Development of the Taxonomic Structure

Research describing these individual facets of Work Context was reviewed, and based upon the literature, the three higher order dimensions were further articulated into subcategories to create a preliminary lower order taxonomy. As noted above, many job analysis questionnaires contain items which, though perhaps not labeled as such, relate to constructs within the domain of Work Context. An examination of these items and the related literature allowed further refinement and, in some cases, redefinition of aspects of the taxonomy. This review of the literature and job analysis questionnaires was utilized both to assess the specific individual factors which fell within the domain of the three higher order dimensions, as well as to "validate" the higher order dimensions as factors which are or can be researched and used to differentiate between jobs.

Measurement of Work Context Dimensions

Although all of the lower order dimensions are assessed by multiple questions, most of the Work Context item-level constructs are measured by a single item or scale. For instance, Communication is a lower order dimension under Interpersonal Relationships, and there are five items assessing Communication. However, each of these five items measures a different type or aspect of Communication. Also, due to the type of information being collected, some of the Physical Work Conditions constructs involve multiple ratings (e.g., level, frequency, etc.), but these also are arguably different aspects of the conditions being assessed.

Research suggests that many of the Work Context variables proposed can be rated quite reliably with single-item scales. The dimensions of the PAQ which correspond to the Work Context dimensions have very high inter-rater and rate-rerate reliabilities (.85 to .95), and the job elements within these dimensions are assessed with single-item scales. For instance, the PAQ dimension of Personally Demanding Situations contains items very similar to some of our Structural Job Characteristics items. As can be seen in Table 7-2, the reliability estimates for this PAQ dimension are very high (McCormick, Mecham, Jeanneret, 1989). Reliability estimates for OAI items with similar content to Work Context taxonomy items are moderate to high (Boese & Cunningham, 1975) and certainly within acceptable standards (see Table 7-3). Further, the results of an analysis of ratings from the *Dictionary of Occupational Titles* (DOT) indicate that many Work Context constructs can be rated very reliably (see Table 7-4) without the need for multiple items on each construct (Geyer, Hice, Hawk, Boese, & Brannon, 1989). A number of the item-level constructs are similar to PAQ job elements, OAI work elements, or DOT ratings, and similar reliabilities would be expected.

Table 7-2
Work Context Taxonomy Items with Similar Content to
PAQ Job Dimension of Personally Demanding Job Situations
(PAQ Dimension Reliability: Median = .94; Low Quartile .89; High Quartile .98)[1]

Work Context Survey	
Item Number	**Content of Item**
24	Consequence of Error
25	Impact of Decisions
26	Responsibility/Accountability
27	Decision Latitude
28	Frustrating Circumstances
31	Exacting/Highly Accurate
32	Details Done Completely
33	Aware of Frequently Changing Events
34	Repeating Same Activities
35	Structured Work
37	Time Pressure
38	Frequent Distractions
39	Paced Work

[1]N = 19,961 analyst pairs

Table 7-3
Reliability Estimates of OAI Items[1] with Similar Content to Work Context Taxonomy Items

Work Context Item Number	OAI Item Number	Context of Item	OAI Reliability Estimate
6b	14P	Persuasion	.84
6g	9P	Coordinating	.69
9	57C	Interpersonal Conflict	.76
10	58C	Unpleasant Social Relationships	.67
15a	10C	High Temperatures	.86
15d	18C	Toxic Conditions	.71
15e	7C	Uncomfortable Body Positions	.73
18	15C	High Places	.83
23a	25C	Business Attire	.93
23e	21C	Safety Apparel	.83
24	47C	Consequences of Error	.64
35	26C	Structured Work	.69
40	32C	Work Schedule	.62

[1]Reliability estimates based on ratings of 88 jobs by three sets of analysts (using an ANOVA procedure).

Table 7-4
Reliability Estimates of DOT Ratings Similar to Work Context Taxonomy Items

Work Context Item Number	Content of Item	DOT Reliability Estimate[1]
22b	Standing	.88
22d	Walking	.77
22a	Sitting	.94
22c	Climbing	.89
22e	Kneeling	.68
22e	Stooping	.63
22e	Crouching	.76
22f	Balancing	.79
22g	Handling	.66

[1]Reliability coefficients were calculated using four raters.

Given the large amount of material that falls under the domain of Work Context, multiple items for all constructs would require an extremely large set of questions which were judged not to provide incremental utility. Accordingly, due to the relative objectivity of most of the constructs and the existing research evidence, multiple items for each construct have not been developed.

Selection of Taxonomy Factors

The contextual taxonomy includes factors believed to differentiate between jobs and to provide meaningful and useful information about any particular job. In some cases, we concluded that particular contextual characteristics did not differentiate meaningfully between jobs for any of a variety of reasons (e.g., overlap with other characteristics, difficulty in operationalization, inappropriate level of detail, etc.). In these instances, the variable was combined with other factors or removed from the taxonomy. For example, some research indicates that features of the work environment, such as the arrangement of furniture, office size, color, and amenities, may affect psychosocial outcomes (Sundstrom & Sundstrom, 1986). This facet of the contextual taxonomy was omitted due to its insensitivity to job differences. In other words, it was deemed infeasible to differentiate meaningfully between jobs with respect to common characteristics such as decor or number of rest rooms and hallways in the work environment.

In developing the taxonomy, we attempted to limit the overlap with other domains. Many variables that we felt would be more appropriately measured elsewhere within O*NET were excluded from this taxonomy. However, given the broad range of constructs in the Work Context domain, it is inevitable that some overlap will occur. This overlap is particularly obvious with respect to the Organizational Context domain. The differentiation between the Work Context and Organizational Context factors (see Chapter 8) involves the focus of the items. The Work Context items focus on the effects of these constructs on the worker, the job, or specific tasks, whereas the Organizational Context items are intended to examine the effects on a broader scale. Where construct overlap occurs, we believe there is sufficient distinction between the items to warrant inclusion in their respective taxonomies and questionnaires.

The literature presented below indicates that the various aspects of Work Context recommended for inclusion in the O*NET are distinct, yet often related, facets of work on which jobs may be expected to differ meaningfully, both intra- and interorganizationally, and which are likely to have substantive impact on important outcome variables. Each level of the three-tiered taxonomy is discussed below. As will be apparent in the following sections, the majority of items assessed are similar to items or constructs which are currently assessed by various job analysis questionnaires. A matrix showing the overlap of our items with constructs evaluated in popular job analysis questionnaires is presented in Appendix 7-A. Citations of job analysis questionnaires (see Source Document Abbreviations) and literature that examine the item-level construct as a facet on which jobs differ are provided when available.

Taxonomic Model of Work Context

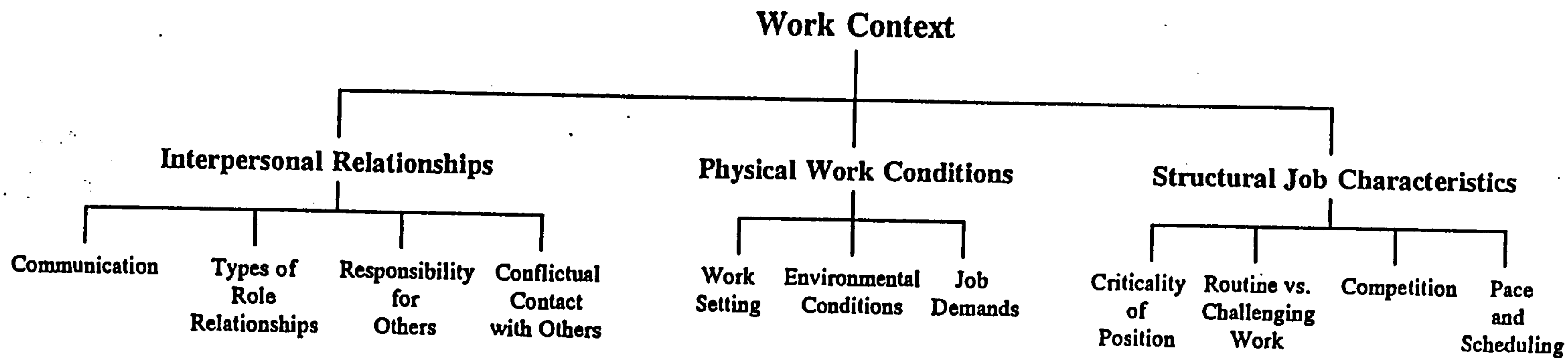
As described above, based on review of the relevant literature and job analysis questionnaires, Work Context was divided into three higher order dimensions: (a) Interpersonal Relationships, (b) Physical Work Conditions, and (c) Structural Job Characteristics. These dimensions were further divided into lower order dimensions from which specific item-level constructs were generated (see Figure 7-3). We examine each of these constructs in the balance of this chapter.

Interpersonal Relationships

Interpersonal Relationships describe the context of the job in terms of human interaction processes. Evans et al. (1994) discussed the psychosocial environment as the social climate of the workplace, the settings produced by the activities of the organization, and the people in those settings. This definition seems to include the types of social relationships and roles the job holder must assume as part of the job, including communication and accountability for others' performance. The Interpersonal Relationships dimension is divided into four second-order factors: (a) Communication, (b) Role Relationships, (c) Responsibility for Others, and (d) Conflictual Contact.

Communication. Baron (1986) defines communication as "the process through which one person or group transmits some type of information to another person or group" (p. 304). Based upon this definition, communication inherently is a factor within the domain of human interaction processes that occur while working. Communication often is included in discussions of organizational behavior as essential to organizational effectiveness. Snyder and Morris (1984) evaluated the importance of communication as an organizational variable and demonstrated the link between communication skills and efficiency with organizational performance. In addition, aspects of communication (e.g., frequency, type, content, etc.) are assessed by many job analysis questionnaires.

There are several work context aspects of communication which have been examined by psychological, communication, management, and other researchers. The specific facets of Communication included in the proposed taxonomy were obtained through review of job



396

397

Figure 7-3
Work Context Taxonomy

analysis questionnaires and relevant literature, as well as by rationally examining the aspects of communication on which jobs may differ. These aspects include: (a) formality of communication, (b) communication methods, (c) degree of subjectivity of information communicated, (d) degree of social interaction, and (e) privacy of communication.

Communication variables have been found to affect many important work behaviors. For instance, communication formality, patterns, and methods have been found to affect workers' proneness to burnout (Hueber, 1992; Leiter, 1988). The type of information communicated and communication patterns affect managers' job performance (Grouch & Nimran, 1989). Additionally, communications and social support affect emotional strain, job dissatisfaction, absenteeism, and turnover (Jackson, 1983).

New technologies and automation in communication methods are affecting the manner in which tasks are performed, the human attributes required to perform the tasks, and the type of interaction incumbents have with each other (Howell, 1992). Different methods of communication, such as computer mediated communication, have been linked to job performance, interpersonal relationships within groups (Adrianson & Hjelmquist, 1991; Hiltz, Johnson, & Turoff, 1986; Valacich, Paranka, George, & Nunamaker, 1993), organizational commitment (Huff, Sproull, & Kiesler, 1989), job satisfaction (Callan, 1993), productivity (Papa & Tracy, 1988), decision making, control, social interaction, work environment, and job enhancement (Kraemer & Danziger, 1990).

Privacy of communication and materials are also important aspects of Work Context. Privacy is defined here as *the extent others beyond the originator and intended recipient have access to communications and materials*. Sundstrom and Sundstrom (1986) have identified several important work outcomes affected by privacy of communication and workspace, and Ornstein (1990) concluded that privacy is related to self-reported satisfaction with the physical environment. Ornstein also stated that privacy is related to job performance; however, this relationship is moderated by various other factors, such as job complexity. Communication privacy, although not assessed in any reviewed job analysis questionnaires, involves salient factors of work which experience indicates may differ from job to job.

Communication is assessed at the item level as:

1. the extent to which communication is informal and personal, such as casual conversation, or formal and impersonal, such as in reports or memos (JEI; OAI);
2. the frequency with which various communication media are used (e.g., face-to-face, telephone, e-mail, reports, etc.) (ACT; FES; GWI; OAI; PAQ; PMPQ; SCANS);
3. the extent to which the job requires the communication of emotionally/ psychologically valued subjective information, feelings, thoughts, and ideas versus the communication of objective and verifiable data-based information (Leiter, 1988; GWI; OAI);
4. the extent to which the worker is required to have interpersonal contact with others, including customers, trainees, supervisors, telephone callers, etc. (Evans et al., 1994; DOL; FES; GWI; JDS; OAI; PAQ); and
5. the extent to which the employee may expect his/her communications to be private (Evans et al., 1994; Ornstein, 1990).

Types of Role Relationships. Katz and Kahn (1966) define human organizations as "an open system of roles" (p. 172). The concept of Role Relationships as a factor in the Work Context taxonomic structure is also inherent in the extensive literature concerning person-environment fit (French, Caplan, & Harrison, 1982). Researchers have linked role ambiguity and role conflict to low satisfaction, tension, feelings of futility, and stress-related illnesses (e.g., Beehr, Walsh, & Taber, 1976; French & Caplan, 1972; Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964; Shirom, Eden, Silberwasser, & Kellerman, 1973). Cooper, Mallinger, and Kahn (1978) extensively evaluated the effects of roles and found several variables which affect employees, and Cooper (1987) stated that the work roles one must assume may be stressful when those roles are unclear or are in conflict with one another.

The aspects of Role Relationships included in the taxonomy include role types, interpersonal contacts, and team membership. Along with being examined in the research literature, these variables are included in many job analysis questionnaires. Jobs may differ in the extent to which the worker participates in various roles; these roles affect the incumbent's effectiveness and power and also lead to important consequences for the worker. Various roles typically played by managers and executives have been associated with job satisfaction, health, self-damaging behaviors, and overall job performance (Davidson & Cooper, 1986). The coaching role is related to burnout (Vealy, Udry, Zimmerman, & Soliday, 1992). Types of interpersonal relations or contacts and team membership affect the way people think, feel, and behave at work. More specifically, work-centered interpersonal relationships and workers' participation in teams have been found to affect workers' job performance (Berkowitz, 1954), job attitudes and beliefs (Deutsch & Gerard, 1955), learning (Ryle, 1949), conformity (Asch, 1951; Kaplan, 1987; Sherif, 1936; 1965), turnover (Fisher, 1985), and illness (LaRocco, House, & French, 1980).

Role Relationships are assessed at the item level as:

1. the importance of interactions requiring the worker to assume a role of trainer, coach, leader, supervisor, manager, team member, etc., with respect to other workers (Harvey, 1991; Neff, 1987; ACT; DOL; GWI; JEI; OAI; PAQ; PMPQ; SCANS);
2. the importance of interpersonal contacts requiring the worker to engage in persuasion or influence (DOL; GWI; OAI; PAQ);
3. the importance of interpersonal interactions requiring the worker to provide others with needed services or to assist others to accomplish an objective, including customer service and advisor-client/patient relationships (DOL; GWI; JEI; OAI; PAQ; SCANS);
4. the importance of interpersonal contacts requiring the worker to state, defend, or advocate some goal or objective in opposition to others' goals or objectives (GWI; OAI; SCANS);
5. the importance of job activities requiring the worker to contribute to group accomplishment of goals or objectives, to work closely with others, to be supportive and cooperative, and to place group accomplishment ahead of individual aspirations (ACT; GWI; OAI; SCANS);
6. the importance of interactions requiring the worker to deal with public customers or the public in general (ACT; DOL; GWI; OAI; PAQ; SCANS); and
7. the importance of job activities requiring the worker to coordinate or lead others (ACT; DOL; GWI; OAI; PAQ; PMPQ; SCANS).

Responsibility for Others. Responsibility for Others is assessed as a contextual factor by several well-known job analysis questionnaires (e.g., DOL, GWI, JDS, JEI, OAI, PAQ, PMPQ). In addition to its frequent assessment in job analysis, Responsibility for Others has been demonstrated to be a particularly stressful occupational variable (Cooper & Marshall, 1976). It has been related also to psychophysiological symptoms (Bhalla, Jones, & Flynn, 1991; Riordan, Johnson, & Thomas, 1991), job satisfaction (Ehrenfeld, 1991; Mayes, Barton, & Ganster, 1991), and other responses to stress (Bartol, Bergen, Volckens, & Knoras, 1992). It also has been almost invariably included as a compensable factor in job evaluation (e.g., Henderson, 1979) and is typically recognized as a facet of the touchstones of compensation in the Equal Pay Act of 1963. Responsibility for Others in the proposed taxonomy includes responsibility for the work results of others, as well as responsibility for others' safety.

Responsibility for Others is assessed at the item level as:

1. the extent to which the job requires the worker to be particularly careful not to cause harm or injury to others, including the responsibility to establish policies and programs to protect others (Gilpatrick, 1977; ACT; GWI; OAI; PAQ); and
2. the extent to which the job requires the worker to assume responsibility for the results of the work of others (Holt, 1983; ACT; FES; JEI; JDS; OAI; PAQ; PMPQ; SCANS).

Conflictual Contact with Others. Conflictual Contact with Others is defined as *the extent to which the requirements of a job put the worker in situations in which conflict or strained interpersonal relationships with others are likely or inevitable* and has been assessed by several job analysis questionnaires (OAI, PAQ). It intuitively is obvious that jobs which involve extensive conflictual contact (e.g., police officers) generate a level of stress not found in other occupations.

Interpersonal conflict is a stressor that results in job dissatisfaction, frustration, and somatic symptoms (Spector & O'Connell, 1994), burnout (Hueber, 1992; Leiter, 1988), and turnover (Taylor & Zimmerer, 1992). The occupational factors of violence and conflictual contact faced by workers such as police officers are linked to irregular sleeping and eating habits, stress-related alcohol dependency, and mortality rates for cancer and suicide (Violanti, Vena, & Marshall, 1986). Some jobs present incumbents with a greater risk for becoming victims of workplace violence (Royal, 1995). This is a critical variable because workplace violence affects the attitudes, behaviors, and stress levels of employees (Bartol et al., 1992; Schwarz & Kowalski, 1993).

Conflictual Contact with Others is assessed at the item level as:

1. the frequency with which the job structure itself creates roles for the worker that inevitably place him/her in conflict with others (e.g., police officer making an arrest, utility worker collecting overdue bills, labor relations manager dealing with grievances) (GWI; OAI; PAQ);
2. the frequency with which the worker must deal with others who are discourteous, angry, hostile, or otherwise unpleasant even when the job structure does not make such encounters inevitable (e.g., food servers, customer service representatives, postal counter workers) (GWI; OAI; PAQ); and
3. the frequency with which the worker must deal with physical aggression or violent individuals.

Leadership

One important aspect of the work environment is supervision or leadership. For example, characteristics of employees' managers or supervisors have been shown to impact their satisfaction (see Yukl, 1989 for a review of relevant research). Early research on leadership identified two relatively independent characteristics that have important implications for their effectiveness. One has been called consideration (Fleishman, 1953) or relationship oriented behavior (Likert, 1961). This is defined as the degree to which a leader acts in a friendly or supportive manner, shows concern for subordinates, and looks out for their welfare. The second is known as structure (Fleishman, 1953) or task oriented behavior (Likert, 1961). Structure is the degree to which a leader defines and structures his or her own role and the role of subordinates toward attainment of the group's formal goals. These two constructs are well accepted, and there is a large body of research that supports their usefulness for describing managers and supervisors (see Yukl, 1989), so measures of these two constructs were included in the content model.

However, other theorists have argued that these two dimensions are deficient for describing managers and supervisors, and have posited more detailed, multidimensional views of leader behaviors or characteristics (e.g., Van Fleet & Yukl, 1986). In order to better cover the breadth of the leadership domain while keeping the number of scales included to a minimum, we chose to include two additional characteristics of managers or supervisors in the content model: visioning and problem solving. The concept of visioning comes from leadership research that has focused on leaders' roles in championing and leading the major changes necessary for their organization's survival and success. Tranformational or charismatic leadership are the terms often used to describe a leader's capability to influence changes in members' attitudes and commitment to the organization (Conger & Kanungo, 1987; Bass, 1985; House, 1977). One of the central propositions of this approach is that leaders appeal to the ideals and hopes of followers through the communication of values, beliefs, and a vision for the organization. Finally, recent research has also identified the importance of creative problem solving for effective leadership (e.g., Mumford & Connelly, 1991). Problem solving in social and task domains is a critical skill for effective management or supervision.

Physical Work Conditions

The actual physical conditions in which an employee is asked to perform the job are arguably the most obvious aspects of a taxonomy of Work Context. There are few, if any, job analysis questionnaires which do not consider the tangible aspects of the work environment. Physical Work Conditions are considered as the relationship or interaction between the worker and the physical job environment. Evans et al. (1994) defined physical characteristics of work as the inanimate facets of the work environment. For the proposed taxonomy, Physical Work Conditions include: (a) the Work Setting, (b) the Environmental Conditions of the work setting that may pose a hazard to the worker, and (c) Job Demands. Aspects of these factors are measured by the frequency with which a job exposes the worker to various work settings, certain environmental conditions and job hazards, as well as the possibility and impact of injuries. Job demands, including body positions and work attire, are also included. The specific facets of Physical Work Conditions included in the taxonomy were mainly obtained through review of the human factors literature, as well as an examination of several job analysis questionnaires. The existing research described in the introductory sections of this chapter indicates that these factors differentiate between jobs and can be reliably measured.

Work Setting. This dimension involves the physical setting in which the work takes place. Settings include whether the work occurs indoors or outdoors, under environmentally controlled conditions, or inside a vehicle. Also included in this dimension are the extent to which the work area is private and the extent to which the work requires close physical contact with others. Although privacy and working in close physical contact are not typically assessed in job analysis questionnaires, they have been found to affect task and job performance, job satisfaction, and worker health (Ornstein, 1990; Rajecki, Ickes, Corcoran, & Lenerz, 1977; Sundstrom & Sundstrom, 1986).

Work Setting is assessed at the item level as:

1. the frequency with which the work is conducted in various work settings, such as indoors, outdoors, or inside a vehicle (DOL; GWI; OAI; PAQ);
2. the extent to which the worker's work area is private; and
3. the extent to which the work is performed physically close to others.

Environmental Conditions. This dimension involves the extent to which work is conducted under hazardous or unpleasant conditions, such as heat, noise, and pollutants, or if job incumbents are exposed to dangerous equipment or situations. These conditions include the likelihood and severity of injuries occurring on the job and the frequency of exposure to extreme conditions or hazards. In numerous studies, poor physical working conditions have been found to increase stress (e.g., Kelly & Cooper, 1981; Otway & Misenta, 1980) and to affect workers' attitudes (Carlopio & Gardner, 1992). Some factors in the physical environment increase individuals' vulnerability to stress or act as stressors. Exposure to certain aspects of the work environment (such as chemical hazards, excessive noise, heat, etc.) may not only affect physical health, but also, under some conditions, can have an adverse effect on mental health. Lindstrom and Mantysalo (1987) report that surveys of various occupational groups indicate noise, thermal conditions, vibration, and chemicals are the most common perceived stressors.

Physical job characteristics (noise, extreme temperatures, vibration, poor lighting, air pollution, and others) have been shown to affect overall job performance, performance accuracy, and visual acuity among other consequences (Nunneley, Reader, & Maldonado, 1982; Poulton, 1978). For instance, employees with high noise exposure had more disciplinary actions, more absenteeism, less productivity, poorer quality of work, more material damages, higher frequency and severity of accidents (Noweir, 1984), more hearing loss (LaBenz, Cohen, & Pearson, 1967), poorer work performance (Levy-Leboyer, 1989), and poorer job satisfaction (Sundstrom, Town, Rice, Osborn, & Briel, 1994). The physical office environment, namely air quality, noise, ergonomic conditions, and lack of privacy, has been found to affect worker satisfaction and mental health. Research also provides evidence that worker assessments of the physical environment are distinct from their assessments of general working conditions, such as work load, decision-making latitude, and interpersonal relationships (Klitzman & Stellman, 1989).

Jobs which involve physical danger and/or hazardous conditions have been found to lead to burnout (Gaines & Jermier, 1983), absenteeism (Leigh, 1991), and tension and ambulatory cardiovascular reactivity (Melamed, Harari & Green, 1993). Some jobs have higher occupational exposure to contaminants and communicable diseases. This exposure is related to stress, health, and attrition (Gauch, Feeney, & Brown, 1990; Ryan, Morrow, & Hodgson, 1988; Turnberg & Frost, 1990).

Environmental Conditions are assessed at the item level as:

1. the extent to which the work is performed under extreme temperatures, high noise levels, inadequate lighting, air contamination, whole body vibrations, or in a confined space (DOL; FES; GWI; OAI; PAQ);
2. the extent to which the work is performed under various hazardous conditions (DOL; FES; GWI; OAI; PAQ);
3. the likelihood the worker will be injured while working under hazardous conditions (PAQ); and

4. the extent, duration, and seriousness of injuries likely to be received on the job (DOL; PAQ).

Job Demands. Job Demands involve the requirements placed upon the worker as a function of the job environment. Job Demands include requirements which must be met in order to maintain a minimal level of safety as well as requirements which must be met simply in order to perform the job duties. These Job Demand factors, as well as environmental conditions, are obviously important to worker health and safety, and any systematic evaluation of the contextual factors of work would be lacking without their inclusion. The Job Demands aspects in the proposed taxonomy include the extent to which the worker must wear certain types of clothing and the body motion or positioning required for job performance.

Body motion, posture, and physical effort have been found to affect objective and subjective stress levels, accident rates, and sickness and absence among workers (Melamed, Luz, Najenson, Jucha, & Green, 1989). Job demands also affect life satisfaction, job satisfaction, job-related mood, and absenteeism (Karasek, Triantis, & Chaudhry, 1982) and have been linked to pregnancy complications (Kalil, 1987).

Business attire and clothing color affect people's perceptions of workers' competence and effectiveness (Scherbaum & Shepherd, 1987). Appearance and attire also affect personnel decisions, such as hiring, retaining, and promoting employees (Blouin, Sweat, Kelley, & Glee, 1982; Sweat, Kelley, Blouin, & Glee, 1981). Protective attire and equipment prevent exposure to contaminants and prevent hearing loss, but also may hinder movement and reduce job performance (Park & Casali, 1991).

Job Demands are assessed at the item level as:

1. the extent to which the worker must wear various types of clothing and equipment (Neff, 1987; DOL; GWI; OAI; PAQ); and
2. the extent to which the worker sits, stands, walks, climbs, etc. (DOL; FES; GWI; OAI; PAQ).

Structural Job Characteristics

Facets of Structural Job Characteristics have been referred to as Work Context factors in the job analysis literature (c.f., Bemis et al., 1983; McCormick, 1979) and are assessed by several job analysis questionnaires (e.g., GWI; JDS; PAQ; PMPQ). Included in this category are assessments of the extent to which the tasks are critical to the organization and whether the work is routine or varied in nature, as well as descriptions of work hours, scheduling, the pace of work, and whether the job involves competition. Research has shown that incumbents' reports of these types of job characteristics correlate significantly with several outcomes, such as job satisfaction, work frustrations, anxiety on the job, turnover intentions, and number of physician visits (Spector & Jex, 1991). The characteristics examined include frustrating circumstances, degree of automation, responsibility level, and decision latitude. These specific facets of the Structural Job Characteristics dimension were obtained both through a review of job analysis questionnaires and relevant literature, as well as by rationally identifying the aspects of job structure on which jobs may differ.

Criticality of Position. Criticality of the position involves the extent to which the performance of a job is essential to the organization or to the people who are served by the job incumbent, either directly or indirectly. Criticality, defined as *scope and effect and ultimate responsibility/accountability*, is commonly cited as a compensable factor in job evaluation (e.g., Henderson, 1979) and is typically thought of as one of the touchstones of compensation in the Equal Pay Act of 1963. Each of the facets of Criticality discussed within this chapter (consequence of error, accountability, decision latitude, etc.) is inherently stressful and therefore may affect individual health, job satisfaction, and job performance. Criticality of position has been found to affect self-damaging behaviors, such as drug use on the job and health (Davidson & Cooper, 1986), and decision latitude affects life satisfaction, job satisfaction, job-related depressed mood, and absenteeism (Karasek, Triantis, & Chaudhry, 1982).

Criticality is assessed at the item level as:

1. the breadth and severity of outcomes resulting from errors made by the worker (McGrath, 1976; GWI; OAI; PAQ; PMPQ);
2. the breadth and impact of results of the decisions required of a worker (ACT; PAQ);

3. the extent to which the worker's performance is judged based on the ultimate outcome of work activities, and/or results of errors and mistakes (French & Caplan, 1972; GWI; JDS; OAI; PAQ; PMPQ); and
4. the level of responsibility assigned to be exercised by the worker, including the level of decision making which must be approved by others before action can proceed (Evans et al., 1994; GWI; JDS; OAI; PAQ; SCANS).

Routine Versus Challenging Work. Routine work is defined as *repetitive or monotonous physical or mental tasks which may or may not be automated.* In addition to being the opposite of routine work, challenging work involves attentiveness, the degree of frustration, and/or general lack of clarity which may increase the difficulty level of the job. Cooper (1987) defined work underload as *performing repetitive, routine, boring, and understimulating tasks or in an understimulating environment.* This type of work has a stronger effect on the worker when paired with the need to maintain vigilance in order to respond to emergency situations (Davidson & Veno, 1980). The maintenance of vigilance under conditions of boredom is difficult and made stressful by the awareness of the consequences of an inadequate response to an emergency.

Research indicates that vigilance creates stress and that the repetitious and monotonous nature of vigilance tasks reduces activity in the reticular activating system of the brain, making people drowsy and less efficient (Warm & Dember, 1986). Routine or monotonous work was associated with more interpersonal conflict, dissatisfaction with life, physical and psychological stress, and hostility (Agervold, 1983; Alfredsson, Karasek, & Theorell, 1982; Appelberg, Romanov, Honkasalo, & Koskenvuo, 1991). Similar results have been found for jobs which involve highly fragmented and repetitive tasks in comparison to jobs with more variety and flexibility (Johansson, Aronsson, & Lindstrom, 1978). Job performance also has been found to be affected by the level of vigilance monitoring required for job accomplishment (Howell, 1992).

Included in this factor is an item regarding Structured versus Unstructured Work. This construct is similar to the Autonomy construct assessed in the Organization Context Questionnaire (see Chapter 8). Our item is specifically focused on the tasks and activities of a job, while the Organizational Context Autonomy construct is more global and refers to all aspects of work. We believe these are distinct levels of analysis and that the constructs are appropriately assessed in both questionnaires.

Routine Versus Challenging Work is assessed at the item level as:

1. the extent to which the worker's goal-oriented behavior is blocked by impediments over which the worker has little or no control (frustration) (OAI; PAQ);
2. the degree to which significant job functions are automated and require little input from the worker beyond monitoring (Buchanan, Davis, & Dunnette, 1980; Evans et al., 1994);
3. the extent to which tasks or objectives are clearly defined or communicated (McGrath, 1976; JDS; OAI);
4. the extent to which the job requires the worker to maintain a high level of accuracy and precision, including both manual and mental precision (DOL; PAQ);
5. the extent to which a job requires a high level of thoroughness to ensure that nothing is left undone or that steps are not taken out of order, including attending to the details of a set of procedures, checking the completion of a series of tasks, auditing the correctness and documentation of activities or financial results (PAQ);
6. the extent to which the job requires the worker to maintain attention or alertness, either for events or circumstances which do not occur often or for those which are subject to continual change (Buchanan et al., 1980; GWI; PAQ).
7. the extent to which the worker is required to perform the same physical and/or mental activities repeatedly in a relatively short period of time, usually less than an hour (Cox, 1980; Evans et al., 1994; Mackay & Cooper, 1987; DOL; GWI; JDS; OAI; PAQ); and
8. the degree to which job activities are at the discretion of the worker rather than being predetermined and requiring following directions and carrying out orders (JEI; OAI; PAQ).

Competition. Competition is assessed at the item level and is defined as *the extent to which the job duties require the worker to perform better than or seek an advantage over others in order to perform the job successfully.* This dimension includes the extent to which the job requires the worker to be aware of and respond to competitive pressures, directly compete with coworkers or with workers in other organizations, compete as a group with other organizational units, or respond to competitive pressures in the larger environment in which the organization functions. Researchers have found that competition influences interpersonal interaction patterns (Fraser, 1980; 1985), stress, and job burnout (Sonnentag, Brodbeck, Heinbokel, & Stolte, 1994). This item, although not assessed in any reviewed job analysis questionnaires, is a salient factor of work which may affect worker stress levels and differ from job to job.

Competition is assessed at the item level as:

1. the extent to which the worker is required to compete with others or be aware of competitive pressures.

Pace and Scheduling. Pace and Scheduling involve the speed and the particular times at which work is or must be performed. Included within this dimension are the actual work period or shift, the extent to which the work pace is controlled, and the extent of deadlines and distractions on the job. Cooper and Davidson (1987) cite previous research indicating a relationship between work overload (which is a common effect of extreme time pressure and interruptions) and cigarette smoking, lowered self-esteem, lowered work motivation, and escapist drinking. Research has shown that frequent interruptions, meeting deadlines, and dealing with crisis situations are important individual stressors which affect performance (Turnage & Spielberger, 1991). Constant time pressure may lead to increased mental strain and to the inability to cope with the work pace (Andries, Bijleveld, & Pot, 1991). Empirical studies have shown that production pressure and forced overtime detract from mental well-being (Caplan, Cobb, French, Van Harrison, & Pinneau, 1980; Loscocco & Spitze, 1990).

The amount of control the worker has over job activities relates to levels of personal satisfaction and adjustment, perception of risk of accidents (Shauksmith, 1990), turnover (Taylor & Zimmerer, 1992), stress (Riordan et al., 1991), and physiological changes (Frankenhauser, 1979; Gardell, 1987). Characteristics of machine-paced work have been found to affect workers' pattern of stressors (French et al., 1982). Studies report higher levels of adrenaline and noradrenaline among workers under machine-paced, assembly-line conditions, as compared to other workers (Frankenhaeuser & Gardell, 1976).

Pace variation and control of work pace are related to cardiovascular, neuroendocrine, and subjective responses (Bohlin, Eliasson, Hjamdahl, & Klein, 1986). Control over work and over work pace consistently have been shown to be related to job satisfaction (Kahn & Byosiere, 1992), physiological strain (Ivancevich, Matteson, & Preston, 1982), and subjective strain (Numerof & Abrams, 1984). Work pace affects the number of labor strikes (Belbin & Stammers, 1972), interpersonal conflict, job and life satisfaction, daily stress, and hostility (Appelberg et al., 1991).

Several studies have found that shiftwork affects physiological and psychological well-being, as well as social relationships. Shiftwork affects body temperature, metabolic rate, blood sugar levels, as well as mental efficiency and work motivation (e.g., Akerstedt, 1985; Kogi, 1985; Rutenfranz, Haider, & Koller, 1985), mood, fatigue, and vigor (Bohle & Tilley, 1993), absenteeism (Akerstedt, 1976), accidents and errors (Colquhoren, 1976), personal relationships, and sexual maladjustment (Mott, 1976). Other research has found that shiftwork affects job satisfaction, life satisfaction, social life, and family interactions (Weiss & Liss, 1988).

Pace and Scheduling is assessed at the item level as

1. the frequency with which the worker must meet strict deadlines (GWI; OAI; PAQ);
2. the extent to which the worker cannot expect to start and complete a task without interruptions, including the extent to which the worker has control over the interruptions (Evans et al., 1994; OAI; PAQ);
3. the extent to which the work pace is machine driven or controlled by the speed of processes, such as assembly lines, leaving the worker little control over it (Cox, 1980; Mackay & Cooper, 1987; OAI; PAQ); and
4. the duration, time of day, and consistency of the work period (Cooper, 1987; Holt, 1983; Kogi, 1985; GWI; OAI; PAQ).

Summary

In addition to skills, knowledge, education, and generalized work activities, the contextual factors of work are clearly important features on which jobs may differ. In conjunction with organizational variables and Generalized Work Activities, contextual factors affect many important work outcomes (see Figure 7-4). Contextual factors have been linked to such outcome variables as job performance, satisfaction, group formation, group cohesion, organizational effectiveness, and physical and psychological health. However, attempts to assess these factors have been unstructured and have lacked a systematic approach. The reviewed job analysis questionnaires tap various aspects of the psychosocial work environment, but do not capture or assess individually the broad range of Work Context factors. The proposed taxonomy builds on research literature and existing job analysis questionnaires to organize relevant Work Context factors into a coherent structure for job analytic purposes. The assessment of these contextual factors is supported by numerous job analysis studies and will provide valuable information for a variety of human resource management functions. The questionnaire based on this taxonomy is Appendix E in Volume II.

Evaluation of the contextual aspects of jobs and differentiation of jobs based on these factors is important for a number of functions, including the formation of job families or groupings, job classification, job evaluation, performance appraisal, the development of questionnaires to assess which individuals would be best suited to a particular job, and to provide realistic job previews to allow individuals opportunities for self-selection based on adequate information. This systematic approach also facilitates person-job matching counseling, development of realistic simulations and training for specific work environments, and the preparation of appropriate equipment and materials. Given the effects of Work Context variables on workers and work performance, only analyzing work requirements and the characteristics of workers is not adequate. Work Context also must be examined and integrated with other job analysis information in order to provide complete information about jobs. Measuring Work Context more systematically will contribute to a better understanding of work and will provide valuable information essential for a comprehensive O*NET.

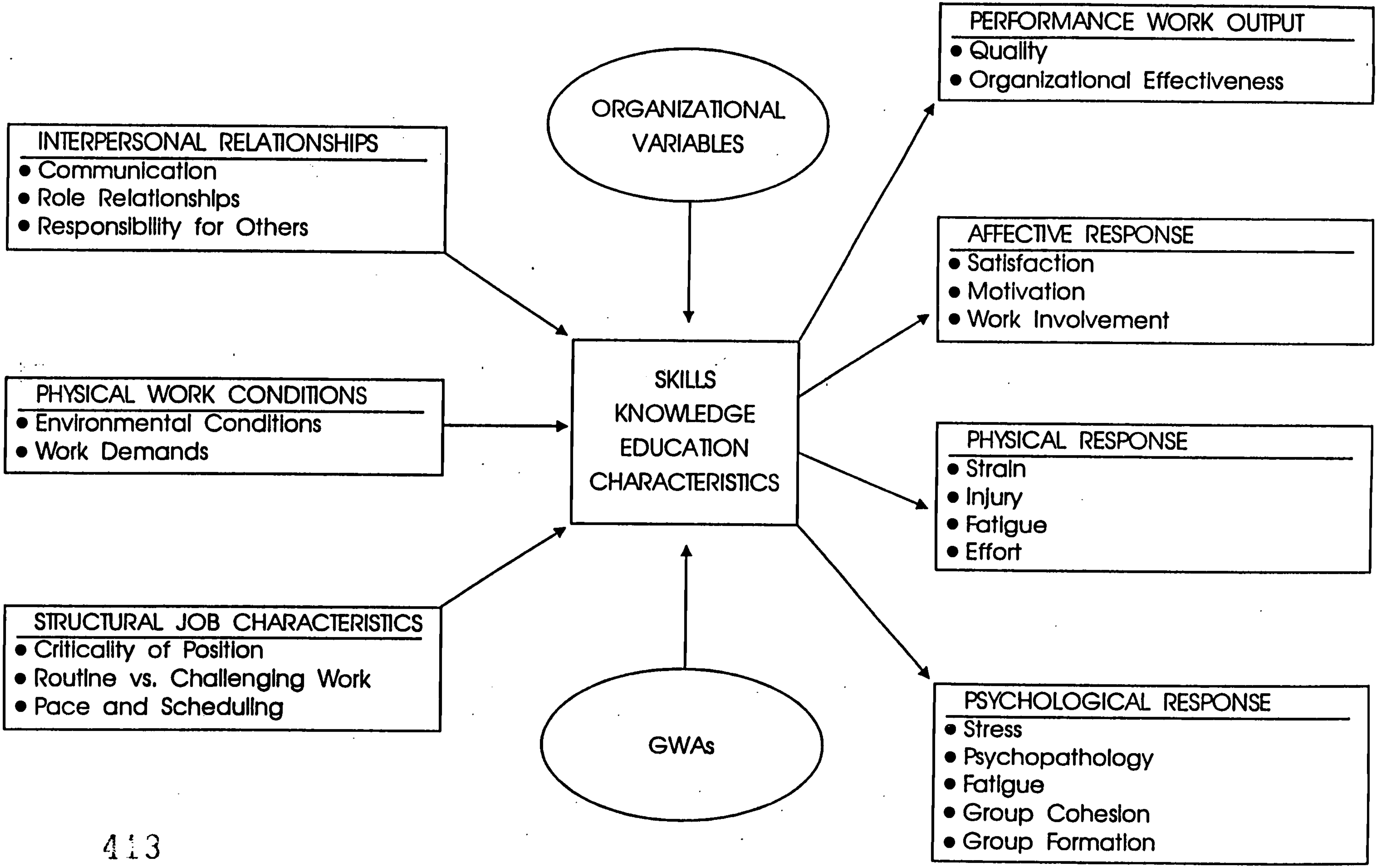


Figure 7-4
Impact of Work Context on Work Outcomes

Source Document Abbreviations

ACT	*Work Activities Survey* (Form A and Form B) (American College Testing)
DOL	Department of Labor *The Revised Handbook for Analyzing Jobs*
FES	*Factor Evaluation System* (Office of Personnel Management)
GWI	*The General Work Inventory* (Copyright, J.W. Cunningham and Rodger D. Ballentine)
JAG	*Job Analysis Guide* (Copyright, Jeanneret & Associates, Inc.)
JDS	*Job Diagnostic Survey* (Copyright, Hackman & Oldham)
JEI	*Job Element Inventory* (Cornelius and Hakel)
OAI	*Occupation Analysis Inventory* (Copyright, J.W. Cunningham)
PAQ	*Position Analysis Questionnaire* (McCormick, Jeanneret, & Mecham; Copyright, Purdue University/Consulting Psychologists Press)
PMPQ	*Professional and Managerial Position Questionnaire* (Mitchell and McCormick; Copyright, Purdue University/Consulting Psychologists Press)

SCANS *Secretary's Commission on Achieving Necessary Skills* (Department of Labor)

References

Adrianson, L., & Hjelmquist, E. (1991). Group processes in face-to-face and computer mediated communication. *Behavior and Information Technology, 10,* 281-296.

Agervold, M. (1983). Process control and psychic strains. *Psykologisk Skriftserie Aarhus, 8*(5), 1-57.

Akerstedt, T. (1976). Shift work and health: Interdisciplinary aspects. In P.G. Rentos & R.D. Shepard (Eds.), *Shift work and health.* Washington, DC: U.S. Government Printing Office.

Akerstedt, T. (1985). Adjustment of physiological circadian rhythms and the sleep-wake cycle to shiftwork. In S. Folkard & T.H. Monk (Eds.), *Hours of work: Temporal factors of work scheduling* (pp. 185-197). New York: John Wiley & Sons.

Alfredsson, L., Karasek, R., & Theorell, T. (1982). Myocardial infarction risk and psychosocial work environment. *Social Science and Medicine, 16*(4), 463-467.

American College Testing. (1993, August). Performing a national job analysis study: Overview of methodology and procedures. *Work Activities Survey (Form A and Form B.* Iowa City, IA: Author.

Andries, F., Bijleveld, C.C., & Pot, F.D. (1991). Working conditions and mental strain of automation personnel. *International Journal of Human Computer Interaction, 3,* 363-373.

Appelberg, K., Romanov, K., Honkasalo, M.L., & Koskenvuo, M. (1991). Interpersonal conflicts at work and psychosocial characteristics of employees. *Social Sciences & Medicine, 32,* 1051-1056.

Asch, S.E. (1951). Effects of group pressure upon the modification and distortion of judgments. In H. Guetzkow (Ed.), *Groups, leadership, and men.* New Brunswick, NJ: Rutgers University Press.

Baron, R.A. (1986). *Behavior in organizations: Understanding and managing the human side of work.* Boston: Allyn and Bacon, Inc.

Bartol, C.R., Bergen, G.T., Volckens, J.S., & Knoras, K.M. (1992). Women in small town policing: Job performance and stress. Special Issue: Psychology of Policing. *Criminal Justice and Behavior, 19,* 240-259.

Bass, B.M. (1985). *Leadership and performance beyond expectations.* New York: Free Press.

Beehr, T.R., Walsh, J.T., & Taber, T.D. (1976). Relationship of stress to individually and organizationally valued states: Higher order needs as a moderator. *Journal of Applied Psychology, 61,* 41-47.

Belbin, R.M., & Stammers, D. (1972). Pacing stress, human adaptation, and training in car production. *Applied Ergonomics, 3,* 142-146.

Bemis, S.E., Belenky, A.H., & Soder, D.A. (1983). *Job analysis: An effective management tool.* Washington, DC: The Bureau of National Affairs.

Berkowitz, L. (1954). Group standards, cohesiveness, and productivity. *Human Relations, 7,* 509-519.

Bhalla, S., Jones, B., & Flynn, D.M. (1991). Role stress among Canadian white-collar workers. *Work and Stress, 5,* 289-299.

Blouin, D., Sweat, S., Kelley, E., & Glee, R. (1982). Recruiter and student evaluation of career appearance. *Adolescence, 17,* 821-830.

Boese, R.R., & Cunningham, J.W. (1975). *Systematically derived dimensions of human work.* (Ergometric Research and Development Series Report No. 14). Raleigh, NC: Center for Occupational Education.

Bohle, P., & Tilley, A.J. (1993). Predicting mood change on night shift. *Ergonomics, 36,* 125-133.

Bohlin, G., Eliasson, K., Hjamdahl, P., & Klein, K. (1986). Pace variation and control of work pace as related to cardiovascular, neuroendocrine, and subjective responses. *Biological Psychology, 23,* 247-263.

Buchanan, J.C., Davis, S.O., & Dunnette, M.D. (1980). *Behavioral reliability program for the nuclear industry.* Report to the U.S. Nuclear Regulatory Commission, NUREG/CR-2076.

Callan, V. (1993). Subordinate-manager communication in different sex dyads: Consequences for job satisfaction. *Journal of Occupational and Organizational Psychology, 66,* 13-27.

Caplan, R.D., Cobb, S., French, J., Van Harrison, R., & Pinneau, S.R. (1980). *Job demands and worker health: Main effects and occupational differences.* Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan.

Cappelli, P. (1995, March). *Systems for classifying occupations based on supply and on demand.* Prepared for the Standard Occupational Classification Revision Policy Committee, U.S. Department of Labor, Washington, DC. Unpublished manuscript.

Carlopio, J.R., & Gardner, D. (1992). Direct and interactive effects of the physical work environment on attitude. *Environment and Behavior, 24,* 579-601.

Christensen, J.M. (1988). Human factors in systems design. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York: John Wiley & Sons.

Colquhoren, W.P. (1976). Accidents, injuries, and shift work. In P.G. Rentos & R.D. Shepart (Eds.), *Shift work and health.* Washington, DC: U.S. Government Printing Office.

Conger, J.A., & Kanungo, R. (1987). Toward a behavioral theory of charismatic leadership in organizational settings. *Academy of Management Review*, 12, 637-647.

Cooper, C.L. (1987). The experience and management of stress: Job and organizational determinants. In A.W. Riley & S.J. Zaccaro (Eds.), *Occupational stress and organizational effectiveness.* New York: Praeger.

Cooper, C.L., & Davidson, M. (1987). Sources of stress at work and their relation to stressors in non-working environment. In R. Kalimo, M.A. El-Batawi, & C.L. Cooper (Eds.), *Psychosocial factors at work and their relation to health.* Geneva: World Health Organization.

Cooper, C.L., Mallinger, M., & Kahn, R. (1978). Identifying sources of occupational stress among dentists. *Journal of Occupational Psychology, 51,* 227-234.

Cooper, C.L., & Marshall, J. (1976). Occupational sources of stress: A review of the literature relating to coronary heart disease and mental ill health. *Journal of Occupational Psychology, 49,* 11-28.

Cooper, C.L., & Payne, R. (1979). *Stress at work.* New York: Wiley.

Cornelius, E.T., & Hakel, M.D. (1978). *A study to develop an improved enlisted performance evaluation system for the U.S. Coast Guard.* Washington, DC: Department of Transportation, United States Coast Guard.

Cox, T. (1980). Repetitive work. In C.L. Cooper & R. Payne (Eds.), *Current concerns in occupational stress.* New York: John Wiley & Sons.

Cunningham, J.W. (1988). Occupational Analysis Inventory. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York: John Wiley & Sons.

Cunningham, J.W., & Ballentine, R.D. (1982). *The General Work Inventory.* Raleigh, NC: Author.

Cunningham, J.W., Tuttle, T.C., Floyd, J.R., & Bates, J.A. (1971). *Occupational Analysis Inventory.* Raleigh, NC: Center for Occupational Education.

Davidson, M.J., & Cooper, C.L. (1986). Executive women under pressure. Occupational and life stress and the family (Special issue). *International Review of Applied Psychology, 35*(3), 301-326.

Davidson, M.J., & Veno, A. (1980). Stress in police officers. In C.L. Cooper & J. Marshall (Eds.), *White collar and professional stress.* New York: John Wiley & Sons.

Deutsch, M., & Gerard, H.B. (1955). A study of normative and informational social influences upon individual judgment. *Journal of Abnormal and Social Psychology, 51,* 629-636.

Ehrenfeld, M. (1991). Social correlates of satisfaction and stress among Israeli nurses within intensive coronary care units. *International Journal of Nursing Studies, 28,* 39-45.

Equal Pay Act. (1963). Fair Labor Standards Act (Sect. 6d). *29 U.S.C.* 206 (d)(1).

Evans, G.W., Johansson, G., & Carrere, S. (1994). Psychosocial factors and the physical environment: Inter-relations in the workplace. In C.L. Cooper & I.T. Robertson (Eds.), *International review of industrial and organizational psychology.* New York: John Wiley & Sons.

Federal Register. (1974). General Industry Safety and Health Regulations, Part 1910.

Federal Register. (1983). Occupational Noise Exposure: Hearing Conservation Amendment.

Fisher, C.S. (1985). Social support and adjustment to work: A longitudinal study. *Journal of Management, 11,* 39-53.

Fleishman, E.A. (1953). The description of supervisory behavior, *Personnel Psychology*, 37, 1-6.

Frankenhaeuser, M. (1979). Psychoneuroendocrine approaches to the study of emotion as related to stress and coping. In H.E. Howard & R.A. Dienstbier (Eds.), *Nebraska Symposium on Motivation, 1978*. Lincoln: University of Nebraska Press.

Frankenhaeuser, M., & Gardell, B. (1976). Underload and overload in working life: Outline of a multidisciplinary approach. *Journal of Human Stress, 2*(3), 35-46.

Fraser, S. (1980). Effects of controversy within a cooperative or competitive context on organizational decision making. *Journal of Applied Psychology, 65*, 590-595.

Fraser, S. (1985). The effects of attribution and social context on superiors' influence and interaction with low performing subordinates. *Personnel Psychology, 38*, 361-376.

French, J.R.P. Jr., & Caplan, R.D. (1972). Organizational stress and individual strain. In A.J. Marrow (Ed.), *The failure of success*. New York: AMACOM.

French, J.R.P., Jr., Caplan, R.D., & Harrison, R.V. (1982). *The mechanisms of job stress and strain*. New York: Wiley.

French, J.R.P., & Kahn, R.L. (1962). A programmatic approach to studying the industrial environment and mental health. *Journal of Social Issues, 18*, 1-47.

Frost, G. (1972). Man-machine dynamics. In H.P. Van Cott & R.G. Kinkade (Eds.), *Human engineering guide to equipment design*. Washington, DC: U.S. Government Printing Office.

Gael, S. (Ed.). (1988). *The job analysis handbook for business, industry, and government*. New York: John Wiley & Sons.

Gaines, J., & Jermier, J.M. (1983). Emotional exhaustion in a high stress organization. *Academy of Management, 26*(4), 567-586.

Gardell, B. (1987). Efficiency and health hazards in mechanized work. In J.C. Quick, R.S. Bhagat, J.E. Dalton, & J.D. Quick (Eds.), *Work stress: Health care systems in the work place*. New York: Praeger.

Gauch, R.R., Feeney, K.B., & Brown, J.W. (1990). Fear of AIDS and attrition among medical technologists. *American Journal of Public Health, 80*, 1264-1265.

Geyer, P.D., Hice, J., Hawk, J., Boese, R., & Brannon, Y. (1989). Reliabilities of ratings available from the *Dictionary of Occupational Titles*. *Personnel Psychology, 42*, 547-560.

Ghorpade, J.V. (1988). *Job analysis*. Englewood Cliffs, NJ: Prentice Hall.

Gilpatrick, E. (1977). The health services mobility study method of task analysis and curriculum design. Research Report No. 11, Vol. 1 (New York: Hunter College, The Research Foundation, City University of New York, 1977). In J. Ghorpade (1988), *Job analysis: A handbook for the human resource director*. Englewood Cliffs, NJ: Prentice Hall.

Grouch, A.G., & Nimran, U. (1989). Perceived facilitators and inhibitors of work performance in an office environment. *Environment and Behavior, 21*, 206-226.

Hackman, J.R., & Oldham, G.R. (1974). *The job diagnostic survey: An instrument for the diagnosis of jobs and the evaluation of job redesign projects*. New Haven, CT: Yale University, Department of Administrative Sciences. (Technical Report No. 4).

Harvey, R.J. (1991). Job analysis. In M.D. Dunnette & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology* (pp. 72-163). Palo Alto, CA: Consulting Psychologists Press.

Hay, E.N., & Purves, D. (1954). A new method of job evaluation: The guide chart-profile method. *Personnel, (July)*, 72-80.

Henderson, R.I. (1979). *Compensation management: Rewarding performance*. Reston, VA: Reston Publishing Company.

Henderson, R.I. (1988). Job evaluation, classification, and pay. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government*. New York: John Wiley & Sons.

Hiltz, S.R., Johnson, K., & Turoff, M. (1986). Experiments in group decision making: Communication process and outcome in face-to-face versus computerized conferences. *Human Communication Research, 13*, 225-252.

Holt, R.B. (1983). Occupational Stress. In I. Goldberger & S. Breznitz (Eds.), *Handbook of stress*. New York: Free Press.

House, R.J. (1977). A 1976 theory of charismatic leadership. In J.G. Hunt & L.L. Larson (Eds.). *Leadership: The cutting edge*. Carbondale, IL: Southern Illinois University Press.

Howell, W.C. (1992). Human factors in the workplace. In M.D. Dunnette & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology*, Vol. 2 (pp. 209-270). Palo Alto, CA: Consulting Psychologists Press.

Hueber, E.S. (1992). Burnout among school psychologists: An exploratory investigation into its nature, extent, and correlates. *School Psychology Quarterly*, 7, 129-136.

Huff, C., Sproull, L., & Kiesler, S. (1989). Computer communication and organizational commitment: Tracing the relationship in a city government. *Journal of Applied Social Psychology*, 19, 1371-1391.

IES Industrial Lighting Committee. (1983). Proposed American national Standard Practice for Industrial Lighting. *Lighting design and application*, 13, (No. 7), 29-68).

Ivancevich, J.M., & Matteson, M.T. (1980). *Stress and work: A managerial perspective.* Glenview, IL: Scott Foresman.

Ivancevich, J.M., Matteson, M.T., & Preston, C. (1982). Occupational stress, Type A behavior, and physical well-being. *Academy of Management Journal*, 25(2), 373-391.

Jackson, S.E. (1983). Participation in decision making as a strategy for reducing job-related strain. *Journal of Applied Psychology*, 68, 3-19.

Jeanneret & Associates, Inc. (1992). *Job Analysis Guide*. Houston, TX: Author.

Johansson, G., Aronsson, G., & Lindstrom, B. (1978). Social psychological and neuroendocrine stress reactions in highly mechanized work. *Ergonomics*, 21(8), 583-599.

Kahn, R.L., & Byosiere, P. (1992). Stress in organizations. In M.D. Dunnette & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology*, Vol. 3 (pp. 571-650). Palo Alto, CA: Consulting Psychologists Press.

Kahn, R.L., Wolfe, D.M., Quinn, R.P., Snoek, J.D., & Rosenthal, R.A. (1964). *Organizational stress: Studies in role conflict and ambiguity*. New York: John Wiley & Sons, Inc.

Kalil, K.M. (1987). Psychosocial stress, anxiety, and pregnancy complications: Issues for public policy. *Pre- and Peri-Natal Psychology Journal*, 1, 239-243.

Kaplan, M.F. (1987). The influencing process in group decision making. In C. Hendrick (Ed.), *Group processes*. Newbury Park, CA: Sage.

Karasek, R.A., Triantis, K.P., & Chaudhry, S.S. (1982). Co-worker and supervisor support as moderators of associations between task characteristics and mental strain. *Journal of Occupational Behavior*, 3,(2), 181-200.

Katz, D., & Kahn, R.L. (1966). *The social psychology of organizations.* New York: John Wiley & Sons, Inc.

Katz, D., & Kahn, R.L. (1978). *The social psychology of organizations.* New York: John Wiley & Sons, Inc.

Kelly, M., & Cooper, C.L. (1981). Stress among blue collar workers. *Employee Relations, 3,* 6-9.

Klitzman, S., & Stellman, J.M. (1989). The impact of the physical environment on the psychological well-being of office workers. *Social Science and Medicine*, 29, 733-742.

Kochhar, D.S., & Armstrong, T.J. (1988). Designing jobs for handicapped employees. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York: John Wiley & Sons.

Kogi, K. (1985). Introduction to the problems of shiftwork. In S. Folkard & T.H. Monk (Eds.), *Hours of work: Temporal factors of work scheduling.* New York: John Wiley & Sons.

Kraemer, K.L., & Danziger, J.N. (1990). The impacts of computer technology on the work life of information workers. *Social Science Computer Review*, 8, 592-613.

LaBenz, P., Cohen, A., & Pearson, B. (1967). A noise and hearing survey of earth-moving equipment operators. *American Industrial Hygiene Association Journal*, 28, 117-128.

LaRocco, J.M., House, J.S., & French, J.R.P., Jr. (1980). Social support, occupational stress and health. *Journal of Health and Social Behavior*, 21, 202-216.

Leigh, J.P. (1991). Employee and job attributes as predictors of absenteeism in a national sample of workers: The importance of health and dangerous working conditions. *Social Science & Medicine*, 33, 127-137.

Leiter, M.P. (1988). Burnout as a function of communication patterns: A study of a multidisciplinary mental health team. *Group and Organization Studies*, 13, 111-128.

Levy-Leboyer, C. (1989). Noise effects on two industrial tasks. *Work and Stress*, 3, 315-322.

Likert, R. (1961). *New patterns of management.* New York: McGraw-Hill

Lindstrom, K., & Mantysalo, S. (1987). Physical and chemical factors that increase vulnerability to stress or act as stressors at work. In R. Kalimo, M.A. El-Batawi, & C.L. Cooper (Eds.), *Psychosocial factors at work and their relation to health.* Geneva: World Health Organization.

Lopez, F.M. (1988). Threshold traits analysis system. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York: John Wiley & Sons.

Loscocco, K.A., & Spitze, G. (1990). Working conditions, social support, and the well-being of female and male factory workers. *Journal of Health and Social Behavior*, 31, 313-327.

Mackay, C.J., & Cooper, C.L. (1987). Occupational stress and health: some current issues. In C.L. Cooper & I.T. Robertson (Eds.), *International review of industrial and organizational psychology.* New York: John Wiley & Sons.

Marshall, J., & Cooper, C. (1979). Work experiences of middle and senior managers: The pressure and satisfaction. *International Management Review*, 19, 81-96.

Mayes, B.T., Barton, M.E., & Ganster, D.C. (1991). An exploration of the moderating effect of age on job stressor-employee strain relationships. *Journal of Social Behavior and Personality*, 6, 289-308.

McCormick, E.J. (1979). *Job analysis: Methods and applications.* New York: AMACOM.

McCormick, E.J., & Jeanneret, P.R. (1988). Position Analysis Questionnaire (PAQ). In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York: John Wiley & Sons.

McCormick, E.J., Jeanneret, P.R., & Mecham., R.C. (1967). *Position Analysis Questionnaire (Form A).* Lafayette, IN: Purdue University, Department of Psychology, Occupational Research Center. (Published by Consulting Psychologists Press, Palo Alto, CA).

McCormick, E.J., Jeanneret, P.R., & Mecham, R.C. (1969a). *The development and background of the Position Analysis Questionnaire (PAQ).* Lafayette, IN: Purdue University, Occupational Research Center. (Technical Report No. 5).

McCormick E.J., Jeanneret, P.R., & Mecham, R.C. (1969b). *A study of job characteristics and job dimensions based on the Position Analysis Questionnaire.* Lafayette, IN: Purdue University, Occupational Research Center. (Technical Report No. 6).

McCormick, E.J., Jeanneret, P.R., & Mecham, R.C. (1972). A study of job characteristics and job dimensions as based on the Position Analysis Questionnaire (PAQ). *Journal of Applied Psychology Monograph, 56,* 347-368.

McCormick, E.J., Mecham, R.C., & Jeanneret, P.R. (1977). *Technical manual for the Position Analysis Questionnaire--System II.* West Lafayette, IN: PAQ Services, Inc.

McCormick, E.J., Mecham, R.C., & Jeanneret, P.R. (1989). *Technical manual for the Position Analysis Questionnaire (Second Edition).* West Lafayette, IN: PAQ Services, Inc.

McGrath, J.E. (1976). Stress and behavior in organizations. In M.D. Dunnette (Ed.), *The handbook of industrial and organizational psychology* (pp.1351-1396). Chicago: Rand McNally.

Melamed, S., Harari, G., & Green, M.D. (1993). Type A behavior, tension, and ambulatory cardiovascular reaching in workers exposed to noise stress. *Psychosomatic Medicine,* 55, 185-192.

Melamed, S., Luz, J., Najenson, T., Jucha, E., & Green, M. (1989). Ergonomic stress levels, personal characteristics, accident occurrence, and sickness absence among factory workers. *Ergonomics,* 32, 1101-1110.

Mitchell, J.L., & McCormick, E.J. (1976). Professional and Managerial Position Questionnaire (PMPQ). Lafayette, IN: Purdue University, Department of Psychological Services. (Published by Consulting Psychologists Press, Palo Alto, CA).

Mott, P.E. (1976). Social and psychological adjustment to shift work. In P.E. Rentos & R.D. Shepond (Eds.), *Shift work and health.* Washington, DC: U.S. Government Printing Office.

Mumford, M.D., & Connelly, M.S. (1991). Leaders as creators: Leader performance and problem solving in ill-defined domains. *Leadership Quarterly,* 2(4), 289-315.

Neff, W.S. (1987). *Work and human behavior* (3rd ed.). New York: Aldine Publishing Company.

Noweir, M.H. (1984). Noise exposure as related to productivity, disciplinary actions, absenteeism, and accidents among textile workers. *Journal of Safety Research*, 15, 163-174.

Numerof, R.E., & Abrams, M.N. (1984). Sources of stress among nurses: An empirical investigation. *Journal of Human Stress*, 10(2), 88-100.

Nunneley, S., Reader, D., & Maldonado, R. (1982). Temperature effects on physiology, comfort, and performance during hyperthermia. *Aviation, Space and Environmental Medicine*, 53(7).

Occupational Safety and Health Act of 1970. Washington, DC: U.S. Government Printing Office.

Office of Personnel Management. (1979). *How to write position descriptions under the Factor Evaluation System*. Washington, DC: U.S. Government Printing Office.

Ornstein, S. (1990). Linking environmental and industrial/organizational psychology. In C.L. Cooper & I.T. Robertson (Eds.), *International review of industrial and organizational psychology, 5* (pp. 195-228). New York: John Wiley & Sons.

Otway, H.J., & Misenta, R. (1980, January 28-31). *The determinants of operator preparedness for emergency situations in nuclear power plants*. Paper presented at Workshop on Procedural and Organizational Measures for Accident Management: Nuclear Reactors. International Institute for Applied Systems Analysis, Laxenberg, Austria.

Papa, M.J., & Tracy, K. (1988). Communicative indices of employee performance with new technology. *Communication Research*, 15, 542-544.

Park, M., & Casali, J.C. (1991). A controlled investigation of in field attenuation performance of selected insect, earmuff, and canal cap hearing protectors. *Human Factors*, 33, 693-714.

Parker, J.F., Jr., & West, V.R. (1973). Bioastronautics data book. Washington, DC: U.S. Government Printing Office.

Payne, R. (1980). Organizational stress and social support. In C.L. Cooper & R. Payne (Eds.), *Current concerns in occupational stress*. London: John Wiley & Sons.

Poulton, E.C. (1970). *Environment and human efficiency*. Springfield, IL: Thomas.

Poulton, E.C. (1978). Blue-collar stressors. In C.L. Cooper & R. Payne (Eds.), *Stress at work* (pp. 51-80). Chichester, England: Wiley.

Rajecki, D., Ickes, W., Corcoran, C., & Lenerz, K. (1977). Social facilitation of human performance: Mere presence effects. *Journal of Social Psychology*, 102, 297-310.

Riordan, C.A., Johnson, G.D., & Thomas, J.S. (1991). Personality and stress at sea. Special Issue: Handbook on job stress. *Journal of Social Behavior and Personality*, 6, 391-409.

Rohmert, W. (1983). Moglichkeiten und grenzen menschengerechter arbeitsgestaltung durch ergonomie. In F. Furstenberg, P. Hanau, H. Kreikebaum, & W. Rohmert (Eds.,) *Menschengerechte gestaltund der arbeit*. Mannheim, Wien, and Zurich: B.I. Wisenschaftsverlag.

Rohmert, W. (1988). AET. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government*. New York: John Wiley & Sons.

Royal, W.F. 91995). Danger in the workplace. *Sales and Marketing Management*, 147, 28.

Rutenfranz, J., Haider, M., & Koller, M. (1985). Occupational health measures for nightworkers and shiftworkers. In S. Folkard & T.H. Monk (Eds.), *Hours of work: Temporal factors of work scheduling* (pp. 199-210). New York: John Wiley & Sons.

Ryan, C.M., Morrow, K.A., & Hodgson, M. (1988). Cacosmia and neurobehavioral dysfunction associated with occupational exposure to mixtures of organic solvents. *The American Journal of Psychiatry*, 154, 1442-1445.

Ryle, G. (1949). *The concept of mind*. London: Hutchinson.

Scherbaum, C.J., & Shepherd, D.H. (1987). Dressing for success: Effects of color and layering on perceptions of women in business. *Sex Roles*, 16, 391-399.

Schwarz, E.D., & Kowalski, J.M. (1993). Malignant memories: Effect of a shooting in the workplace on school personnel attitudes. *Journal of Interpersonal Violence*, 18, 468-485.

Secretary's Commission on Achieving Necessary Skills (SCANS). (1991). What work requires of schools: *A SCANS report for American 2000*. Washington, DC: U.S. Department of Labor.

Selye, H. (1980). *Selye's guide to stress research: Volume 1.* New York: Van Nostrand Reinhold.

Shauksmith, G. (1990). Job control, paced tasks, and discretion. *Perceptual and Motor Skills*, 71, 409-410.

Shaw, J.B., & Riskind, J.H. (1983). Predicting job stress using data from the Position Analysis Questionnaire. *Journal of Applied Psychology*, 68, 253-261.

Sherif, M. (1936). *The psychology of social norms*. New York: Harper Collins.

Sherif, M. (1965). Formation of social norms: The experimental paradigm. In H. Proshansky & B. Seidenberg (Eds.), *Basic studies in social psychology*. New York: Holt, Rinehard and Winston.

Shirom, A., Eden, D., Silberwasser, L., & Kellerman, J. (1973). Job stresses and risk factors in coronary heart disease among occupational categories in Kibbutzim. *Social Science and Medicine, 7,* 875-892.

Snyder, R.A., & Morris, J.H. (1984). Organizational communication and performance. *Journal of Applied Psychology, 69,* 461-465.

Sonnentag, S., Brodbeck, F., Heinbokel, T., & Stolte, W. (1994). Stressor-burnout relationship on software development teams. *Journal of Occupational and Organizational Psychology*, 67, 327-341.

Spector, P.E., & Jex, S.M. (1991). Relations of job characteristics from multiple data sources with employee affect, absence, turnover intentions, and health. *Journal of Applied Psychology*, 76, 46-53.

Spector, P.E., & O'Connell, B.J. (1994). The contribution of personality traits, negative affectivity, locus of control and Type A to the subsequent reports of job stressors and job strains. *Journal of Occupational and Organizational Psychology*, 67, 1-12.

Sundstrom, E., & Sundstrom, M.G. (1986). *Work places: The psychology of the physical environment in offices and factories*. Cambridge: Cambridge University Press.

Sundstrom, E., Town, J.P., Rice, R.W., Osborn, D.P., & Briel, M. (1994). Office noise, satisfaction, and performance. Environment and Behavior, 26, 195-222.

Sweat, S., Kelley, E., Blouin, D., & Glee, R. (1981). Career appearance perceptions of selected university students. *Adolescence*, 16, 359-370.

Taylor, G.S., & Zimmerer, T.W. (1992). Voluntary turnover among middle level managers: An analysis of perceived causes. *Journal of Managerial Issues*, 4, 424-437.

Turnage, J.J., & Spielberger, C.D. (1991). Job stress in managers, professionals, and clerical workers. *Work and Stress*, 5, 155-176.

Turnberg, W.L., & Frost, F. (1990). Survey of occupational exposure of waste industry workers to infection waste in Washington State. *American Journal of Public Health*, 80, 1262-1264.

U.S. Department of Labor. (1972). *Handbook for analyzing jobs*. Washington, DC: U.S. Government printing Office.

U.S. Department of Labor. (1991). *The revised handbook for analyzing jobs*. Washington, DC: U.S. Government Printing Office.

Valacich, J.S., Paranka, D., George J.F., & Nunamaker, J.F. (1993). Communication concurrency and the new media: A new dimension for media richness. *Communication Research*, 20, 249-276.

Van Fleet, D.D., & Yukl, G.A. (1986). *Military leadership: An organizational behavior perspective*. Greenwich, CT: JAI Press.

Vealy, R.S., Udry, E.M., Zimmerman, V., & Soliday, J. (1992). Intrapersonal and interpersonal predictors of coaching burnout. *Journal of Sport and Exercise Psychology*, 14, 40-58.

Violanti, J.M., Vena, J.E., & Marshall, J.R. (1986). Disease risk and mortality among police officers: New evidence and contributing factors. *Journal of Police Science and Administration*, 14, 17-23.

Warm, J.S., & Dember, W.N. (1986). Awake at the switch. *Psychology Today*, 20, 46-53.

Weiss, M.G., & Liss, M.B. (1988). Night shiftwork: Job and family concerns. Special Issue: Work and Family Theory. *Journal of Social Behavior and Personality*, 3, 279-286.

Yukl, G.A. (1989). *Leadership in organizations.* Englewood Cliffs, NJ: Prentice Hall.

Zerga, J.E. (1943). Job analysis: A resume and bibliography. *Journal of Applied Psychology*, 27, 249-267.

Appendix 7-A

Work Context Items - Job Analysis Instruments Matrix

Work Context Dimensions	Job Analysis Instrument								
	ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Interpersonal: Communication									
1. Formality of Communication						✓	✓		
2. Communication Methods	✓		✓	✓		✓	✓	✓	✓
3. Objectivity vs. Subjectivity of Information Communicated				✓		✓			
4. Job Required Social Interaction		✓	✓	✓	✓	✓	✓		
5. Privacy of Communications									
Work Context: Interpersonal: Role Relationships									
6. Job Interactions			✓						
a. Supervise, coach, train, or develop other employees?	✓	✓		✓		✓	✓	✓	✓
b. Persuade someone to a course of action (informally) or influence others to buy something (to sell)?		✓		✓		✓	✓		
c. Provide a service to others (e.g., customers)?		✓		✓		✓	✓		✓
d. Take a position opposed to coworkers or others?				✓		✓			✓
e. Work with or contribute to a work group or team to perform this job?	✓			✓		✓			✓
f. Deal with public customers (e.g., retail sales) or the public in general (e.g., police work)?	✓	✓		✓		✓	✓	✓	✓
g. Coordinate or lead others in accomplishing work activities (not supervision)?	✓	✓		✓		✓	✓	✓	✓
Work Context: Interpersonal: Responsibility for Others									
7. Responsibility for Others' Health and Safety	✓			✓		✓	✓		
8. Responsibility for Work Outcomes and Results	✓		✓		✓		✓	✓	✓

Appendix 7-A

Work Context Items - Job Analysis Instruments Matrix (Continued)

Work Context Dimensions	Job Analysis Instrument								
	ACT	DOL	FES	GWI	JDS	QAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Interpersonal: Conflictual Contact									
9. How frequently do the job requirements place the worker in conflict situations?				✓		✓	✓		
10. How frequently does the worker have to deal with unpleasant, angry, or discourteous individuals as part of the job requirements?				✓		✓	✓		
11. How frequently does the worker have to deal with physical aggression of violent individuals?									
Work Context: Physical Work Conditions: Work Setting									
12. How frequently does this job require the worker to work:									
a. indoors, environmentally controlled?				✓		✓	✓		
b. indoors, not environmentally controlled (e.g., un-air-conditioned warehouse)?				✓		✓	✓		
c. outdoors, exposed to all weather conditions?		✓		✓		✓	✓		
d. outdoors, under cover (e.g., open shed)?									
e. open vehicle or operating equipment (e.g., tractor)?		✓							
f. enclosed vehicle or operating equipment		✓							
13. Privacy of Work Area									
14. Physical Proximity									
Work Context: Physical Work Conditions: Environmental Conditions									
15. Environmental Conditions			✓						
a. sounds and noise levels that are distracting and uncomfortable?		✓		✓		✓	✓		
b. very hot (above 90° F) or very cold (under 32° F) temperatures?		✓		✓		✓	✓		

Appendix 7-A

Work Context Items - Job Analysis Instruments Matrix (Continued)

Work Context Dimensions	Job Analysis Instrument								
	ACT	DOL	FES	GWI	JDS	QAI	PAQ/ JEI	PMPQ	SCANS
c. extremely bright or inadequate lighting conditions?						✓	✓		
d. contaminants (pollutants, gases, dust, odors, etc.)?		✓		✓		✓	✓		
e. cramped work space that requires getting into awkward positions?						✓			
f. whole body vibration (e.g., operating a jackhammer or earthmoving equipment)?		✓		✓		✓	✓		
Work Context: Physical Work Conditions: Environmental Conditions:Job Hazards			✓				✓		
16. Exposure to Radiation		✓		✓		✓			
17. Exposure to Diseases/Infections (e.g., patient care, some laboratory work, sanitation control, etc.)									
18. Exposure to High Places (such as heights above 8 feet on ladders, poles scaffolding, catwalks, etc.)		✓		✓		✓			
19. Exposure to Hazardous Conditions (such as high voltage electricity, combustibles, explosives, chemicals; do not include hazardous equipment or situations - see questions 20 and 21).		✓		✓		✓			
20. Exposure to Hazardous Equipment, such as saws, machinery/mechanical parts (include exposure to vehicular traffic, but not driving vehicle).		✓				✓			
21. Exposure to Hazardous Situations involving likely cuts, bites, stings, or minor burns						✓			
Work Context: Physical Work Conditions: Job Demands: Body Positioning									
22. Body Positioning			✓						
a. Sitting?		✓		✓		✓	✓		
b. Standing?		✓		✓		✓	✓		

Work Context Items - Job Analysis Instruments Matrix (Continued)

Work Context Dimensions	Job Analysis Instrument								
	ACT	DOL	FES	GWI	JDS	QAI	PAQ/ JEI	PMPQ	SCANS
c. Climbing ladders, scaffolds, poles, etc?		✓				✓	✓		
d. Walking or running?		✓		✓		✓	✓		
e. Kneeling, crouching, stooping, or crawling?		✓		✓		✓	✓		
f. Keeping or regaining balance?		✓		✓		✓	✓		
g. Using hands to finger, handle, control, or feel objects, tools or controls?		✓		✓		✓	✓		
h. bending or twisting the body?		✓		✓					
i. Making repetitive motions?		✓					✓		
Work Context: Physical Work Conditions: Job Demands: Work Attire			✓						
23. Work Attire				✓					
a. business clothes, such as ties an dresses that are often worn in offices?						✓	✓		
b. a special uniform, such as that of a commercial pilot, nurse, police officer, or military personnel?						✓	✓		
c. work clothing such as that worn by production or maintenance workers?						✓	✓		
d. Common protective or safety attire, such as safety shoes, glasses, gloves, hearing protection, hard-hat, or personal flotation device?		✓				✓	✓		
e. specialized protective or safety attire, such as breathing apparatus, safety harness, full protection suit, or radiation protection?		✓					✓		

Appendix 7-A

Work Context Items - Job Analysis Instruments Matrix (Continued)

Work Context Dimensions	Job Analysis Instrument								
	ACT	DOL	FES	GWI	JDS	QAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Structural Job Characteristics: Criticality of Position			✓						
24. Consequences of Error				✓		✓	✓	✓	
25. Impact of Decisions	✓						✓		
26. Responsibility/Accountability				✓	✓	✓	✓	✓	
27. Decision Latitude				✓	✓	✓	✓		✓
Work Context: Structural Job Characteristics: Routine vs. Challenging Work									
28. Frustrating Circumstances						✓	✓		
29. Degree of Automation									
30. Task Clarity					✓	✓			
31. How important is being very exact or highly accurate in performing this job?		✓					✓		
32. How important is it to be sure that all the details of this job are performed and everything is done completely?							✓		
33. How important is being constantly aware of either frequently changing events (e.g., security guard watching for shoplifters) or infrequent events (e.g., radar operator watching for tornadoes) top performing this job?				✓			✓		
34. How important is repeating the same physical. (E.g., key entry) or mental (e.g., checking entries in a ledger) activities over and over, without stopping, to performing this job?		✓		✓	✓	✓	✓		
35. Structured vs. Unstructured Work						✓	✓		

Appendix 7-A

Work Context Items - Job Analysis Instruments Matrix (Continued)

Work Context Dimensions	Job Analysis Instrument								
	ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
Work Context: Structural Job Characteristics: Level of Competition									
36. Level of Competition									
Work Context: Structural Job Characteristics: Pace and Scheduling									
37. Deadlines and Time Pressure				✓		✓	✓		
38. How important is working under frequent distractions or interruptions to performing this job?						✓	✓		
39. How important is it to this job that the pace is determined by the speed of equipment or machinery? (This does not refer to keeping busy at all times on this job.)						✓	✓		
40. Please check the usual work schedule for this job. (Check only <u>one</u>.)									
a. Regular Work (established routine, with set schedule)						✓	✓		
b. Irregular Work (subject to weather conditions, production demands, contract duration)						✓	✓		
c. Seasonal Basis (only work during certain times of the year)				✓		✓	✓		
41. Please check the usual work shift for this job. (Check only <u>one</u>.)									
a. Day Shift						✓	✓		
b. Other Than Day Shift (i.e., evening shift or night shift)				✓		✓	✓		
c. Split or Variable Shift (work busy times or shift changes due to staffing demands)						✓	✓		
d. Rotating Shift (rotate days, evenings, nights)				✓		✓			

Appendix 7-A

Work Context Items - Job Analysis Instruments Matrix (Continued)

Work Context Dimensions	Job Analysis Instrument								
	ACT	DOL	FES	GWI	JDS	OAI	PAQ/ JEI	PMPQ	SCANS
42. Please check the usual work shift duration.									
43. Please check the usual overtime work.									
44. Please check the number of hours typically worked in one week.							✓		
45. Please check the usual work cycle for this job.									
46. Please check the number of days usually worked in the cycle.									

Chapter 8
Organizational Context
Table of Contents

Figures

Appendices

Chapter 8
Organizational Context

Sharon Arad, Rob Schneider,
& Mary Ann Hanson
Personnel Decisions Research Institute, Inc.

Introduction

Work context can be viewed as the context specific to a particular job or occupation, as well as the context of the organization in which the job is performed. This section focuses on the context provided by the organization as a whole, whereas Chapter 7 focused on characteristics of the work environment specific to a particular job or occupation.

The Dictionary of Occupational Titles (DOT; U.S. Department of Labor [DOL], 1991) currently includes little information about the organizations in which jobs or occupations occur. The only such information included is a designation of the industry(s) in which each occupation can be found. However, there appears to be a growing need for this type of information on the part of a variety of DOT users. First, it is reasonable to expect that the organizations providing the context within which jobs occur will affect the very nature of the jobs themselves. In fact, the industry designations included in the current DOT are used to distinguish among different occupations that have the same titles but occur in different industries. Additional descriptive information about the organizations in which jobs occur is likely to further aid in classification analyses aimed at clustering jobs that are similar in specified ways. It is likely that jobs will vary as a function of characteristics of the organizations in which they occur.

Information about organizations in the United States is inherently interesting to many DOT users as well. Westat's (1994) needs analysis indicated that DOT users were interested in information about the "occupational environment" (i.e., industry, work conditions, type of work place). In fact, almost half of the surveyed users reported that this kind of information was very important to them. A DOL program designed to assist American business and help to improve its organizational and administrative effectiveness is one of the potential users of organizational context information. This program, referred to as the Office of the American Workplace, attempts to integrate state-of-the art technology and human resources policy to promote "high-performance" workplaces. Available research on relationships between certain business practices and effectiveness, along with case studies of companies that are successfully using these state-of-the-art practices, has been used to come up with a profile of the practices that high-performance organizations use and a checklist of these practices (U.S. DOL, 1994).

National and state-level award programs have been established to reward businesses for quality and for high-performance business practices. The Malcolm Baldrige National Quality Award is awarded based on a list of criteria that are similar to the practices listed on the DOL's checklist. Westat (1994) reviewed all of this information, along with popular business literature on the nature of high-performance workplaces, and identified a set of characteristics of high-performance workplaces that is consistent with the Malcolm Baldrige and DOL criteria as well as with the literature. High-performance organizations are typically described as using state-of-the-art personnel and management practices and having organizational structures that facilitate flexibility and employee involvement. These characteristics are expected, based on the literature and on case studies of successful organizations, to help organizations effectively adapt to today's rapidly changing and highly competitive business environment.

The concept of high-performance workplaces is a new one, and only a limited amount of information is available concerning the extent to which U.S. businesses use "high-performance" business practices and the extent to which these practices are related to effectiveness when they are used. O*NET, as a database system, will integrate information about the characteristics of "high-performance" organizations with descriptions of incumbents' skills and other characteristics (U.S. DOL, 1994). It is reasonable to expect that the characteristics of high-performance organizations affect the design of jobs and the tasks and responsibilities involved in those organizations. Thus, the description of high-performance organizations was a high priority in developing the content model underlying O*NET.

Finally, the occupational classification systems associated with O*NET must be capable of describing future jobs, in addition to currently existing jobs. The U.S. business economy continues to change and evolve. Recent changes in the workplace, rapid technological advances, highly competitive international markets, and an increasingly diverse work force, are likely to lead to additional changes in how U.S. businesses function and adapt. Such changes typically occur at the organization level, and are likely to have substantial implications for the nature and scope of jobs.

Thus, global socio-economical changes, combined with theoretical assumptions about the interaction between workers and organizations, set the stage for inclusion of organizational context descriptors in O*NET. The Advisory Panel for the Dictionary of Occupational Titles (APDOT) suggested, in its final report (U.S. DOL, 1993), that the content model used to develop the O*NET include organizational context descriptors such as the industry in which a given job is performed, the organizational structure (e.g., size, type, reward structure), and the organizational culture. Their recommendations were based on the assumption that the broader context of jobs will impact on how jobs are described and will provide meaningful and relevant information for DOT users.

Approach

An emphasis on describing high-performance organizations guided our first attempts to conceptualize the organizational context domain. Several checklists are available that outline the concepts believed to be indicators of effective organizational adaptation to the fast changing business market and work force. One objective in developing the organizational context descriptors for O*NET was to measure, as comprehensively as possible, those organizational characteristics thought to differentiate "high-performance" organizations from more traditional or less effective organizations.

However, the primary source of input for our taxonomy was the rich, well-established, and extensive literature that is available concerning organizations. We chose not to focus exclusively on the "high performance" concept for several reasons. First, "high performance" is a relatively new concept and there is still a great deal to be learned about the exact nature and correlates of "high-performance" business practices. Because these concepts are relatively new, there is always the possibility that this is just a passing fad and that the concept of "high performance" will not withstand the test of time. Finally, the available checklists may not be sufficiently comprehensive for our purposes; additional organizational characteristics and business practices, beyond those typically associated with "high-performance" organizations, may also be critical to the effectiveness and adaptability of American businesses.

The relative newness and potential limitations of the "high performance" concept highlight the importance of attending to the rich and extensive literature that is available concerning organizational development, effectiveness and adaptability. The research and theory embodied in this literature were the bases for development of the organizational context portion of the content model. This literature will ensure that the organization-level descriptors included in the new DOT provide a thorough and comprehensive description of important organizational characteristics that are likely to be of use to both present and future users of the O*NET. The remainder of this section provides a brief review of these portions of the literature of most relevance to the content model.

Organizations typically are complex and exist in a wide variety of different forms. Thus, one difficult challenge in developing a system of organizational context descriptors is to identify constructs that will be appropriate for describing this diversity of organizations. The literature does not provide any one theory of organizations that is most appropriate to guide our efforts. The extensive literature on organizations comes from numerous approaches, schools, and models. Perhaps the best known and most widely discussed approaches for studying organizations are those that emphasize scientific management, human relations, socio-technical, and sociological constructs. Each emphasizes different aspects and components of organizations. However, when integrated, all of these different approaches offer a comprehensive view and description of organizations. Accordingly, we reviewed and integrated the major theoretical and empirical writings from these different schools of thought in order to identify a comprehensive framework for our taxonomy. We compared and synthesized the constructs of organizational context proposed and studied in each approach, and came up with a list of topic areas. These topic areas serve as a summary of the most important organizational context variables that are discussed and researched in the literature. They are presented in Appendix 8-A.

From this list, we selected constructs on the basis of the following criteria. First, constructs were included if they had been measured with reasonable levels of reliability and validity in past research, or if suggested measures had good potential for being reliable and valid. Second, we tried to include constructs for which the measures could be generalized to different types of organizations without losing their meaning. Third, constructs were included if they were expected, based on theory or past research, to be useful in describing or classifying jobs, or in describing important features of organizations that would be of interest to one or more O*NET users.

Based on these criteria, we identified a variety of relatively specific constructs of organizational context constructs that appeared useful, and organized these constructs into a hierarchical taxonomy. We then developed measures to tap each construct. Once these measures had been developed, we went back to the Malcolm Baldrige Award criteria, the DOL high-performance checklist, and the popular literature on high-performance organizations to determine whether any "high performance" constructs had not emerged in our review of the organizational literature. A few such constructs were identified and added to our taxonomy. Measures of these additional high performance constructs were also developed.

Finally, because some of the constructs included in our taxonomy had not been previously measured and were thus quite experimental, we obtained a preliminary assessment of the questions we had developed to measure these new constructs from two subject matter experts. These individuals worked for two different Fortune 500 companies and had PhDs in psychology, as well as many years of experience in the Human Resources domain. They were asked to assess the feasibility of collecting accurate and reliable data with our constructs and items, and to assess the usefulness of the constructs in describing both organizations in general and high-performance organizations in particular. Some of the questions and their related constructs were dropped or rewritten based on feedback from these experts. On the basis of their feedback we also added items concerning recent changes in size, hierarchy, and other aspects of organizational structure.

Issues in Developing Organizational Context Descriptors

Before we discuss our proposed taxonomy of organizational context, we should highlight some issues encountered in taxonomy development that affected the outcome. First, the collection of organizational context information had multiple purposes, and even within a fairly narrow portion of the taxonomy, different constructs included for different purposes. In other instances, a single construct served multiple purposes. For example, use of state-of-the-art human resources practices is a characteristic often associated with high-performance organizations, but the typical selection procedures and salary structure for a given occupation will also be of enormous interest to job seekers and thus to job counselors as well.

Second, the development of organization-level descriptors was somewhat guided by sampling and other data collection constraints. One goal in developing measures of the organizational context descriptors was to measure as many of the constructs as possible with questions that could be answered by a single personnel department representative (or an individual with access to similar information) from each organization participating in the data collection. We made every effort to keep the questions that would only be asked of a single organizational representative as objective and concrete as possible because of reliability concerns. In fact, 84 percent of the questions that were ultimately included in the questionnaire for these individuals asked for concrete, verifiable information. Any questions that could not be answered by such an individual were only included if they could be answered by job incumbents themselves. Thus, we excluded one promising construct, "span of control," because questions concerning number of subordinates would only be appropriate for individuals working in supervisory or managerial positions.

Third, the level of analysis employed by the operational definitions, and thus the source of the data, varied across constructs, and depended in part on who was to provide the most appropriate and best data. Each construct in our model had to be examined and operationalized at a level that promised accurate and high quality data. For example, organizational structure constructs such as size, formalization, and reward systems could be best measured and observed at the organization level. However, role characteristics and processes in an organization are individual psychological experiences. Hence, the appropriate level of analysis for roles is the individual.

Another principle guiding our selection of a particular level of analysis for a construct was the underlying purposes and potential uses of the classification system as part of O*NET. Since the main purpose of this occupational database is to provide information about jobs and occupations, we found it necessary to measure some of the variables at the job level. This would enable us to provide information to DOT users about the manifestations of various organizational systems (e.g., selection and training systems) at the job level. Some questions (e.g., about rewards) were designed to provide information both about a particular job and to identify high-performance organizations. In some cases, these questions must be asked twice

— once of the job incumbents concerning their particular job and once of the personnel representative concerning the organization as a whole.

Finally, when selecting organizational context constructs and developing measures of those constructs, we attempted to minimize potential overlap with the work context domain. Organizational context concepts for which the appropriate level of analysis is the job and for which the most appropriate source of information is the job incumbent have the most potential for overlap. Whenever similar concepts occur in both the organizational and work context domains, the organizational context constructs and measures focus on the impact of the organization on the job. The work context items focus on the impact of the job on the individual. For example, both domains include items related to work groups. The work context measures deal with how important interactions involving a work group or a team are for a job; the organizational context measures focus on the number and types of teams to which the individual belongs.

Proposed Hierarchical Taxonomy of Organizational Context

The constructs of organizational context we selected for the taxonomy can be grouped according to six higher order constructs or topic areas. These six higher order constructs are: type of industry, organizational structure, human resources (HR) systems and practices, culture, goals, and roles. These general categories correspond to relatively distinct areas of theory and research in the literature. They provide a useful heuristic for categorizing the lower order constructs, but do not themselves represent actual, measurable characteristics of organizations or jobs.

Taxonomies of organizations can be based on different dimensions and characteristics and are designed to indicate a meaningful difference between the types or classes identified. The usefulness of a taxonomy largely depends on its purpose and the circumstances (Hall, 1982). The first construct, type of industry is regarded by most organizational theorists and researchers as an important element in understanding and studying organizations (Katz & Kahn, 1978; Hall 1982; Thompson, 1967). Some taxonomies of organizations are solely based on structural characteristics and thus do not provide useful information beyond the descriptors of structure already included in the proposed taxonomy. However, differentiations based on organizations' type of output (e.g., industry) clearly provide additional useful information and were thus included in the proposed taxonomy.

The second higher order construct, organizational structure, can be viewed as the architecture or the anatomy of an organization. One would be hard pressed to uncover any theories or models of organizations that did not regard organizational structure as a critical element of organizations (e.g., Child, 1972; Dalton, Todor, Spendolini, Fielding, & Porter, 1980; Duncan, 1979; Katz & Kahn, 1978; Hall, 1982). Organizational structure affects the behavior of organizational members as well as the ability of organizations to adapt effectively to their environments. Elements of organizational structure include the hierarchy of the organization, the degree of centralization, and the nature of work groups used to accomplish organizational objectives.

Human resources (HR) systems and practices exist to ensure that an organization has employees who are capable of meetings its goals. The management of employees clearly is important to organizations, and, to the extent that HR practices become systematized, they are an unmistakable part of the organizational context within which employees must work. The aspects of HR systems and practices most relevant to O*NET and consequently included in the proposed taxonomy are organizational socialization practices, organizational reward systems, recruitment and selection practices, and employee training and development.

Organizational culture is often regarded as a general label for social and behavioral patterns observed in organizations. Culture typically is thought of as composed of shared assumptions, values, norms, and artifacts, and is described as important by most organizational theorists and writers (e.g., Katz & Kahn, 1978; Lawler, 1992; Limerick & Cunnington, 1993; Mintzberg, 1979; Perrow, 1961; Schein, 1992). A well-developed and business-specific culture has been thought to underpin stronger organizational commitment, higher morale, more efficient performance, and generally higher productivity (Deal & Kennedy, 1982; Furnham & Gunter, 1993; Graves, 1986; Peters & Waterman, 1982).

Few organizational theorists exclude goal constructs from their models and discussions. Goal setting — both organizational and individual — is central to the functioning of modern organizations. There are two distinct goal setting literatures: one line of research deals with

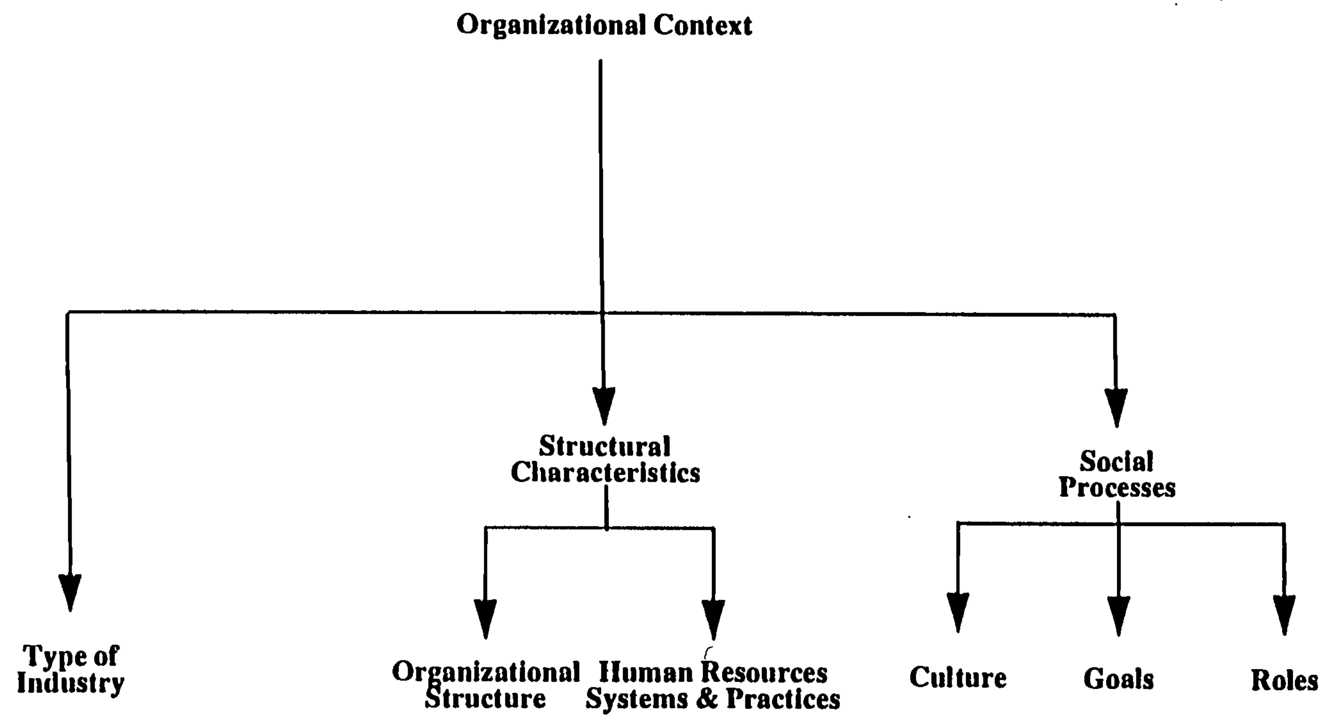


Figure 8-1
Higher Order Taxonomy of Organizational Context Constructs

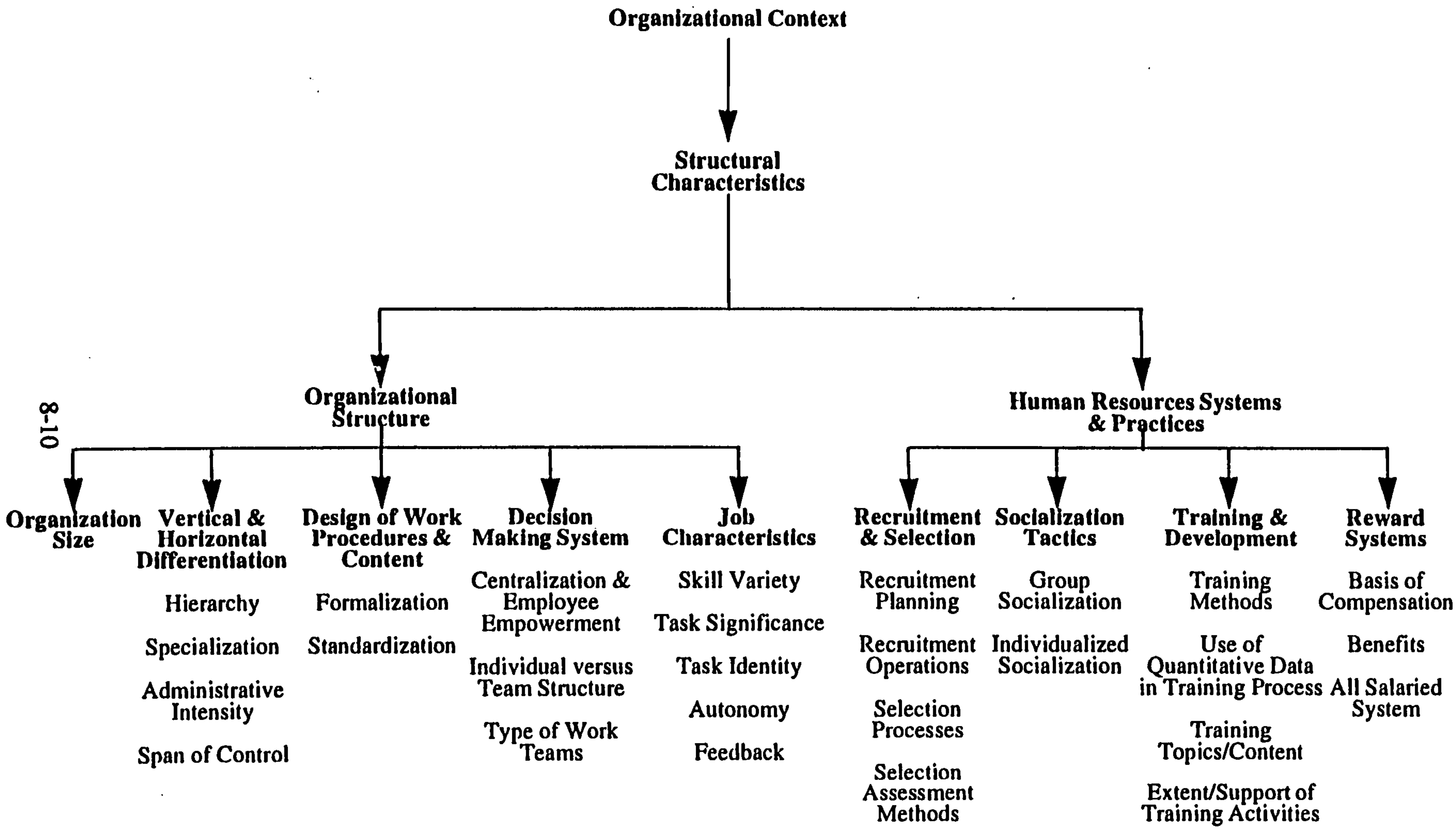


Figure 8-2
Lower Order Taxonomy of Structural Characteristics

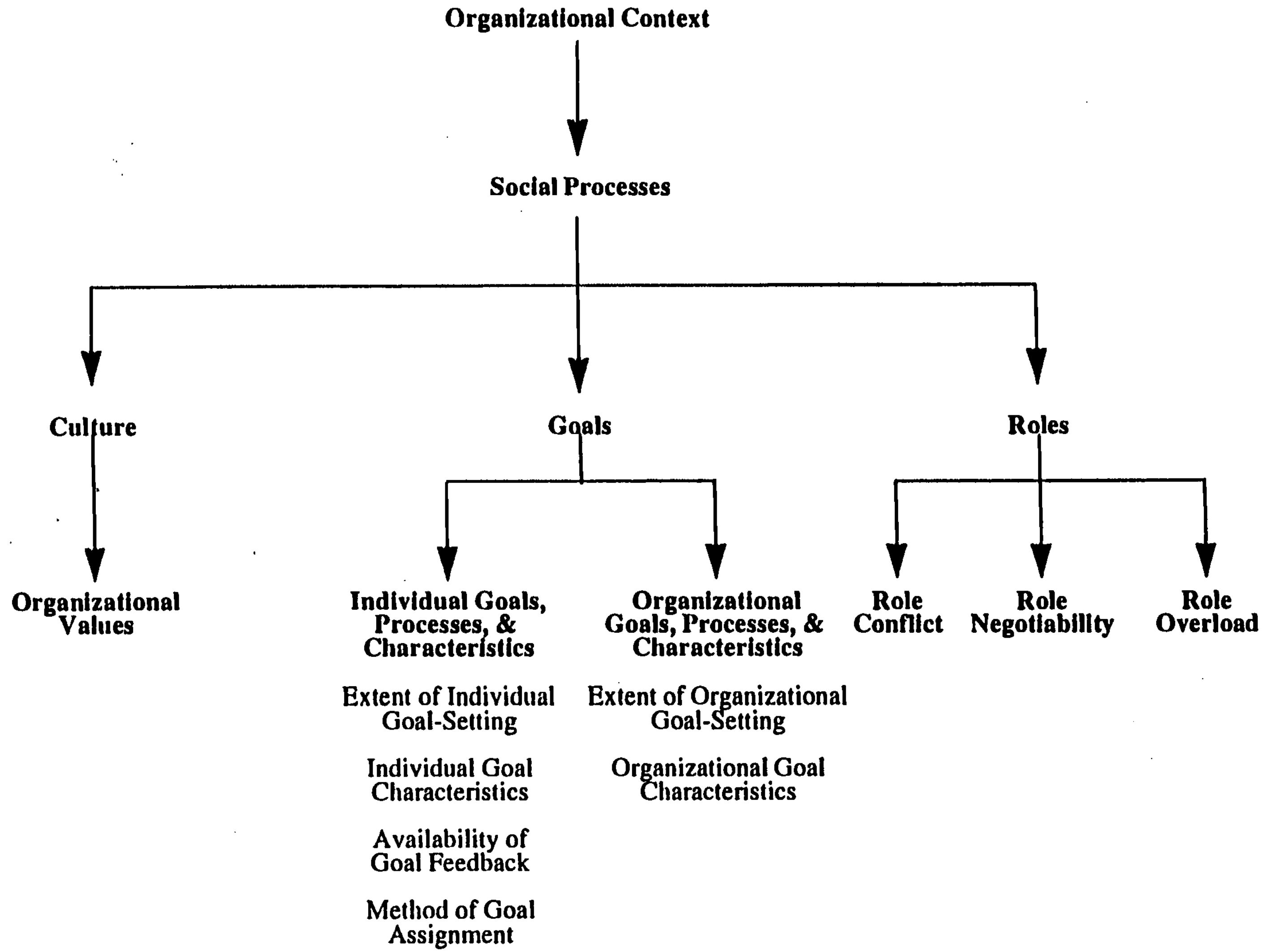


Figure 8-3
Lower Order Taxonomy of Social Processes

organizational goals and the other deals with individual goals. Aspects of both are relevant to O*NET users and thus were included in the proposed taxonomy.

Finally, roles are sets of behaviors expected of role incumbents (Ilgen & Hollenbeck, 1991). The literature suggests several aspects of roles that are likely to be relevant to O*NET: role conflict, role overload, and role negotiability. For example, the extent to which a job is likely to involve role overload or role conflict would be of interest to job seekers and counselors.

These six higher order constructs can be grouped into even more general categories based on a systems approach. Organizations can be viewed as composed of subsystems which in turn consist of components. The most documented application of this approach to the study and analysis of organizations is the socio-technical systems approach. In this application, the two main subsystems in an organization are the technical and social subsystems. The technical subsystem involves the process of transforming raw materials into output, which includes elements such as technology and structure. The social subsystem links human operators both to technology and to each other and includes elements such as values, goals, leadership, and roles (Fuqua & Kurpius, 1993; Katz & Kahn, 1978). The socio-technical approach proposes that technology, structure, and social process in an organization are interrelated and interdependent. Furthermore, organizational or unit performance can be maximized by joint optimization of the technical and social subsystems (Katz & Kahn, 1978).

This approach provided the basic classification of the organizational context domain into two components: the structural and the social processes subsystems. Consistent with the literature, organizational structure and HR systems and practices were grouped together under structural characteristics, while organizational culture, goals, and roles were considered elements of social processes in organizations. Figures 8-1 through 8-3 provide graphical illustrations of how the higher order and lower order constructs fit in this taxonomy. Appendix 8-B provides definitions of each of the lower order constructs and information about their psychometric properties. Appendix 8-B also provides information about the appropriate level of analysis for the lower order constructs by describing the source(s) of ratings (i.e., incumbents or personnel representative) for each construct. However, while Figures 8-1 through 8-3 contain the full conceptual model, Appendix 8-B contains only the constructs that were included in the final instrument.

Our taxonomy subsumes many of the concepts that appear in the OPM's Organizational Assessment Survey (OAS), such as training, rewards, teamwork, innovation, and measurement. Other OAS constructs, such as communication, resource allocation, supervision, and job security, are very similar to concepts included in the work context domain of our content model.

Each of the six higher order constructs is described in more detail in the sections that follow. The lower order constructs within each area also are described, as well as the justification for including these constructs in the proposed taxonomy. Most of the higher order constructs that were identified in the literature review (see Appendix 8-A) but not included in the proposed model were excluded because they failed to meet the criterion of yielding reliable, valid measures. For constructs such as leadership and strategic decision making, the literature does not suggest promising measurable lower level constructs, and we were unable to derive promising measures for them per se. In addition, within each of the higher order constructs included in the taxonomy, lower order constructs were sometimes excluded if they did not appear relevant to O*NET objectives or measurable.

Type of Industry

Type of industry is regarded by most organizational theorists and researchers as an important element in understanding and studying organizations (Katz & Kahn, 1978; Hall 1982; Thompson, 1967). Organizational theorists and researchers have suggested various approaches to classifying organizations. These typologies are generally theoretical (e.g., Hall, 1982; Etzioni, 1960; Gerth, 1952; Weber, 1947), not agreed upon (Blau & Scott, 1962), unmeasurable, and not empirically based (Pugh, Hickson, & Hinings, 1969). The lack of agreement among organizational theorists concerning a single, reliable and valid taxonomy of organizations implies that the selection of a single typology should be based on a criterion of utility. In other words, one should select the taxonomy that is most informative and appropriate for one's objectives.

We compared some of the central organizational typologies in terms of their reliability, validity and potential utility for O*NET. Organizations can be categorized according to the type of industry to which they belong. The Standard Industrial Classification codes (SIC: Office of Management and Budget, 1987) provide a widely accepted taxonomy of types of industry. Collecting information concerning the industry to which organizations belong was also suggested by the APDOT in its proposed content model (DOL, 1993). This type of taxonomy will be very useful for identifying jobs that occur in growing and declining industries and may be useful in classifying jobs. Industry information may also be useful in interpreting the other structural variables. In addition, this information will be of interest to job seekers. Therefore, we included the SIC codes and the associated list of industry categories in our proposed content model for organizational context.

Organizational Structure

Organizational structure may be considered the architecture or the anatomy of an organization. Virtually any theory or model of organizational development or adaptation includes structure as a critical component. Structure facilitates the flow of information, as well as the coordination and integration of activities within an organization (Child, 1972; Dalton, et al., 1980; Duncan, 1979; Katz & Kahn, 1978; Hall, 1982). Furthermore, structural variables are believed to be related to organizational performance and effectiveness. Theorists in this area have argued that flat decentralized structures with more widely spread decision influence can reduce cognitive overload for managers, thereby facilitating the assimilation of new patterns and associations (Duncan, 1979). In contrast, tall, centralized and functional structures may be efficient but are less likely to adapt effectively (Dalton et al., 1980; Duncan, 1979).

Consistent with the literature, "high-performance" organizations, as defined by the Malcolm Baldrige Award criteria and the DOL checklist, demonstrate common structural characteristics which are thought to be related to their adaptability and effectiveness. Structural elements such as flat hierarchy, large span of control, and the use of self-managed work teams are among the prominent characteristics of "high-performance" organizations (DOL, 1994; Westat, 1994).

The structure of organizations can also provide rich information about the context within which jobs are carried out. Organizational structure variables such as the hierarchy of an organization, the degree of centralization, and the nature of work groups used have important implications for organization members. These structural characteristics affect the way jobs are designed, the amount of autonomy and involvement in decision making that employees have, and also impact the immediate work environment for job holders. Duncan (1979) suggested that organizational structure affects jobs and job holders through its essential objectives: facilitating the flow of information within the organization and coordinating and integrating organizational processes and activities. The structure of an organization determines the degree to which incumbents will experience autonomy, involvement in decision making, social interaction, and flexibility in their jobs. Also, structural characteristics of team-based organizations will have impact on the skills and capabilities required from incumbents (Lawler, 1992). For example, the job of a sales representative in a flat organization, where teams of sales representatives manage and support their own customers, will require different skills and abilities than that same job in an hierarchical organization, where all decisions are made by the head of the sales department. The tasks and responsibilities of this job in these two different organizations are most likely to be different as well.

Review of available conceptual and empirical taxonomies of the structural characteristics of organizations guided our selection of lower order constructs in this area. Based on their review of the literature, Pugh, Hickson, Hinings, and Turner (1968) postulated and developed operational measures of five primary dimensions of organizational structure: specialization, standardization, formalization, centralization, and hierarchy. Other conceptual taxonomies of organizational structure (Blau, 1974; Blau & Schoenherr, 1971; Hall, 1982; Lawler, 1992; Mintzberg, 1979) provide support for Pugh et al.'s dimensions and suggest additional dimensions such as size and administrative intensity. These taxonomies typically incorporate both the physical characteristics of an organization (i.e., organization size, shape of hierarchy, span of control, and administrative intensity) and the contextual characteristics that prescribe or restrict the behavior of organizational members such as specialization, formalization, centralization, and organization of labor (Campbell, Bownas, Peterson, & Dunnette, 1974).

The relationship between organizational structure and organizational outcomes has been well documented in the literature (see review by Dalton et al., 1980). Structural dimensions such as centralization, shape of organizational hierarchy, standardization, and formalization have been found to be associated with organizational performance and members' attitudes and behaviors. For example, studies have found positive relationships between organization size and absenteeism and turnover (Indik & Seashore, 1961; Ingham, 1970; Porter & Steers, 1973). Many studies have examined the relationship between organization and unit size and other structural characteristics. In these studies, size has been operationalized in terms of the physical capacity of the organization, number of employees, number of clients, revenues of an organization, and the assets of an organization (Blau, 1974; Blau & Schoenherr, 1971; Meyer, 1968). Size was found to be related to other structural elements such as specialization, formalization, standardization, and span of control (Pugh et al., 1968) as well as to performance and turnover (see review by Dalton et al., 1980).

The relationship between the shape of an organization's hierarchy and its success has been found to be moderated by other structural variables, as well as by certain employee individual differences such as personality and abilities (see review by Dalton et al., 1980; Mintzberg, 1979). This line of research has shown that the effect of organizations' hierarchies on their effectiveness depends on the level of job specialization, span of control, similarity of jobs in a unit, the existence of work teams, employee empowerment, and members' needs for autonomy.

Unfortunately, the majority of the studies that have examined the relationships between job specialization and organizational outcome variables have not used hard performance criteria, but rather have correlated job specialization with variables such as innovation and inter-unit conflicts. Thus, solid conclusions can not be drawn concerning the direction or strength of the relationship between degree of job specialization and organizational performance. Similarly, the relationships between levels of formalization/standardization and organizational performance have not yet been empirically demonstrated (Dalton et al., 1980).

There is some empirical support for a negative relationship between centralization and organizational performance for samples of managers and professionals (Beck & Betz, 1975; McMahon, 1976; Pennings, 1976). Similarly, the participative decision-making and empowerment literatures suggest that when the power to make decisions is given to all organizational members and the authority to make decisions is dispersed throughout the organization, employees are more productive, more satisfied, and more committed to the organization (Cotton, Vollrath, Froggat, Lengnick-Hall, & Jennings, 1988; Liden, Wayne, & Sparrow, 1994). Thus, decentralization and employee empowerment are expected to facilitate organizational adaptability and effectiveness.

There is a great deal of agreement among theorists and researchers concerning the key dimensions of organizational structure, and an ample amount of research available documenting relationships between these structural dimensions and organizational behavior and effectiveness. Thus, the task of selecting lower order constructs to describe organizational structure was primarily driven by criteria such as relevance to the O*NET objectives and user needs, the expected impact on jobs, reliability and other measurement issues.

With the above criteria in mind, we selected lower order constructs reflecting eight important dimensions of organizational structure that consistently appear in the literature and have been judged to be relevant to organizational success. These dimensions are: organization size, hierarchy, specialization, administrative intensity, span of control, formalization, standardization, and centralization. The high performance literature emphasizes a team orientation and empowering employees, so we added eight additional lower order dimensions — employee empowerment, individual versus team structure, type of work teams, skill variety, task significance, task identity, autonomy, and feedback. All of these lower order constructs, their definitions, and the expected psychometric properties of the measures are presented in Appendix 8-B.

The available empirical research on organizational structure provides reasonably reliable and valid measures of many of these constructs (Blau & Schoenherr, 1971; Pugh, Hickson, & Hinings, 1969; Pugh, Hickson, Hinings, & Turner, 1968). Thus, most measures for these lower order organizational context constructs were adapted from existing questionnaires. Measures of size included number of employees and yearly revenues. Shape of hierarchy was operationalized as the number of management levels (Blau, 1974; Pugh at al., 1968). Organizational research has found this measure to be related to organizational performance and to other structural characteristics (see review by Dalton et al., 1980). The simplicity of this measure and the fact that it can be verified using an organization's chart suggest that this measure will be adequately reliable.

Measures of formalization, standardization, and specialization were adapted from Pugh et al.'s (1968) measures, which have been found to be reasonably reliable and to differentiate between organizations. The measure of centralization was adapted, with minor adjustments, from Arthur (1994), and reflects the extent to which nonsupervisory employees monitor data on quality and costs, determine work flow, invest in equipment, and develop new products. Arthur reports that this measure is reliable and differentiates between high-performance organizations and more traditional organizations. Another characteristic of "high-performance" organizations (Westat, 1994), which can be viewed as an aspect of centralization, is the extent of information sharing. This was operationalized as the percentage of employees who are provided with different types of information. The measure we used was adapted from the Employee Involvement Survey developed by the Center for Effective Organizations (Lawler, Mohrman, & Ledford, 1992).

The measures of employee empowerment we selected had been developed by Spreitzer (1992) to tap the two critical elements of empowerment: autonomy and influence on decision making. The measures were reported to be reliable (alpha's of .80 and .88) and to load highly on a factor labeled empowerment. We used items from the revised version of the Job Diagnostic Survey (JDS) developed by Hackman and Oldham (1980) to measure the five core job characteristic dimensions (i.e., skill variety, task identity, task significance, autonomy, and feedback). Extensive research using this instrument has shown that these scales are reliable (median alpha in the .70s) and are moderately correlated with job satisfaction, commitment, and performance (see review by Fried & Ferris, 1987). The autonomy construct measured in our questionnaire bears some resemblance to the concepts of Decision Latitude and Structured vs. Unstructured work in the Work Context questionnaire. However, whereas the construct of autonomy is global, broad, and applies to a variety of facets of work, Decision Latitude specifically refers to the amount of autonomy involved in making decisions. Similarly, Structured vs. Unstructured work focuses more narrowly on work methods and activities than does autonomy. The construct of task significance also bears some resemblance to the work context domain, but in our conception, significance focuses more broadly on work results and products. Moreover, the items used to measure autonomy and significance are intact scales adopted from the JDS, which is a well-established instrument with reliable and valid scales (Fried & Ferris, 1987).

Finally, we developed items that are designed to assess the nature and type of work groups in organizations. The nature of work groups was assessed by questions concerning the extent to employees work in teams versus independently and the extent to which the organization uses teams to accomplish its goals. Questions were also developed to assess the extent to which organizations use various types of teams such as functional teams, project teams and management teams.

In summary, the available research and theory on organizational structure, adaptation, and effectiveness suggests that specific structural variables interact with personal attributes and affect individual and organizational outcomes. Also, knowledge about structural elements of organizations can provide useful information about the potential adaptability of an organization and its capability to function effectively and successfully in today's rapidly changing and competitive world.

Human Resources (HR) Systems and Practices

Human resources (HR) systems and practices exist to ensure that an organization has employees who are capable of meetings its goals. Macro treatments of organizations tend not to focus on this domain. Nevertheless, the management of employees is clearly important to organizations, and, to the extent that HR practices become systematized, they are an unmistakable part of the organizational context within which employees must work. The HR systems and practices identified as most relevant for O*NET were: recruitment and selection practices (Cascio, 1987; Rynes, 1991), socialization tactics (e.g., Van Maanen & Schein, 1979), training and development (Campbell, 1988; Goldstein, 1991, 1993), and reward systems (Lawler & Jenkins, 1992; Gerhart & Milkovich, 1992). These lower order constructs were primarily selected on the basis of anticipated O*NET user needs but an extensive literature on each of these constructs is available, and this literature was reviewed in developing measures for these constructs.

The information provided by measures of these constructs will be very valuable. Individuals considering a particular career will be interested in the kinds of training and development opportunities likely to be available in the types of organizations in which they would be working if they enter a given career. Likewise, these individuals will be interested in how they might be recruited, selected, and rewarded in a given career. For example, data on recruitment practices may help job seekers in their job search by indicating the recruitment sources most often used by organizations with career opportunities that match their interests.

HR systems and practices may also affect job requirements. For example, the availability of certain kinds of socialization practices may mean that less social insight and feedback-seeking behavior will be necessary in order for an individual to succeed in a given job. Team-based reward systems may mean that a greater amount of cooperativeness will be necessary in order for people to succeed. Lack of formal training programs in certain areas may mean that greater education or experience will be required. Finally, the DOL and others have identified certain state-of-the-art HR systems and practices have been associated with high-performance organizations, and information concerning these constructs may aid in the identification and improved understanding of high-performance organizations.

The lower order constructs suggested by the HR systems and practices construct have, for the most part, not been measured in previous research. Measures of these constructs, however, will be fairly straightforward and likely to yield reliable and valid data. In addition, constructs are not organization-specific; they are relevant to virtually all organizations. In the next sections, we describe each of the lower order constructs that are subsumed under HR systems and practices, focusing on their measurability and usefulness.

Recruitment and selection. Recruitment refers to organizational practices and decisions that affect either the number or types of individuals who are willing to apply for, or accept, a given vacancy (Rynes, 1991). Cascio (1987) describes the recruitment process as involving two major phases: (1) recruitment planning and (2) recruitment operations. Recruitment planning involves specifying staffing goals (including affirmative action needs) and timetables, and calculating and recording statistics that provide information regarding the time, money, and recruiting staff necessary to generate a specified number of hires within a specified period of time. Examples of such statistics are time lapse data and yield ratios. Time lapse data provide information about the time between recruiting events such as identifying prospects, inviting them to complete applications, interviewing them, extending an offer, and hiring them. Yield ratios are ratios of the number of prospects at an earlier stage of recruiting to the number of prospects remaining at the next stage in the recruiting process (e.g., the ratio of number of prospects interviewed to the number of prospects offered a position). Calculating the amount of money to spend on recruiting is another example of the recruitment planning process.

Recruitment operations involve the use of various sources (e.g., employment agencies, newspaper advertising) to generate leads, and tracking prospects administratively as they go through the recruitment process. Cascio (1987) actually specifies a third phase of the recruitment process, which he calls measurement, evaluation, and control, but this last phase seems to involve largely the same activities as those that he includes under the recruitment planning phase.

We came across no instances in the literature where the recruitment practices of an organization have been operationalized. However, assessing recruitment practices should be fairly straightforward, using personnel department representatives as a data source.

Recruitment practices were included in the content model largely because of their potential usefulness to job seekers, vocational counselors, and people interested in characterizing high-performance organizations. For example, knowledge of the most common recruiting sources for certain kinds of jobs may be very useful to job seekers and vocational counselors. In addition, the use of realistic job previews is sometimes associated with high-performance organizations.

Intimately related to the recruitment process is the area of personnel selection. Selection refers to the processes by which an organization identifies individuals for hiring, promotion, and other personnel decisions (Casio, 1987; Guion, 1991). Traditionally, the selection process involves performing a job analysis, specifying criteria based on that job analysis, identifying predictors of performance on those criteria, validating and cross-validating the predictors using the criteria, and then implementing a selection system based on the surviving predictors.

We broke the selection domain into two lower order constructs: (1) selection processes (i.e., the procedures used by an organization to develop their selection systems), and (2) selection assessment methods (the actual methods used to select individuals). Although there were no existing measures operationalizing these constructs, both seem measurable.

Selection processes were included in the content model because of their relevance to high-performance organizations. According to the high performance literature (e.g., Westat, 1994), high-performance organizations make decisions based on data. Performing job analyses and validating predictor measures provide data that facilitate decision making in the selection domain.These procedures are likely to be used by high-performance organizations. Selection assessment methods will primarily be useful to job seekers and vocational counselors. Knowledge concerning the types of tests and other assessment procedures one is likely to be exposed to when applying for certain types of jobs may help job seekers determine whether they need to develop additional test-taking or interviewing skills, for example. It may also reduce anxiety for some job seekers, since they will know something about the selection processes they are likely to undergo.

Socialization tactics. Organizational socialization is the process by which individuals acquire the knowledge, skills, abilities, and other characteristics necessary for them to successfully perform an organizational role (Van Maanen & Schein, 1979). Although socialization is largely thought of as a process that organizational newcomers go through, individuals must get resocialized whenever they take on a new role in an organization (Feldman, 1989). Thus, organizational socialization is an integral part of organizational life.

Much organizational socialization research deals with the stages that individuals go through during socialization, and some research has begun to deal with the content of socialization (Chao, O'Leary-Kelly, Wolf, Klein, & Gardner, 1994). More relevant, however, are the tactics and strategies that organizations use to socialize their employees. Van Maanen (1978; Van Maanen & Schein, 1979) has suggested that organizational socialization tactics can be summarized along seven dimensions: (1) collective versus individual, (2) formal versus informal, (3) social versus disjunctive, (4) sequential versus random, (5) fixed versus variable, (6) self-destructive and reconstructing versus self-enhancing, and (7) tournament versus contest.

Two of these dimensions — collective versus individual and formal versus informal — seemed most broadly applicable and were thus included in our proposed taxonomy. Many job seekers will be interested in whether or not they will be likely to have a mentor early in their career, that is, the individual socialization construct. Moreover, formal individualized and group socialization practices should enhance individual (and therefore organizational) performance by helping employees to perform competently in their roles. They can, therefore, be thought of as characterizing high-performance organizations, although they are not normally included in discussions of high-performance organizations.

Both individualized and group socialization practices are likely to have an impact on job requirements, which has further implications for job seekers and vocational counselors. A major function of organizational socialization is to make explicit what was implicit. When, for example, a mentor explains certain unstated behavioral norms that apply in an organization, he or she relieves the worker of the task of deciphering those norms through social perceptiveness. Violation of behavioral norms in organizations can carry severe consequences. Thus, a mentor (or, equivalently, a group socialization process) may partly compensate for lack of social perceptiveness, thereby changing the requirements for successful job performance.

Therefore, we decided to measure two socialization constructs, derived from Van Maanen's constructs: group socialization and individualized socialization. Individualized socialization refers to whether an organization has a formal one-on-one socialization process in place (e.g., a mentoring program). Group socialization refers to whether an organization has a formal socialization process targeted toward groups of people. The reliability and validity of measures of these constructs is unknown. Given that we are using personnel department representatives as a data source, however, both constructs appear measurable.

Training and development. A fair amount of literature is available concerning the design, implementation, and evaluation of training programs (e.g., Campbell, 1988; Goldstein, 1991, 1993; Noe, 1986). In general, the training process is defined as "the systematic acquisition of attitudes, concepts, knowledge, roles, or skills that result in improved performance at work" (Goldstein, 1991, p. 508). Based on review of the training models of Goldstein (1993), Campbell (1988), and Noe (1986), we identified a sequence of steps involved in the training process. Some of these steps either did not appear to be particularly relevant to O*NET, or were unlikely to be endorsed by any organization, even high-performance organizations, and are thus not included in our proposed taxonomy. The following constructs, however, showed some promise for describing high-performance organizations and are thus included in the proposed taxonomy:

- Needs Assessment — Identifying the components of job performance relevant to the organization's goals that should be targeted for training.

- Training Methods and Media — Specifying learning methods (e.g., simulations, question-and-answer sessions) and media (e.g., readings, lectures) that are most appropriate to the training content.

- Evaluating the Training Program — Determining experimentally whether the training program achieved its objectives.

Several additional training and development constructs were suggested by the high performance literature. Lawler (1993), for example, indicates that high-performance organizations emphasize the importance of training by requiring that their employees spend a certain amount of time each year in training activities. High-performance organizations are also more likely to support continuous learning through programs such as job rotation. Lawler also indicates that high-performance organizations often provide training in areas such as team skills, problem solving, quality control, and economic and business literacy. In addition to reviewing the popular high performance literature, we also incorporated items from the DOL's high performance checklist (U.S. Department of Labor, 1994).

We ultimately selected four lower order training and development constructs: (1) training methods refers to whether an organization uses various available training methods; (2) use of quantitative data in the training process reflects the extent to which an organization uses quantitative data to design and evaluate its training and development programs; (3) training topics/content refers to whether or not an organization offers training programs in various "high performance" domains, and (4) extent/support of training activities by the organization is the extent to which an organization provides, or financially supports, training.

Most of these training and development constructs will be useful for characterizing high-performance organizations. In addition, they will provide information for job seekers and vocational counselors regarding the extent to which organizations they are most likely to work for will provide various kinds of training. This may be a factor in their choice of career. As with the other HR systems and practices constructs, no existing measures were available to operationalize these training and development constructs. However, all of the training and development constructs included in the content model appear very measurable.

Reward Systems. Rewards, in this context, refer to both monetary compensation and monetary and non-monetary benefits. Most employees engage in role behaviors primarily in exchange for rewards that the organization provides (Gerhart & Milkovich, 1992). Rewards are, therefore, of great interest to both job seekers and job incumbents. Organizational reward systems also figure prominently in the high-performance organization literature (e.g., Lawler, 1987, 1993). According to that literature, high-performance organizations pay the person, rather than the job, through knowledge-, skill-, and merit-based pay systems. In addition, they often reward team performance as well as individual performance, as a means of supporting a team-based organizational culture. Finally, they provide benefits that help to accommodate the needs of their employees, such as flexible working hours and paid leave.

Based on our review of the literature, we identified 13 types of formal compensation systems. One of these — two-tiered wage structures — did not appear particularly relevant to our objectives and was not included. The remaining 12 reward constructs are listed and defined below:

- Skill and Knowledge-Based Pay — Rewarding the acquisition of job- or organization-relevant skills and knowledges (Luthans & Fox, 1989)

- Merit Pay — Rewarding employees based on the results of periodic performance reviews (Lawler & Jenkins, 1992)

- Incentive-Based Pay — Rewarding employees based on the quality and/or quantity of individual or group output (Brown, 1990)

- Gainsharing — Rewarding employees based on prespecified employee-controllable indices of organization or unit effectiveness, such as production or labor costs (Lawler, 1983)

- Profit-Sharing — Providing employees with one-time bonuses based on the overall profitability of the organization during the previous fiscal year (Smith, 1989)

- Employee Ownership Programs/Stock Options — Providing eligible employees with stock in the organization as a benefit (Hammer, 1988)

- Job Evaluation and Job Level Systems — Rewarding employees based on an objective determination of the worth of their job to the organization (Lawler & Jenkins, 1992)

- Seniority/Job Experience — Rewarding employees based on their job or organizational tenure, or on their tenure in a highly similar job in another organization (Wallace & Fay, 1983)

- External Comparisons — Rewarding employees based on surveys regarding the pay levels that other companies assign to a similar position (Ellig, 1985)

- Compensating Wage Differentials — Providing increased compensation levels to employees who work in particularly hazardous or unpleasant environments

- Non-Obligatory Benefits — Providing employees with benefits such as pensions, health insurance, family leave, or pay for time not worked as part of their compensation (Gerhart & Milkovich, 1992)

- All-Salaried Programs — Elimination of hourly pay for all regular employees (Lawler, 1983)

The literature did not yield measures of any of these reward constructs. Nevertheless, reliable and valid measures can be developed for all of them.

Some of these constructs, such as all salaried systems and skill- and performance-based pay, have been associated with high-performance organizations. A few additional reward-related constructs were included because they were identified in the high performance literature. For example, high-performance organizations are more likely to use rewards based on group rather than individual performance. Also, high-performance organizations are expected, by some, to have fewer salary levels, and to provide employees with flexible working hours. There is evidence that some of the reward systems associated with high-performance organizations are, in fact, associated with enhanced job performance. For example, Kahn and Sherer (1990) found that the degree to which pay is made sensitive to performance influences subsequent performance in a sample of 92 managers. Similarly, Wagner, Rubin, and Callahan (1988) found significant increases in productivity in a unionized foundry after the institution of a group-based incentive plan (where employees received no other wages). Finally, Lawler and Jenkins (1992) indicate that, among other effects, gainsharing plans cause employees to try to reduce overtime and work smarter, to produce ideas, to work better as a team, and to focus on cost savings rather than just quantity of production.

As indicated above, job seekers and vocational counselors will clearly find information generated by these constructs useful. For example, some people may dislike the idea of having a substantial portion of their pay determined by the performance of their workgroup. Others may object to having their compensation tied to their job, rather than to their performance. For still others, certain benefits (e.g., daycare) may be of paramount importance.

We have chosen to include the following three reward systems constructs in the model: basis of compensation, benefits, and all salaried system. Like the other constructs in the model, these constructs are defined and described in detail in Appendix 8-B.

Summary. The HR systems and practices constructs we have selected for the content model have broad applicability, will be useful to job seekers and vocational counselors, and are diagnostic of high-performance organizations. They appear measurable, but have not been measured in the past. They appear likely to affect job requirements in some instances, and therefore may have important implications for the classification and description of jobs.

Culture

During the last two decades, the concept of culture in organizations has received a great deal of attention from organizational researchers and practitioners. It is often regarded as a general label for the social and behavioral patterns observed in organizations. Attempts to define this abstract concept have yielded multiple definitions. However, culture is typically thought to be composed of shared assumptions, values, norms, and artifacts. Organizational culture is discussed by most organizational theorists as important for understanding organizations and for understanding individual behavior in organizations (Katz & Kahn, 1978; Lawler, 1992; Limerick & Cunnington, 1993; Mintzberg, 1979; Perrow, 1961; Schein, 1992). Information about the culture of an organization provides background concerning the values, norms, and priorities of the organization, which in turn can have substantial impact on other elements of the organization as well as on job holders.

The significance of the 'culture' concept in the writings of both researchers and practitioners has been enhanced through the relationship it is often assumed to hold with organizational performance. A well-developed and business-specific culture has been thought to underpin stronger organizational commitment, higher morale, more efficient performance, and generally higher productivity (Deal & Kennedy, 1982; Furnham & Gunter, 1993; Graves, 1986; Peters & Waterman, 1982).

Reviews of the literature suggest several important elements of culture which are layered from readily accessible to difficult to assess. Rousseau (1988) provides an excellent description of these culture elements and suggests a conceptual framework which includes fundamental assumptions, values, behavioral norms, and larger patterns of behavior. At the core of the culture concept are fundamental assumptions that typically are unconscious and unknown even to organizational members. The next layer includes values, which are the priorities assigned to certain states or outcomes, such as innovation, risk taking, and predictability. At the surface are material artifacts which reflect physical manifestations and products of cultural activities (e.g., logos and badges).

Researchers in organizational culture tend to focus on a preferred set of culture elements (e.g., values, norms, stories). Thus, it is not the definition of culture that varies greatly across organizational researchers, but rather the type of data they collect. Schein (1992) studies unconscious assumptions implied in the action and communications of organizational members; Martin and Siehl (1983) focus on the values observed in rituals and artifacts; Cooke and Rousseau (1988) examine the behaviors required to fit in and get ahead in an organization; and Ouchi (1981) focuses on sets of symbols, ceremonies, and myths that communicate the underlying values and beliefs of the organization and its employees. Numerous measures of organizational culture and values have been developed, but there appears to be little psychometric validation of these measures, particularly of their dimensional structure and their construct or predictive validity. Where psychometric data are available, the measures often lack adequate reliability or validity.

Many if not all researchers in the area of organizational culture would argue that organizational values are a core and defining element of any organization's culture. Katz and Kahn (1978) included a system of norms and values in their theory of organizations. They suggest that values serve as the ideological glue that ties people into the system (Katz & Kahn, 1987).

Perrow's (1970) sociological analysis of organizations conceptualized organizational culture and values as system goals, which refer to the way the organization is functioning and the emphasis it puts upon growth, stability, or risk taking. These goals/values convey to organization members the choices and priorities of the organization in terms of its mode of functioning. Lawler (1991) describes values as underlying guiding principles, and suggests that, in high-performance organizations, values should be consistent with participative approaches to organizing and managing people.

In any case, values are generally seen as the defining elements around which norms, symbols, rituals, and other cultural activities revolve (Enz, 1988; Martin & Siehl, 1983; Schein, 1992). These values have been defined as a shared symbolic system which serves as a criterion or standard for behavior (Parsons, 1951). Rokeach (1973) offers a very similar definition of values: "a value is an enduring belief that a specific mode of conduct is personally or socially preferable to an opposite or converse mode of conduct" (p.11). In this sense, values may be thought of as internalized normative beliefs that can guide behavior (O'Reilly, Chatman, & Caldwell, 1991).

Quinn (1988) proposed a model of organizational values which are mapped on criterion of organizational effectiveness. He distinguishes among four organizational value systems that correspond to different effectiveness standards: human resource values, innovation values, rational goal values, and hierarchical values. A human resource value system focuses on the development of employees through participation and involvement as a criteria for effectiveness. An innovation value system emphasizes responsiveness to the environment through vision, flexibility, and growth. A rational goal system focuses on tasks, goals achievement, efficiency, and productivity. Finally, a hierarchical value system emphasizes control, predictability, stability, and order.

Quinn further suggested that each value system is associated with different elements of performance. In other words, organizations that try to be adaptive, effective, and innovative should emphasize innovation, human resource and rational goal values, while de-emphasizing hierarchical values. The high performance literature supports this notion. Typically, high-performance organizations are associated with values such as innovation, employee involvement, goal achievement, vision, growth, and flexibility (Lawler, 1992; Galbraith & Lawler, 1990; Peters & Waterman, 1982).

Based on the available literature, we concluded that assessment of organizational values would be the most practical approach to measuring culture. Values can be classified into three categories: (1) general/universal values (e.g., Allport, Vernon, & Lindzey, 1970; Rokeach, 1973), (2) work-related values (e.g., Super, 1962; Lofquist & Dawis, 1969), and (3) organizational values (e.g., Enz, 1988). Most measures of values use judgment methods that involve either some kind of ranking or rating and are typically scaled on an importance dimension (Dawis, 1991). General/universal values and work-related values have a long tradition of research, but values more specifically targeted toward organizations appeared much more relevant for assessing values likely to be related to organizational culture. In addition, an available measure of organizational values — the Organizational Culture Profile (OCP; O'Reilly, Chatman & Caldwell, 1991) — has been shown to be reliable and valid for assessing important organizational values.

The Organizational Culture Profile (OCP) was originally developed to assess the fit between the values of individuals and organizations, and thus it attempts to characterize the preference for a particular configuration of values on the part of an organization or an individual. The OCP is made up of a set of 54 value statements which were identified on the basis of an extensive review of the academic and practitioner-oriented writings on organizational values and culture (see reviews by Davis, 1984; Kilmann, 1984; Ouchi, 1981; Peters & Waterman, 1982; Schein, 1992). To obtain these value profiles for organizations, O'Reilly et al. (1991) identified "key informants" in each organization. These were groups of people who had a broad range of experience within the company (e.g., senior accountants in accounting firms and middle-level managers in government agencies). They were asked to sort the 54 value items (i.e., statements) in terms of how characteristic each was of their organization using a Q-sort procedure. Results showed high levels of agreement among senior organizational members concerning the values that typified their companies, with reliability coefficients ranging from .84 to .90. In addition, factor analyses revealed seven clearly defined factors: (1) innovation and risk-taking, (2) stability, (3) respect for people, (4) outcome orientation, (5) attention to detail, (6) aggressiveness, and (7) team orientation.

O'Reilly et al. (1991) also obtained data supporting the construct validity of these measures. They showed that congruency (similarity) between individuals' values and organizational values (i.e., person-organization fit) was positively correlated with intrinsic organizational commitment and job satisfaction, and negatively correlated with intention to leave and turnover (after two years). O'Reilly et al. concluded that organizational values are an important element of an individual's adjustment to and attitudes toward an organization. Their results provide empirical support for the common hypothesis that high commitment and satisfaction are outcomes of high person-organization fit (Kilmann, 1984; Ouchi & Wilkins, 1985).

Using the factor structure reported by O'Reilly et al. (1991), we selected several values that loaded highly on each of the seven factors mentioned above. By selecting values central to each factor, we hoped to represent these important value dimensions using fewer items. In addition, we selected several other values from their instrument that did not load highly on these factors, but were related to concepts discussed in the high performance literature (e.g., flexibility, adaptability, autonomy, customer service, and quality). The resulting list of values was condensed to accommodate the capacity of the data collection effort (see item 22 in Appendix F of Volume II). Organizational culture is characterized by shared values and assumptions (Schein, 1990). Therefore, the measurement of culture, or in our case organizational values, should be based on an agreement among organizational members about the importance or centrality of certain values in their organization.

Goals

Few organizational theorists exclude goal constructs from their models and discussions. Goal-setting — both organizational and individual — is central to modern organizations. There are two distinct goal-setting literatures. One deals with organizational goals, and the other deals with individual goals. Several constructs from each were found relevant for our purposes and are thus included in the proposed taxonomy.

Organizational goal-setting permeates the literature on organizational theory and behavior (e.g., Cyert & March, 1963; Etzioni, 1964; Hall, 1982; Perrow, 1961, 1970; Porras & Robertson, 1992). It has, however, resisted definition to some extent (Gross, 1969; Mohr, 1973). Goals require intentions (Heckhausen & Kuhl, 1985), and only people can have intentions. Thus, we defined organizational goals as aggregates of the intentions of individuals within an organization to attain some desired state. The literature suggests a number of different organizational goal-setting constructs. One that is implied by our definition is goal consensus, or the extent to which members of an organization agree regarding what an organization's goals are or should be. Another is the type of interdependence among the goals of individual organizational members, that is, the cooperativeness, competitiveness, or independence of goal structure (Tjosvold, 1986). Unfortunately, measurement of these first two constructs is problematic, and neither was critical to any objectives of the O*NET, so neither is included on our proposed taxonomy.

Another construct, referred to by Campbell (1977), is simply the extent to which an organization systematically engages in goal-setting behavior. In Campbell's (1977) review, this construct was associated conceptually with organizational effectiveness, and systematic goal-setting behavior has also been associated with high-performance organizations (Lawler, 1993; Limerick & Cunnington, 1993). To our knowledge, the construct of extent of organizational goal-setting behavior has never been measured. However, it suggests operationalizations such as whether the organization has a mission statement and whether it has specific, quantitative goals. Thus, it seems measurable.

In the individual goal-setting literature, there is a great deal of evidence linking goal specificity and difficulty (which we refer to collectively as goal characteristics) with increments in individual performance (e.g., Kanfer, 1990; Locke, 1968; Locke, Shaw, Saari, & Latham, 1981). It makes some sense to assume that this might be true at the organizational level as well, although only a small amount of research exists to support that assumption. One supportive study was reported by Smith, Locke, and Barry (1990), who showed that organizations simulated in a university laboratory tended to do better if they were given specific and difficult collective goals. Also, Komaki has shown in programmatic research (see Komaki, 1986) that group goals (with feedback) cause significant improvements in group performance. Organizational goal characteristics have not been previously operationalized. However, they appear measurable. Goal difficulty can be operationalized as the probability that the goal can be achieved; specificity can be operationalized as whether a specific, quantitative level of performance signifies attainment of the goal.

There is a great deal of literature in industrial/organizational psychology on individual goal-setting. As indicated above, the individual goal-setting literature tells us that people who are given difficult and specific goals perform better than people not given such goals (e.g., Kanfer, 1990; Locke, 1968, Locke et al., 1981). Moreover, that literature indicates that people who receive goal-relevant feedback perform better than those who merely have goals

(Bandura & Cervone, 1983; Erez, 1977; Komaki, Collins, & Penn, 1982). Thus, goal specificity, difficulty, and goal-relevant feedback are all important individual goal-setting constructs, and we have incorporated them into the content model. To parallel the organization level, we also included the extent of individual goal-setting in our proposed taxonomy. This construct has not been operationalized in the literature, but assessing the extent to which individual goal-setting occurs in organizations is relatively straightforward.

Another individual goal-setting construct included in the content model is the method used to assign individual-level goals. This refers to whether employees are allowed to have input into the nature of the goals they set. This process is often referred to as participative goal-setting. Although the goal participation literature has not been without controversy (e.g., Latham, Erez, & Locke, 1988), recent evidence suggests that participative goal-setting may have a positive effect on performance, particularly when people lack confidence in their ability to attain the goal or consider the person assigning the goal unsupportive (Kanfer, 1990).

The individual goal-setting constructs that we have included in the content model — extent of individual goal-setting, individual goal characteristics, availability of goal feedback, and method of goal assignment — will be primarily useful as characteristics of high-performance organizations. Goal-setting, feedback, and participation are all prominently represented in the literature on high-performance organizations (e.g., Lawler, 1993). Goal specificity and difficulty are not typically mentioned in the literature on high-performance organizations, but they clearly improve the performance of individuals, and will therefore improve the performance of organizations. The presence of individual goals may also affect job requirements. For example, the presence of specific difficult goals may create stress, thereby making the ability to tolerate stress an important job requirement. No existing measures are available for any of the individual goal-setting constructs in the content model, but again the development of measures was very straightforward.

The two organizational goal-setting constructs we have included in the content model are extent of organizational goal-setting and organizational goal characteristics.

Roles

Roles are sets of behaviors expected of role incumbents (Ilgen & Hollenbeck, 1991). The expected behaviors are specified by individuals in the role incumbent's social environment, known as the "role set," who have a stake in his or her behavior (Katz & Kahn, 1978). Roles have occupied a prominent place in the sociological (Merton, 1957; Parsons, 1951), social psychology (Sarbin & Allen, 1968), and organizational psychology (Kahn et al., 1964; Katz & Kahn, 1978; King & King, 1990) literatures.

Roles are likely to affect job requirements. To understand why, consider the relationship between jobs and roles. In organizations, roles and jobs are not the same thing, although they do overlap. Ilgen and Hollenbeck (1991) argue that jobs are formally specified sets of tasks, usually written down in the form of a job description, that incumbents must perform. Roles, however, involve additional tasks that the incumbent's role set either imposes or agrees to. For example, the job of secretary would probably not include a formal requirement of getting coffee for the boss, but in some social systems, such behavior may be part of the secretary's role. Likewise, the job description of attorney would be unlikely to include bringing in a major percentage of a law firm's business, but some attorneys may play that role in their law firms (popularly known as "rainmaker"). Perhaps the crucial distinction between jobs and roles is that roles occur within the context of a social system and are therefore fluid, and to a large extent subjective, whereas jobs tend to be more fixed and objectively specified.

Ilgen and Hollenbeck (1991) suggest that in many "low-scope jobs," job and role are essentially the same. They give as examples hydraulic pallet unloader at a canning factory, handpackager at a small chemical manufacturing firm, or part assembler in an electronics manufacturing plant. However, in other cases, jobs are more narrowly specified than roles. For example, a newly-created position may be only vaguely specified at the time an incumbent is hired. Moreover, management in high-performance organizations may, because of the premium they place on autonomy and empowerment, provide individuals with job behavior prescriptions only at a general level, resulting in many opportunities for individuals to define their own roles.

The literature on roles suggested three constructs for inclusion in the content model: role conflict, role overload, and role negotiability. One additional construct, role ambiguity (e.g., Kahn et al., 1964; Katz & Kahn, 1978; King & King, 1990), has received a great deal of attention in the literature. Role ambiguity refers to an individual's uncertainty about his/her role set's expectations. However, role ambiguity has weaker validity evidence than the other three role constructs and requires a large number of items for reliable measurement. Thus, role ambiguity is not included in the proposed taxonomy.

Role conflict refers to incompatible role expectations (e.g., Kahn, et al., 1964; Katz & Kahn, 1978; King & King, 1990). Role overload was originally conceptualized as a variant of role conflict, but has more recently been studied independently (Beehr, Walsh, & Taber, 1976; Kahn & Byosiere, 1992). It refers to a discrepancy between the demands of one's role set and one's ability to meet those demands. Role negotiability refers to the extent to which an incumbent is able to negotiate his/her role as opposed to simply being given one (Graen, 1976; Graen & Scandura, 1987). It reflects the adaptability of the organization to individual needs and organizational environments that are increasingly characterized by a need for fast and flexible behavior (Lawler, 1993). Of the role constructs suggested by the literature, role negotiability is the one that appears most likely to be an indicator of high-performance organizations. To our knowledge, role negotiability has not been measured. However, development of a reasonable measure of role negotiability appeared straightforward so this construct was included in the proposed taxonomy.

Role conflict and role overload have been measured with adequate reliability and validity in past research (King & King, 1990; Rizzo, House, & Lirtzman, 1970; Schuler, Aldag, & Brief, 1977). There is ample evidence that role conflict has plausible correlations with a variety of important organizational constructs. Meta-analytic data cited in King and King (1990) indicate that role conflict is correlated with propensity to leave, organizational commitment, tension-anxiety, overall job satisfaction, satisfaction with coworkers, satisfaction with supervisor, satisfaction with promotion opportunities, and satisfaction with the work itself. Role overload has been shown to correlate positively with employee fatigue and tension, job dissatisfaction, job involvement and effort toward quantity (i.e., trying to do a lot of work; Beehr, Walsh, & Taber, 1976). In addition, Kahn and Byosiere (1992) summarized evidence that "work load" (largely the same construct as Role Overload) also correlates with physiological indicators of strain (e.g., adrenaline and noradrenaline levels).

We have uncovered no data indicating that jobs differ systematically on these role constructs, although occupations are often selected for investigation based on their hypothesized level of role conflict. Moreover, Katz and Kahn (1978) suggest that jobs located close to organizational boundaries (e.g., labor negotiators, salespersons, people who act as liaisons between two organizational sub-units) are likely to involve relatively larger amounts of role conflict because those job incumbents are more likely to have to deal with differing constituencies. It, therefore, seems plausible to suggest that some of the variance in these role constructs will be tied to jobs as well as to organizations. The role variables included in the content model — role conflict, role negotiability, and role overload — will be assessed by administering scales to incumbents. This is appropriate, since role conflict and role overload are posited to impact the psychological state of the role incumbent. The role overload construct is similar to the 'Frustrating Circumstances' measured in the work context area, but role overload deals more specifically with a lack of adequate resources and time. Role negotiability could be addressed by someone other than the incumbent, but it was judged that incumbents would provide the most accurate data.

Try-out of Organizational Context Descriptors

Procedures. The items developed to measure the organizational context constructs were pilot tested in 32 organizations across the nation. The purpose of the pilot test was to examine the clarity, relevance and appropriateness of the items. Personnel representatives from these organizations were interviewed and asked to respond to the organizational context items. After responding to the items, the personnel representatives were asked specific questions about the clarity of the items, the accessibility of information required to answer them, and the relevance of the items and constructs to their organizations. Data analyses included computing means, standard deviations, and counts of missing data for each question, and correlations between selected variables.

Results and proposed revisions. Based on the pilot test results, some items were revised, definitions were added to clarify some terms, and one construct was eliminated. Both the subject matter expert and the results of the field pilot test suggested that the construct "administrative intensity" cannot be measured accurately and reliably in today's organizations. The distinction between 'administrative' and 'non-administrative' personnel is fuzzy and the meaning of these concepts differs across organizations, a problem which poses a threat to the reliability and validity of this construct. Most personnel representatives in the pilot sample were unable to distinguish accurately between administrative and non-administrative personnel in their organizations.

Overview of the Purposes of the Proposed Taxonomy

Our discussion so far has illustrated how including organization-level descriptors in O*NET will accomplish multiple purposes which are consistent with the objectives guiding the development of a new occupational database. This section summarizes the contributions that the proposed organizational descriptors will make in fulfilling four key purposes of O*NET: describing jobs, describing organizations, describing high-performance organizations, and providing useful information for job seekers. Appendix 8-C lists the lower order organizational context descriptors and highlights which purposes are served by each.

Describing jobs. The relevance of organization-level variables to the description of jobs and job requirements has been demonstrated throughout this section. Structural constructs such as centralization, formalization, and type of teams have substantial implications concerning the nature of jobs. These organization-level variables can affect the design of a job, the tasks associated with it, and the level and importance of interpersonal, decision making, and management skills required for performing a job (Child, 1972; Katz & Kahn, 1978; Lawler, 1992). It is even possible that jobs that have the same title but occur in very different organizations will be classified, based on the tasks included or skills and abilities needed, as different occupations. Thus, information about organizational characteristics can provide information useful for the description and classification of jobs carried out within that organization.

Providing useful information for job seekers. As indicated by the needs analysis of DOT users (Westat, 1994), job seekers and other DOT users are interested in information about the organizational context within which jobs occur. Many of our proposed descriptors provide such information. Information about the structure, human resources practices, and culture of the organization should be useful to job seekers in making career and employment decisions.

Describing organizations and high-performance organizations. One of the important stated objectives of O*NET is to describe organizations, and particularly the characteristics of high-performance organizations. Throughout the development of the content model, we addressed high performance issues. As a result, the final organizational context classification system not only reflects key organizational context elements, but also critical high performance elements.

We found conceptual parallels between many of the structural characteristics of high-performance organizations and the structural elements discussed in the extensive organizational theory and research we reviewed. The one exception was the current emphasis on team-based organizations in the high performance literature. To address this issue, we included measures of the nature of work groups and type of work teams as additional second level elements of organizational structure.

Organizational culture was a central element in all of the high performance criteria we encountered (Baldrige Award, 1994; DOL, 1994). Moreover, Lawler (1992) and other authors (Quinn, 1988; Schein, 1990) argue that high-performance organizations have a particular culture that promotes and supports innovation, growth, quality, human resource development, employee involvement, and team work. The Baldrige Award criteria address organizational culture in terms of the vision and values of senior executives. They also emphasize high performance values such as quality, information, customer orientation, empowerment, team orientation, and results orientation. All of these values are included in our organizational value questionnaire.

The Baldrige Award criteria also list several HR practices, including rewards, training and development, recruitment, and employee involvement programs. Similarly, the DOL's guide to high performance identified training, continuous learning programs, employee involvement programs, and reward systems, as high performance HR practices. The lower order HR systems and practices constructs in our proposed taxonomy include those most likely to be used by high-performance organizations.

Many of the constructs included in the proposed organizational context taxonomy will be both relevant and useful for describing and understanding high-performance organizations. Appendix 8-D illustrates the extent to which the proposed organization-level descriptors describe key elements of high-performance organizations. This table presents a crosswalk between the proposed content model's constructs and the characteristics of high-performance organizations summarized in a recent review of high performance literature and practices conducted by Westat (1994).

Summary

In this section, we describe a proposed taxonomy of organizational context descriptors to be included in O*NET content model and present the justification for the constructs and measures proposed. The higher order classification of these constructs is included primarily to organize the extensive literature we reviewed. The lower order organizational constructs are the measurable variables that we propose should be used to describe and classify organizations. These variables reflect the essential elements of the organizational context domain, as suggested by the organizational literature. The constructs also include the critical characteristics and practices of high-performance organizations (DOL, 1994; Lawler, 1992; Westat, 1994). Appendix F in Volume II presents the questions that were developed to measure all of these constructs.

Our proposed taxonomy of organizational context descriptors will accomplish numerous important objectives specified by the Department of Labor. First, this classification can be used to describe organizations and differentiate between high-performance organizations and more traditional organizations. Thus, information collected using these descriptors will assist the Office of the American Workplace program in providing businesses with relevant and systematic information about high-performance organizations.

Second, this organizational context taxonomy can be used to enhance the quality and accuracy of any occupational classification system that is developed based on the data collected for the entire content model. The ways in which organizational context variables affect jobs and job requirements have been illustrated throughout this section. Accordingly, our taxonomy will provide the information necessary to understand variations in jobs across organizations. If job characteristics are found to be systematically related to certain characteristics of organizations, these organizational characteristics can be used to develop a more accurate and useful occupational classification system.

Finally, potential users of the new occupational database such as job seekers and counselors will also benefit from this organizational-level taxonomy. It will provide rich and systematic information about the organizational context of jobs, which will be useful in making occupational decisions (Westat, 1994).

References

Allport, G. W., Vernon, P. E., & Lindzey, G. (1970). *Manual: Study of values.* Boston: Houghton Mifflin.

Arthur, J. B. (1994). Effects of human resource systems on manufacturing performance and turnover. *Academy of Management Journal, 37(3)*, 670-687.

Bandura, A., & Cervone, D. (1983). Self-evaluative and self-efficacy mechanisms governing the motivational effects of goal systems. *Journal of Personality and Social Psychology, 45*, 1017-1028.

Beehr, T. A., Walsh, J. T., & Taber, T. D. (1976). Relationship of stress to individually and organizationally valued states: Higher order needs as a moderator. *Journal of Applied Psychology, 61*, 41-47.

Beck, E.M., & Betz, M. (1975). A comparative analysis of organizational conflict in schools. *Sociology of Education, 48*, 59-74.

Blau, P. M. (1974). *On the nature of organizations*. New York: Wiley.

Blau, P. M., & Schoenherr, R. A. (1971). *The structure of organizations.* New York: Basic Books.

Blau, P. M., & Scott, W. R. (1962). *Formal organizations.* San Francisco: Chandler Publishing Co.

Brewer, M. B. (1979) In-group bias in the minimal intergroup situation: A cognitive-motivational analysis. *Psychological Bulletin, 86,* 393-400.

Brown, C. (1990). Firms' choice of method of pay. *Industrial and Labor Relations Review, 40,* 165S-182S.

Campbell, J. P. (1977). On the nature of organizational effectiveness. In P. S. Goodman, J. M. Pennings, & Associates (Eds.), *New perspectives on organizational effectiveness* (pp. 13-55). San Francisco, CA: Jossey-Bass.

Campbell, J. P. (1988). Training design for performance improvement. In J. P. Campbell, R. J. Campbell, & Associates (Eds.), *Productivity in organizations; New perspectives from industrial and organizational psychology* (pp. 177-215). San Francisco: Jossey-Bass.

Campbell, J.P., Bownas, DE., Peterson, N.G., & Dunnette, M.D. (1974). (Eds.) *The measurement of organizational effectiveness: A review of relevant research and opinion*. San Diego: Navy Personnel Research and Development Center.

Cappelli, P., & Sherer, P. D. (1990). Assessing worker attitudes under a two tier wage plan. *Industrial and Labor Relations Review, 43*, 225-244.

Cascio, W. F. (1987). *Applied psychology in personnel management* (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Chandler, A. D. (1962). *Strategy and structure.* Cambridge, MA: MIT Press.

Chao, G. T., O'Leary-Kelly, A. M., Wolf, S., Klein, H. J., & Gardner, P. D. (1994). Organizational socialization: Its content and consequences. *Journal of Applied Psychology, 79,* 730-743.

Child, J. (1972). Organizational structure, environment, and performance: The role of strategic choice. *Sociology, 6,* 1-22.

Child, J., & Kieser, A. (1981). Development of organizations over time. In P. C. Nystrom & W. H. Starbuck (Eds.). *Handbook of organizational design: (pp. 28-64).* Oxford: Oxford University Press.

Cooke, R.A., & Rousseau, D.M. (1988). Behavioral norms and expectations: A quantitative approach to the assessment of organizational culture. *Group and Organizational Studies, 13,* 245-273.

Cotton, J.L, Vollrath, D.A., Froggatt, K.L., Lengnick-Hall, M.L., & Jennings, K.R. (1988). Employee participation: Diverse forms and different outcomes. *Academy of Management Review, 13,* 8-22.

Cyert, R., & March, J. (1963). *A behavioral theory of the firm.* Englewood Cliffs, NJ: Prentice-Hall.

Dalton, D. R., Todor, W., Spendolini, M. J., Fielding, G. J., & Porter, L. W. (1980). Organization structure and performance: A critical review. *Academy of Management Review, 5(1),* 49-64.

Davis, S. (1984) *Managing corporate culture.* Cambridge, MA: Ballinger.

Davis, G. F., & Powell, W. W. (1992). Organization-environment relations. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., vol. 3, pp. 315-375). Palo Alto, CA: Consulting Psychologists Press. *(2nd ed., vol. 2, pp. 833-871).*

Dawis, R.V. (1991). Vocational interests, values, and preferences. In M.D. Dunnette & L.M. Hough (Eds.), *(2nd ed., vol. 2, pp. 833-871). Handbook of industrial and organizational psychology,* Vol. 2, 833-871.

Deal, T., & Kennedy, A. (1982). *Corporate cultures.* Reading, MA: Addison-Wesley.

Dumaine, B. (1991). The bureaucracy busters. *Fortune,* June, 23-26.

Duncan, R. (1979). What is the right organization structure. *Organizational Dynamics,* Winter, 59-79.

Ellig, B. R. (1985). *Compensation and benefits: Design and analysis.* The American Compensation Association.

Enz, C. (1988). The role of value congruity in intraorganizational power. *Administrative Science Quarterly, 33*, 284-304.

Erez, M. (1977). Feedback: A necessary condition for the goal setting-performance relationship. *Journal of Applied Psychology, 62,* 624-627.

Etzioni, A. (1960). New directions in the study of organizations and society. *Social Research, 27(2),* 8-223.

Etzioni, A. (1964). *Modern organizations.* Englewood Cliffs, NJ: Prentice-Hall.

Feldman, D. C. (1989). Socialization, resocialization, and training: Reframing the research agenda. In I. Goldstein (Ed.), *Training and development in work organizations: Frontiers of industrial and organizational psychology* (pp. 121-182). San Francisco: Jossey-Bass.

Fried, Y., & Ferris, G. R. (1987). The validity of the job characteristics model: A review and meta-analysis. *Personnel Psychology, 40,* 287-322

Fuqua, D. R., & Kurpius, D. J. (1993). Conceptual models in organizational consultation. *Journal of Counseling & Development, 71*, 607-618.

Furnham, A., & Gunter, B. (1993). *Corporate assessment.* London: Routledge.

Gerhart, B., & Milkovich, G. T. (1992). Employee compensation: Research and practice. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., vol. 3, pp. 481-569). Palo Alto, CA: Consulting Psychologists Press.

Gerth, H. H. (1952). The Nazi party: Its leadership and composition. In R. K. Merton et al., (Eds.), *Reader in bureaucracy: 100-113*. Glencoe, IL: Free Press.

Goldstein, I. L. (1991). Training in work organizations. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., vol. 2, pp. 507-619). Palo Alto, CA: Consulting Psychologists Press.

Goldstein, I. L. (1993). *Training in organizations* (3rd ed.). Monterey, CA: Brooks/Cole.

Graen, G. (1976). Role-making processes in organizations. In M. D. Dunnette (Ed.), *Handbook of industrial and organizational psychology* (pp. 1201-1245). Chicago: Rand McNally.

Graen, G., & Scandura, T. A. (1987). Toward a psychology of dyadic organizing. In L. L. Cummings, & B. A. Staw (Eds.), *Research in organizational behavior* (pp. 175-208). Greenwich, CT: JAI Press.

Graves, D. (1986). *Corporate culture: Diagnosis and change*. New York: St. Martins Press.

Gross, E. (1969). The definition of organizational goals. *British Journal of Sociology, 20*, 282-293.

Guion, R. M. (1991). Personnel assessment, selection, and placement. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., vol. 2, pp. 327-397). Palo Alto, CA: Consulting Psychologists Press.

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*, 250-279.

Hackman, J. R., & Oldham, G. R. (1980). *Work redesign*. Reading, MA: Addison-Wesley.

Hall, R. H. (1982). *Organizations: Structure and process* (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Hammer, T. (1988). New developments in profit sharing, gain sharing and employee ownership. In J. P. Campbell, & R. J. Campbell and Associates (Eds.), *Productivity in organizations* (pp. 328-366). San Francisco: Jossey-Bass.

Heckhausen, H., & Kuhl, J. (1985). From wishes to action: The dead ends and short cuts on the long way to action. In M. Frese, & J. Sabini (Eds.), *Goal directed behavior: The concept of action in psychology* (pp. 134-160). Hillsdale, NJ: Erlbaum.

Ilgen, D. R., & Hollenbeck, J. R. (1991). The structure of work: Job design and roles. In M. D. Dunnette & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (pp. 165-207). Palo Alto, CA: Consulting Psychologists Press.

Indik, B.P., & Seashore, S.F. (1961). *Effects of organizational size on member attitude and behavior.* Ann Arbor: Survey Research. Center of the Institute of Social Research, University of Michigan.

Ingham, G. (1970). Size of industrial organization and worker behavior. Cambridge: Cambridge University Press.

Kahn, L. M., & Sherer, P. D. (1990). Contingent pay and managerial performance. *Industrial and Labor Relations Review, 43,* 107S-120S.

Kahn, R. L., & Byosiere, P. (1992). Stress in organizations. In M. D. Dunnette & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., vol. 3, pp. 571-650). Palo Alto, CA: Consulting Psychologists Press.

Kahn, R. L., Wolfe, D. M., Quinn, R. P., Snoek, J. D., & Rosenthal, R. A. (1964). Occupational stress: Studies in role conflict and ambiguity. New York: Wiley.

Kanfer, R. (1990). Motivation theory and industrial and organizational psychology. In M. D. Dunnette & L. M. Hough (Eds.), Handbook of industrial and organizational psychology (2nd ed., vol. 1, pp. 75-170). Palo Alto, CA: Consulting Psychologists Press.

Katz, D., & Kahn, R. L. (1978). *The social psychology of organizations* (2nd ed.). New York: Wiley.

Kilmann, R. (1984). *Beyond the quick fix.* San Francisco: Jossey-Bass.

King, L. A., & King, D. W. (1990). Role conflict and role ambiguity: A critical assessment of construct validity. *Psychological Bulletin, 107*, 48-64.

Komaki, J. L. (1986). Applied behavior analysis and organizational behavior: Reciprocal influences of the two fields. In B. M. Staw & L. L. Cummings (Eds.), *Research in organizational behavior: An annual series of analytical essays and critical reviews* (No. 8). Greenwich, CT: JAI Press.

Komaki, J. L., Collins, R. L., & Penn, P. (1982). The role of performance antecedents and consequences in work motivation. *Journal of Applied Psychology, 67*, 334-340.

Latham, G. P., Erez, M., & Locke, E. A. (1988). Resolving scientific disputes by the joint design of crucial experiments by the antagonists: Applications to the Erez-Latham Dispute regarding participation in goal setting [Monograph]. *Journal of Applied Psychology, 73*, 753-772.

Lawler, E. E., III (1983). *Pay and organization development.* Reading, MA: Addison-Wesley.

Lawler, E. E., III (1987). Pay for performance. In H. R. Halbantian (Ed.), *Incentives, cooperation and risk sharing.*Rowman & Littlefield.

Lawler, E. E., III. (1991). *High involvement management: Participative strategies for improving organizational performance.* San Francisco: Jossey-Bass.

Lawler, E. E., III (1992). *The ultimate advantage: Creating the high-involvement organization.* San Francisco: Jossey-Bass.

Lawler, E. E., III (1993). Creating the high-involvement organization. In Galbraith, J. R., Lawler, E. E. III, and Associates (Eds.), *Organizing for the future: The new logic for managing complex organizations* (pp. 172-193). San Francisco: Jossey-Bass.

Lawler, E. E. III, & Jenkins, J. D., Jr. (1992). Strategic reward systems. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., vol. 3, pp. 1009-1055). Palo Alto, CA: Consulting Psychologists Press.

Lawler, E. E., Mohrman, S. A., & Ledford, G. E. (1992). *Employee involvement and total quality management*. San Francisco: Jossey-Bass.

Liden, R.C., Wayne, S.J., & Sparrow, R. (1994). Leading empowered work groups. Paper presented at the annual meeting of the Society of Industrial and Organizational Psychology, Nashville, Tennessee.

Limerick, D., & Cunnington, B. (1993). *Managing the new organization: A blueprint for networks and strategic alliances*. San Francisco: Jossey-Bass.

Locke, E. A. (1968). Toward a theory of task motivation and incentives. *Organizational Behavior and Human Performance, 3,* 157-189.

Locke, E. A., Shaw, K. N., Saari, L. M., & Latham, G. P. (1981). Goal-setting and task performance: 1969-1980. *Psychological Bulletin, 90,* 125-152.

Lofquist, L., & Dawis, R. (1969). *Adjustment to work.* New York: Appelton-Century-Crofts.

Luthans, F., & Fox, M. L. (1989, March). Update on skill-based pay. *Personnel,* 26-31.

Martin, J., & Siehl, C. (1983). Organizational culture and counterculture: An uneasy symbiosis. *Organizational Dynamics, 12(2),* 52-64.

McMahon, J.T. (1976). Participative and power-equalized organizational systems: An empirical investigation and theoretical integration. *Human Relations, 29,* 203-214.

Merton, R. K. (1957). *Social theory and social structure.* Glencoe, IL: Free Press.

Meyer, M. W. (1968). Expertness and span of control. *Sociological Review, 33,* 944-951.

Mintzberg, H. (1979). *The structuring of organizations.* Englewood Cliffs, NJ: Prentice-Hall.

Mohr, L. B. (1973). The concept of organizational goals. *American Political Science Review, 62,* 470-481.

Noe, R. A. (1986). Trainee attributes and attitudes: Neglected influences on training effectiveness. *Academy of Management Review, 11,* 736-749.

Ouchi, W. G. (1981). *Theory Z: How American business can meet Japanese challenge.* Reading, MA: Addison-Wesley.

Ouchi, W. G., & Wilkins, A. (1985). Organizational culture. In R. Turner (Ed.), *Annual Review of Sociology,* (vol. 11, pp. 457-483). Palo Alto, CA: Annual Reviews.

O'Reilly, C. A., Chatman, J., & Caldwell, D. (1991). People and organizational culture: A profile comparison approach to assessing person-organization fit. *Academy of Management Journal, 34(3),* 487-516.

Parsons, T. (1951). *The social system.* New York: Free Press.

Pennings, J.M. (1976). Dimensions of organizational influence and their effectiveness correlates. *Administrative Science Quarterly, 21,* 688-699.

Perrow, C. (1961). The analysis of goals in complex organizations. *American Sociological Review, 26,* 688-699.

Perrow, C. (1970). *Organizational analysis: A sociological view.* Belmont, CA: Wadsworth.

Peters, T., & Waterman, R. (1982). *In search of excellence.* New York: Addison-Wesley.

Porras, J. I., & Robertson, P. J. (1992). Organizational development: Theory, practice, and research. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., vol. 3, pp. 720-822). Palo Alto, CA: Consulting Psychologists Press.

Porter, L.W., & Steers, R.M. (1973). Organizational, work, and personal factors in employment turnover and absenteeism. *Psychological Bulletin, 80,* 151-176.

Pugh, D. S., Hickson, D. J., & Hinings, C. R. (1969). An empirical taxonomy of structure of work organizations. *Administrative Science Quarterly. 14,* 115-126.

Pugh, D. S., Hickson, D. J., Hinings, C. R., & Turner, C. (1968) Dimensions of organization structure. *Administrative Science Quarterly, 13(1),* 66-105.

Quinn, R. E. (1988). *Beyond rational management: Mastering the paradoxes and competing demands of high performance.* San Francisco: Jossey-Bass.

Rizzo, J. R., House, R. J., & Lirtzman, S. I. (1970). Role conflict and ambiguity in complex organizations. *Administrative Science Quarterly, 15,* 150-163.

Rokeach, M. (1973). *The nature of human values.* New York: Free Press.

Rousseau, D. M. (1988). The construction of climate in organizational research. In C. L. Cooper, & I. Robertson (Eds.), *International Review of Industrial and Organizational Psychology* (Vol. 3). New York: Wiley.

Rynes, S. L. (1991). Recruitment, job choice, and post-hire consequences: A call for new research directions. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd. ed., vol. 2, pp. 399-444). Palo Alto, CA: Consulting Psychologists Press.

Sarbin, T. R., & Allen, V. L. (1968). Role theory. In G. Lindzey & E. Aronson (Eds.), *The handbook of social psychology* (2nd ed.). Reading, MA: Addison-Wesley.

Schein, E. H. (1990). Organizational culture. *American Psychologist, 45,* 109-119.

Schein, E. H. (1992). Organizational culture and leadership. San Francisco: Jossey-Bass.

Schneider, B. (1987). The people make the place. *Personnel Psychology, 40,* 437-453.

Schuler, R. S., Aldag, R. J., & Brief, A. P. (1977). Role conflict and ambiguity. *Organizational Behavior and Human Performance, 20, 111-128.*

Smith, I. (1989). *Incentive schemes: People and profits.* London, UK: Croner.

Smith, K. G., Locke, E. A., & Barry, D. (1990). Goal setting, planning, and organizational performance: An experimental simulation. *Organizational Behavior and Human Decision Processes, 46,* 118-134.

Spreitzer, G.M.,(1992). *When organizations dare: The dynamics of individual empowerment in the workplace.* Unpublished Dissertation. Ann Arbor: University of Michigan.

Starbuck, W. H. (1965). Organizational growth and development. In J.C. March (Ed.). *Handbook of organizations,* pp 451-533. Chicago: Rand McNally.

Super, D. E. (1962). The structure of work values in relation to status, achievement, interest, and adjustment. *Journal of Applied Psychology, 46,* 234-239.

Thompson, J. D. (1967). *Organizations in action.* New York: McGraw Hill.

Tjosvold, D. (1986). The dynamics of interdependence in organizations. *Human Relations, 39,* 517-540.

U.S. Department of Labor (1991). *Dictionary of occupational titles* (4th ed.). Washington DC: Author.

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

U.S. Department of Labor, (1994). *Road to high-performance workplaces: A guide to better jobs and better business results.* Washington, DC: Author.

U.S. Office of Management and Budget. (1987). *Standard Industrial Classification Manual.* Washington, DC: Author.

Van Maanen, J. (1978). People processing: Strategies of organizational socialization. *Organizational Dynamics, 7,* 18-36.

Van Maanen, J., & Schein, E. H. (1979). Toward a theory of organizational socialization. In B. M. Staw, & L. L. Cummings (Eds.), *Research in organizational behavior* (vol. 1, pp. 204-264). Greenwich, CT: JAI Press.

Wagner, J. A. III, Rubin, P., & Callahan, T. J. (1988). Incentive payment and nonmanagerial productivity: An interrupted time series analysis of magnitude and trend. *Organizational Behavior and Human Decision Processes, 42,* 47-74.

Wallace, M. J., & Fay, C. H. (1983). *Compensation theory and practice.* Reading, MA: Wadsworth/Kent.

Weber, M. (1947). *The theory of social and economic organization* (translated by Enderson, A. M., & Parsons, T.) Parsons, T. (Ed.). New York: Free Press.

Westat, Inc. (1994). *Sampling plan: Part 1.* Rockville, MD.

Table 8-A
Summary of Organizational Context Domains from the Literature

1. **Type of Industry**

- e.g., non-profit, conglomerate, multinational
- Mintzberg's (1979) taxonomy: simple structure, machine bureaucracy, professional bureaucracy, and adhocracy
- Katz & Kahn's (1978) taxonomy:
  - Productive Organizations – organizations that manufacture goods
  - Maintenance Organizations – organizations that socialize people into societal roles (e.g., schools and churches)
  - Adaptive Organizations – organizations that create knowledge and test theories (e.g., universities)
  - Political Organizations – organizations that adjudicate, coordinate, and control resources, people, and subsystems (e.g., state and local government agencies)

2. **Organizational Structure**

A. Organization Size
- Physical capacity of organization (e.g., number of beds in a hospital)
- Number of different locations
- Number of permanent employees in the organization
- Total number of employees in the organization
- Number of clients/customers served per unit time
- Sales volume, or other output measure
- Net assets, or other measure of financial resources

B. Vertical & Horizontal Differentiation
- Hierarchical versus flat structure
- Allocation of roles (e.g., degree of role differentiation)
- Functional versus cross-functional structure
- Top-down versus bottom-up decision-making locus

C. Decision Making System
- Shrirvastava and Grant's (1985) taxonomy of strategic decision-making processes
- Taylor's (1982) explication of the components of the strategic decision-making process

Table 8-A
Summary of Organizational Context Domains from the Literature (Continued)

D. Job Characteristics
- Degree and nature of interdependence with other jobs
- Degree of empowerment
- Hackman and Oldham (1976) job characteristics (skill variety, task identity, task significance, autonomy, and feedback)
- Job challenge
- Job intensity (e.g., pace, time pressure)
- Degree of supervision of others required
- Job alienation (e.g., isolation from people, only indirect impact on valued organizational outcomes)

3. **Human Resources Systems and Practices**

A. Recruitment & Selection
- Types of assessment practices used for selection and promotion (e.g., employment interview, standardized tests, assessment centers)
- Recruitment sources (e.g., newspaper, educational institutions, employment agencies)
- Realism of recruitment messages
- Extent to which organization promotes from within
- Rate of promotion
- Nature of application process
- Percent of applicants accepted

B. Socialization Tactics
- e.g., training, education, apprenticeship, mentoring, debasement, etc.
- Process models of Feldman (1976), Schein (1978), and Van Maanen (1978)

C. Training & Development
- Kinds of training available (internally and externally)
- Amount of time provided by organization for training and development activities
- Does organization pay for outside training and development activities?
- Does organization provide assessment-based training and development?
- Is training integrated with performance appraisal and career development systems?
- Does organization perform needs analysis prior to internal training?
- Are instructional objectives clearly specified for in-house training?
- What kinds of learning media are used for in-house training?
- What kinds of training methods are used for in-house training?

Table 8-A
Summary of Organizational Context Domains from the Literature (Continued)

D. Reward Systems
   - Pay systems (e.g., pay for performance, pay for skills)
   - Benefit systems (e.g., 401(k) plan)
   - Employee Ownership Plans
   - Bonuses
   - Non-monetary rewards
   - Formal performance monitoring processes
   - Formal performance appraisal process

4. **Culture**

- Values
- Climate

5. **Goals**

- Does organization have mission, vision, philosophy (higher-order goals)?
- Does organization routinely set concrete goals?
- Difficulty of goals
- Degree of goal conflict
   - Between groups within organization
   - Between official and operational goals
   - Between organizational goals
   - Between goals of employees and organization
- Degree of employee commitment to organizational goals
- Degree of top management commitment to organizational goals
- Timeframe of goals (short-term versus long-term)

6. **Roles**

- Role conflict
- Role ambiguity
- Role overload
- Role negotiability (role-making opportunities)

Table 8-A
Summary of Organizational Context Domains from the Literature (Continued)

---

7. **Leadership/Supervision**

- Are goals negotiated with direct reports?
- Do supervisors provide a performance-enhancing work environment for direct reports?
- Do supervisors monitor performance of direct reports?
- Do supervisors provide informal performance feedback for direct reports?
- Do supervisors provide performance consequences for direct reports?
- To what extent do supervisors share information with direct reports?
- To what extent do supervisors share power with direct reports?

8. **Social Interaction** (Between Individuals, Within Groups, Between Groups)

- Communication processes
- Conflict resolution processes (e.g., Thomas'(1992) taxonomy of competing, collaborating, compromising, avoiding, accommodating)
- Social influence processes (e.g., French & Raven's five sources of power; see also Yukl's work on influence tactics)

9. **Organization-Environment Relations**

- Characteristics of organizational environments
  - e.g., stability, complexity, diversity, and hostility (Mintzberg, 1979)
- Inter-organizational relationships
  - Resource exchange networks
  - Information or advice networks
  - Research consortia
  - Board of director interlock networks
  - Centrality of organization in various networks
  - Extent to which networks constrain organization
- Organizational adaptation and innovation processes

10. **Technology**

- Prevalence and importance of technology to organization
- Speed of technological shifts with which organization has to cope
- Functions performed by technology
- Complexity of technologies used by organization (level of expertise required)
- Distinguish core from peripheral technologies

Appendix 8-B

Descriptions and Definitions of Organizational Context Variables

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
Type of Industry (i.e., Organizational Output)	Reflects the kind of products or services produced by an organization.	Identifies the class of industry to which the organization belongs.	Personnel managers	Adequate reliability Unknown validity	Useful information for describing organizations and jobs; somewhat useful for job applicants.	Katz & Kahn (1978) Mintzberg (1979) US Office of Management and Budget (1987)
Organization Size	Indicates the scope, as well as the amount of growth and decline, of human and capital resources.	Identifies the number of full-time and part-time employees in an organization, growth and decline in number of employees, number of different locations, and financial measures of operation scope and annual revenue.	Personnel managers	Adequate reliability Moderate validity	Useful information about organizational growth & decline; somewhat useful for job applicants; useful in interpreting other variables.	Blau (1974) Blau & Schoenherr (1971) Child (1972) Hall (1982) Pugh, Hickson, Hinings, & Turner (1968)
Hierarchy	Reflects the vertical structure of an organization and changes in this structure.	Identifies the number of management levels and reduction in the number of levels in the last five years.	Personnel managers	Adequate reliability Moderate validity	Useful information about high-performance organizations; somewhat useful for job applicants.	Blau (1974) Blau & Schoenherr (1971) Child (1972) Hall (1982) Katz & Kahn (1978) Mintzberg (1979)
Specialization	Indicates the form of division of labor and changes in these variables.	Identifies the number of different occupation titles, the different functional activities pursued within an organization, and the number of new jobs created in the last five years.	Personnel managers	Adequate reliability Unknown validity	Useful information about high-performance organizations; somewhat useful for selection, training, and counseling; somewhat useful for job applicants.	Blau (1974) Mintzberg (1979) Pugh, Hickson, Hinings, & Turner (1968) Pugh, Hickson, & Hinings (1969)

Appendix 8-B

Descriptions and Definitions of Organizational Context Variables (Continued)

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
Formalization	The extent to which rules, procedures, instructions, and communication are written.	Identifies the number of written documents that describe appropriate behavior of organizational members.	Personnel managers	Low-moderate reliability Low-moderate validity	Somewhat useful for describing organizations; somewhat useful for describing jobs; somewhat useful for job applicants.	Blau (1971, 1974) Hall (1982) Katz & Kahn (1978) Mintzberg (1979) Pugh, Hickson, Hinings, & Turner (1968)
Standardization	The extent to which organizational behavior is controlled by procedures and regulations.	Identifies the number of behavior-control procedures that exist in an organization.	Personnel managers	Adequate reliability Moderate validity	Useful information about high-performance organizations, somewhat useful for selection , training, and counseling; somewhat useful for job applicants.	Blau (1971, 1974) Hall (1982) Katz & Kahn (1978) Mintzberg (1979) Pugh, Hickson, Hinings, & Turner (1968)
Centralization & Employee Empowerment	Reflects the extent to which employees have influence and control in decision-making.	Indicates the degree to which employees are provided with different types of information and participate in decision-making, and rates the level of autonomy and influence employees experience in their jobs.	Personnel managers Incumbents	Adequate reliability Moderate reliability	Useful information about high-performance organizations; somewhat useful for selection, training, and counseling; somewhat useful for job applicants.	Arthur (1994) Conger & Kanungo (1988) Lawler (1993) Liden, Wayne, & Sparrow (1993) Spreitzer (1992)
Individual versus Team Structure	The extent to which work is being performed by groups of employees versus individual employees.	Identifies the number of employees that work in permanent intact teams; identifies the percentage of performance rewards that are based on team performance and individual performance.	Personnel managers Incumbents	Low-moderate reliability Unknown validity	Useful information about high-performance organizations; useful for selection, training, and counseling; useful for describing jobs; useful for job applicants.	Galbraith & Lawler (1993) Katz & Kahn (1978) Lawler (1991, 1992, 1993) Limerick & Cunningham (1993) Mohrman, Cohen, & Mohrman (1993)

Appendix 8-B
Descriptions and Definitions of Organizational Context Variables (Continued)

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
Type of Work Teams	Reflects the different kinds of work teams utilized by an organization.	Identifies the existence of the following work groups: (1) functional work teams, (2) cross-functional work teams, (3) quality/improvement teams, (4) project/development teams, and (5) management teams.	Personnel managers	Moderate reliability Unknown validity	Useful information about high-performance organizations; useful for selection, training, and counseling; useful for job applicants.	Galbraith & Lawler (1993) Lawler (1991, 1992, 1993) McGrath (1984) Mohrman, Cohen, & Mohrman (1995) Wellins, Byham, & Dixon (1994)
Job Characteristics	Reflects different aspects of a job that are indicators of an enriched job.	Indicates the level of skill variety, task significance, task identity, autonomy, and feedback in a job.	Incumbents	Adequate reliability Good validity	Useful information about high-performance organizations; useful for describing jobs; useful for selection, training, and counseling; useful for job applicants.	Hackman & Oldham (1976, 1980) Fried & Ferris (1987)
Recruitment Planning	Specifying staffing goals and timetables, and calculating and recording statistics that provide information regarding time, money, and recruiting staff necessary to generate a specific number of hires within a given period of time.	Determining staffing needs and collecting information to help ensure that those needs are met on a timely basis.	Personnel managers	Adequate reliability Unknown validity	Useful information about high-performance organizations.	Cascio (1987)
Recruitment Operations	Activities involved in implementing recruitment plans (e.g., selecting sources, realistic job preview).	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Unknown validity	Useful for job applicants; useful for counseling; useful information for high-performance organizations.	Cascio (1987) Rynes (1991)

Appendix 8-B

Descriptions and Definitions of Organizational Context Variables (Continued)

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
Selection Processes	Whether selection system involves the use of a formal job analysis and the validation of predictors against criteria.	Whether people are selected based on thorough, objective analysis of the job for which they are applying; whether the arena in which individuals are assessed have been shown statistically to relate to success on the job.	Personnel managers	Adequate reliability Good validity	Useful information about high-performance organizations; useful information for describing organizations.	Cascio (1987)
Selection Assessment Methods Used	The methods used for selection or promotion of employees.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Good validity	Useful for counseling; useful for job applicants; may be useful for describing organizations.	Cascio (1987)
Group Socialization	Whether formal programs exist that involve socializing employees in groups.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Unknown validity	Useful for counseling; useful information about high-performance organizations.	Feldman (1989) Van Maanen (1978) Van Maanen & Schein (1979)
Individualized Socialization	Whether formal programs exist that involve socializing employees individually.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Unknown validity	Useful for counseling; useful information about high-performance organizations.	Feldman (1989) Van Maanen (1978) Van Maanen & Schein (1979)
Training Methods	The methods used in training programs.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Adequate validity	Useful information for describing organizations.	Campbell (1988) Goldstein (1993)

Appendix 8-B

Descriptions and Definitions of Organizational Context Variables (Continued)

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
Use of Quantitative Data in Training Process	The use of quantitative methods to identify training needs and evaluate training programs.	Same as technical definition.	Personnel managers	Adequate reliability Good validity	Useful information for high-performance organizations.	Campbell (1988) Goldstein (1993)
Training Topics/Content	What trainers intend to teach trainees through training programs.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Good validity	Useful information for high-performance organizations.	Lawler (1991, 1992, 1993)
Extent/Support of Training Activities	The extent to which an organization makes training available to its employees and provides financial support for training activities.	Same as technical definition.	Personnel managers	Adequate reliability Unknown validity	Useful information for high-performance organizations.	US Department of Labor (1994)
Basis of Compensation	The extent to which organizations reward individuals based on: (a) their knowledge, skills, and performance, (b) seniority, (c) team performance, (d) organizational performance, and (e) job attributes.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Unknown validity	Useful for counseling; useful for job applicants; useful information about high-performance organizations.	Brown (1990) Hammer (1988) Kahn & Sherer (1990) Lawler (1983) Luthans & Fox (1989) Smith (1989) Wallace & Fay (1983)
Benefits	The extent to which employees' compensation includes benefits such as pensions, insurance, paid leave, awards and bonuses, pay for time not worked, etc.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Unknown validity	Useful for counseling; useful for job applicants; useful information about high-performance organizations.	Smith (1989)

Appendix 8-B

Descriptions and Definitions of Organizational Context Variables (Continued)

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
All Salaried System	Whether all employees are salaried.	Same as technical definition.	Personnel managers Incumbents	Adequate reliability Unknown validity	Useful for counseling; useful for job applicants; useful information about high-performance organizations.	Lawler (1983)
Organizational Values	Reflects the hierarchy of values that guide an organization.	Indicates the importance of different organizational values, such as tradition, stability, innovation, and collaboration.	Personnel managers and Senior executives	Adequate reliability Unknown validity	Useful information about high-performance organizations; somewhat useful for job applicants.	O'Reilly, Chatman & Caldwell (1991) Perrow (1961, 1970) Quinn (1988)
Extent of Individual Goal-Setting	The extent to which an organization requires its members to periodically set goals.	Same as technical definition.	Personnel managers	Adequate reliability Good validity	Useful information for high-performance organizations.	Kanfer (1990) Locke (1968) Locke, Shaw, Saari, & Latham (1981)
Individual Goal Characteristics	The extent to which an individual's goal is made explicit, and the probability that an individual can attain the goal.	Same as technical definition.	Incumbents	Adequate reliability Good validity	Useful for describing high-performance organizations.	Kanfer (1990) Locke (1968) Locke, Shaw, Saari, & Latham (1981)
Availability of Goal Feedback	The extent to which an individual is given periodic feedback regarding his or her progress against a goal.	Same as technical definition.	Incumbents	Adequate reliability Good validity	Useful information for high-performance organizations; may be useful for counseling job applicants.	Bandura & Cervone (1983) Erez (1977) Kanfer (1990) Locke, Shaw, Saari, & Latham (1981)

Appendix 8-B

Descriptions and Definitions of Organizational Context Variables (Continued)

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
Method of Goal Assignment	The extent to which employees of an organization are allowed to participate in setting their own goals.	Same as technical definition.	Personnel managers	Low-moderate reliability Moderate validity	Useful information for high-performance organizations; useful for counseling; useful for job applicants.	Kanfer (1990) Latham, Erez, & Locke (1988) Locke, Shaw, Saari, & Latham (1981)
Extent of Organizational Goal-Setting	The extent to which an organization systematically sets organizational goals.	Same as technical definition.	Personnel managers	Adequate reliability Adequate validity	Useful information about high-performance organizations.	Cyer & March (1963) Etzioni (1964) Hall (1982) Perrow (1961, 1970)
Organizational Goal Characteristics	The extent to which an organization's goals are made explicit and challenging.	Same as technical definition.	Personnel managers	Low-moderate reliability Adequate validity	Useful information about high-performance organizations.	Smith, Locke, & Barry (1990)
Role Conflict	The simultaneous occurrence of two or more role expectations such that compliance with one would make compliance with the other more difficult.	The extent to which an individual has to deal with conflicting demands.	Incumbents	Adequate reliability Adequate validity	May be useful for selection, training, and counseling; somewhat useful for job applicants; may be useful for describing organizations.	Ilgen & Hollenbeck (1991) Kahn, Wolfe, Quinn, Snoek, & Rosenthal (1964) Katz & Kahn (1978) Kelloway & Barling (1990) King and King (1990) Rizzo, House, & Lirtzman (1970) Schule, Aldag, & Brief (1977)

Appendix 8-B

Descriptions and Definitions of Organizational Context Variables (Continued)

Construct Label	Technical Definition	Operational Definition	Raters	Reliability/ Validity	Purpose	Citation
Role Negotiability	The extent to which the role set can be influenced by the focal person to modify the role.	The extent to which an individual can negotiate his/her role in an organization.	Incumbents	Unknown	May be useful for counseling; may be useful for describing high-performance organizations.	Graen (1976) Graen & Scandura (1987)
Role Overload	A special case of role conflict, where the conflict involves quantity, quality, or time allotted.	A discrepancy between the demands of others and one's ability to meet those demands.	Incumbents	Adequate reliability Adequate validity	May be useful for selection, training, and counseling; somewhat useful for job applicants; may be useful for describing organizations.	Beehr, Walsh, & Taber (1976) Katz & Kahn (1978) Kahn & Byosiere (1992) Rizzo, House, & Lirtzman (1970)

Note: This table includes only the constructs included in the final instrument. Figures 8-1 through 8-9 include the complete conceptual model.

Appendix 8-C

Correspondence between Proposed Organizational Context Variables and Key Purposes of the New DOT

Organizational Context Variables	Describe Jobs	Describe Organizations	Describe High Performance Organizations	Provide Useful Information for Job Seekers
Type of Industry	x	x		x
Organization Size		x		x
Hierarchy		x	x	
Specialization	x	x		
Formalization	x	x		
Standardization	x	x		
Centralization & Employee Empowerment	x	x	x	
Individual versus Team Structure	x	x	x	x
Type of Work Teams	x	x	x	x
Job Characteristics	x		x	x
Recruitment & Selection	x	x	x	x
Socialization Tactics	x	x	x	x
Training & Development	x	x	x	x
Reward Systems	x	x	x	x
Organizational Values		x	x	x
Individual Goals, Processes, & Characteristics			x	
Organizational Goals, Processes, & Characteristics		x	x	
Role Conflict	x			x
Role Negotiability	x		x	
Role Overload	x			x

Note: This table includes only the constructs included in the final instrument. Figures 8-1 through 8-9 include the complete conceptual model.

Appendix 8-D

Crosswalk Between Organizational Context Variables and High Performance Characteristics

	Organizational Context Variables										
High Performance Characteristics[1]	Vertical & Horizonal Differentiation[2]	Design of Work Procedures & Content[3]	Decision Making System[4]	Job Characteristics	Recruitment & Selection	Socialization Tactics	Training & Development	Reward Systems	Organizational Values	Individual Goals, Processes, & Characteristics	Organizational Goals, Processes, & Characteristics	Roles
Benchmarking									x			
Customer Orientation									x			
Data Collection & Performance Measurement					x		x	x		x	x	
Employee Involvement		x	x	x					x	x		x
Empowerment	x	x	x	x					x			x
Enriched Jobs	x	x	x	x								
Self-Managed Teams	x	x	x	x					x			x
Flat Structure	x											
Information Sharing			x			x			x			
Leadership & Support in Top Management									x			
Managing Personnel to Reduce Layoffs												
Multiple Skill Training	x		x	x		x	x					
Partnering									x			x
Pay Incentive Practices			x					x				

Appendix 8-D

Crosswalk Between Organizational Context Variables and High Performance Characteristics (Continued)

High Performance Characteristics[1]	Organizational Context Variables: Vertical & Horizonal Differentiation[2]	Design of Work Procedures & Content[3]	Decision Making System[4]	Job Characteristics	Recruitment & Selection	Socialization Tactics	Training & Development	Reward Systems	Organizational Values	Individual Goals, Processes, & Characteristics	Organizational Goals, Processes, & Characteristics	Roles
Problem Solving Groups			x									
Quality Design									x			
Recruiting for Long Term									x			
Speed of Product Development			x		x							
Strategic Planning									x			
Statistical Control Processes								x				
Workplace Diversity			x						x	x		

[1] High performance characteristics were extracted from Westat's literature review and the Baldrige Award criteria.

[2] Vertical & horizontal differentiation includes the constructs: hierarchy and specialization.

[3] Design of work procedures and content includes the constructs: formalization and standardization.

[4] Decision making system includes the constructs: centralization and employee empowerment, individual versus team structure, and type of work teams.

SECTION III

EXPERIENCE REQUIREMENTS

Section III
Experience Requirements

In the preceding sections we have described worker requirements and occupational requirements. The section on worker requirements dealt with malleable attributes of the worker, such as skills (Chapter 3), knowledges (Chapter 4), and education (Chapter 5). The section on occupational requirements described the nature of jobs, including the generalized work activities that are undertaken (Chapter 6), the immediate context within which work occurs (Chapter 7), and the broader organizational environment (Chapter 8).

In this section, consisting of a single chapter, we deal with the amounts and types of experience that are required by a particular job. Such requirements encompass experience in particular types of jobs, job-related training, on-the-job training and licensure or certification requirements. The chapter describes a taximony of experience requirements, its development, and its application in an employee questionnaire. Throughout, the focus is on descriptions of the kinds of experience required on different jobs.

Chapter 9
Training, Experience, and Licensure
Table of Contents

Tables

Chapter 9
Training, Experience, and Licensure

Lance E. Anderson
American Institutes for Research

Experience requirements are an important part of the content model. Experience requirements include work experience, training, and licensure/certification. Through these kinds of experiences, people acquire job knowledge and skills that they are expected to bring with them as they enter or progress in an occupation (Fleishman & Mumford, 1989). The purpose of this chapter is to explain how we developed taxonomies of experience requirements, and then developed measures for those constructs. We first discuss work experience, then consider training and licensure/certification.

Work Experience

For many reasons work experience is an important construct to describing occupations. One particularly important use of experience data is for employee selection (e.g., Ash, Johnson, Levine, & McDaniel, 1989; Hunter & Hunter, 1984). Within the context of O*NET, the construct of experience is best defined so that it matches the interests of a broad spectrum of users. Westat (1993) conducted a survey of DOT users. More than 50 percent of the sampled users in each of a number of areas rated information about work experience as "very important" to their work. These areas include:

- career and vocational counseling
- vocational rehabilitation and counseling
- employment placement
- human resource management.

If these kinds of users in these area primarily make use of occupational information for the purpose of matching people with occupations, then it is likely that they are most interested in whether occupational require certain experiences for acceptable entry level performance.

The approaches to describing the experience needed to perform a job can be sorted into two broad categories. The first is to inquire about tenure, or the amount of time the incumbent has been working in occupation. The second is to ask about the experience vis a vis specific skills (Ash et al., 1989; Campion, Gowing, Lancaster, & Pearlman, 1994). Both approaches are likely to be of interest to users because scores on these experience variables have been related to job performance.

Experience as the total amount of time, or tenure in a job. A description of overall experience, or tenure, is important. Direct, self-report questions about tenure have been positively related to measures of job performance (Hunter & Hunter, 1984; McDaniel, Schmidt, & Hunter, 1988). These authors indicate that mean years of experience and job complexity moderate the relationship between amount of experience and job performance. The researchers suggest that this finding is fairly conclusive because there generally are few confounds in the research (e.g., incumbents can and do report their tenure accurately) (McDaniel, Schmidt, & Hunter, 1988).

Appendix C in Volume II of this report shows our approach for determining the amount of experience required for the performance of an occupation. Our questions ask about four kinds of job experience. The first question focuses on experience in related jobs. Acceptable performance in some jobs requires a certain amount of experience in related jobs. For example, many managerial occupations require a particular number of years of experience in a related technical job. The second, third and fourth questions ask about training experiences that occur in the work context. These include on-site/in-plant training, apprenticeships/ internships, and on the job training. Apprenticeships/internships are training experiences that require one or more years of on-the-job training through work experience supplemented by related instruction. Such experience is often required before one can be considered a qualified and skilled worker (DOL, 1991). On-site/in-plant training is organized classroom study required and provided by an employer. And on-the-job-training (OJT) is when an individual serves as a learner or trainee on the job under the instruction of a more experienced worker (DOL, 1991). Table 9-1 summarizes characteristics of the four questions.

Specific experience requirements. Another way to examine experience is to look at the various "types of experience" that are needed prior to entry on into a job. Types of experience can be defined in terms of the skills that have been acquired over time.

Table 9-1
Summary of Question Characteristics for Experience as an Amount of Time

Number of Questions	Four
Type of Rating	Amount of experience in time (e.g., years)
Raters	Incumbents or supervisors
Reliability/validity	Reliability - adequate Validity - adequate Discrimination - probably good across career levels
Cost	Low, given that there are only four questions
Purposes	Career and vocational counseling; Vocational rehabilitation and counseling; Employment placement; and Human resource management.

Therefore, a listing of the skills that are required upon entry into a particular job would provide a useful measure of the experience requirements. This information would mirror the level and importance of a given skill to job performance, as discussed in Chapter 3. This information is likely to be of interest to users who could use the data in many ways. Table 9-2 contains some examples of actions that various users can take given this information.

One might, of course, also look at specific experience requirements in terms of knowledge and generalized work activities as well as skills. Skills, however, seemed to provide a more appropriate basis for the assessment of experience requirements because they (a) incorporate experience required outside the work context, and (b) focus on what one can do rather than what one knows.

Table 9-2

Examples of actions users could take given the minimum experience requirements on certain skills

User	Examples of actions they could take given the information
Job Seekers	- Choose to take a course that would provide increased skill in a deficit area. - Choose to volunteer in a position that would provide the skills in a deficit area. - Choose to pursue another occupation/job that has a better fit with their own KSAs
Counselors	- Provide career guidance that focuses on occupations where the minimum requirements are attainable by the individual
Employers	- Redesign entry level jobs to include only those skills that are likely to be possessed by individuals in the entry-level applicant pool

Experience relevant to certain skills has also been found to be a valid predictor of job performance. The rationale for gathering these data in an employee selection context is that experience is one piece of evidence that an individual has acquired certain skills, and that these skills are related to overall performance. Some empirical evidence exists to support this notion. For example, Hough (1984) showed that when individuals are provided with a description of a knowledge, skill or ability, they can respond with an example of their past behavior that demonstrates their possession (or lack) of that knowledge, skill, or ability. Ratings of these examples have been empirically linked to job performance.

Therefore, we decided to gather data about requirements for specific types of experience by asking the question: "Is [the level of skill that you have identified above] required for entry into this job?" We are only collecting this information with regard to basic and cross-functional skills. A simple yes/no scale is provided for the response. This item format is similar to that used in previous work (Peterson, 1992) where the item stem asked respondents to indicate the percentage of a skill acquired before entry. In that study, respondents were asked to respond on a five-point percentage scale. Researchers in the current study opted for a two-point scale because it was felt that

- this would reduce the complexity of the question for respondents
- this format would allow us to make it clear that this was not another level scale (like other ratings being made on the same page)

Table 9-3
Summary of Question Characteristics for Experience with Skills

Number of Questions	The number of Basic and Cross-Functional Skills
Type of Rating	Marking a circle on a two-point yes/no scale
Raters	Incumbents or supervisors
Reliability/validity	Reliability – insufficient data Validity – insufficient data Discrimination – probably good across career levels
Cost	Moderate to high given the number of constructs; however, these questions are only add-ons to the importance and level questions
Purposes	Career and vocational counseling; Vocational rehabilitation and counseling; Employment placement; and Human resource management.

Appendix A of Volume II presents the questions that apply to basic and cross-functional skills. Table 9-3 summarizes characteristics of questions about skill requirements.

Training and Licensure/Certification

Similar to experience, training and licensure/certification tend to apply to tasks being performed in a particular position (Goldstein & Gilliam, 1990). However, training and licensure/certification may also be relevant to tasks occurring in a number of positions. For example, a training program may seek to develop general leadership or problem-solving skills.

When training and licensure/certification are intended to extend across a specific set of position activities, these kinds of constructs may provide yet another potentially useful type of cross-job descriptor. In fact, prior training and licensure/certification are often used as a basis for personnel selection, counseling, and job matching.

The U.S. workplace has changed and will continue to change in a number of ways that will increase the relevance of training and licensure/certification programs. Individuals who will enter the workforce in the next 15 years have already been born, so future trends in labor force participation can be predicted with reasonable accuracy (Fullerton, 1985). The many projected changes in the workforce will affect how organizations manage their human resources (Cascio & Zammuto, 1987). Perhaps the most important change is the decrease in the growth of the workforce. Fewer and fewer young people will be available for entry level jobs (Fullerton, 1985). Increasing numbers of the young people who will be available will lack the necessary skills for doing the work. This is due to two factors: 1) jobs will likely increase in complexity with changes in technology, shifts from manufacturing to service jobs, and increases in the impact of the global marketplace;, and 2) the poor and uneducated segments of our population are growing the fastest (Goldstein & Gilliam, 1990). Various commissions (e.g., Commission on the Skills of the American Workforce, 1990; Commission on Workforce Quality and Labor Market Efficiency, 1989) have agreed that our present workforce too often is poorly prepared for high-performance work because of outmoded current work skills and schools and training institutions that are not changing fast enough to provide appropriate skills.

To remain competitive under these circumstances, American industries will have to have highly competent workforces. Scholars and blue-ribbon commissions appointed by the government and Congress (e.g., Dertouzos, Lester, & Solow, 1989; U.S. Congress, Office of Technology Assessment, 1990) tell us that high-performance workplaces among other things must advance employees on the basis of certified skills.

Some national action has been taken to move employers and professional organizations toward greater use of training and licensure/certification. The Secretary's Commission on Achieving Necessary Skills (SCANS), formed by the former Secretary of Labor, examined the demands of the workplace and defined a set of competencies and foundation skills needed by today's and tomorrow's workplace (SCANS, What Work Requires of Schools, 1991; 1992). The federal Departments of Labor and Education jointly have launched National Skill

Standards to promote the development of voluntary skill standards in different industries by involving all stakeholders including industry associations, unions, and educators. The U.S. isn't the only country taking action — the United Kingdom has developed industry-based skill standards and assessment procedures in the form of National Vocational Qualifications, and this has resulted in an increase in the number of skilled workers in the trades (Newton, 1993).

Training. According to a recent survey of DOT users (Westat, 1993), a majority of users in virtually every user group viewed training information to be "very important." Here are some of the current uses of training information:

- career selection
- career planning
- curriculum development
- human resources management
- vocational rehabilitation counseling.

This means that training data collected within the new O*NET could potentially be used by (at a minimum) career counselors, employers, students, training developers, and job seekers.

Taxonomy development. In developing items for the training descriptors, we took the following steps:

- defined what users want in terms of training data
- examined training/education literature for training taxonomies
- examined how training data are gathered in organizations
- developed brief, clear, easy to read items.

<u>What users want from training descriptors</u>. From an examination of results of the recent DOL Users Survey (Westat, 1993) and the APDOT report (DOL, 1993), it became clear that users wanted an indication of:

- the amount of training needed to enter the occupation
- the type of training needed to enter the occupation
- education setting (e.g., High School, College, Certificate Program)
- course major and subject areas.

Examination of training/education literature for taxonomies. We examined the training literature for various taxonomies that might meet the needs of users. We discuss these taxonomies in detail in Chapter 5, *Education*. Our discussion in the *Education* chapter points out that most taxonomies applied to training are not useful in the job analysis context. The exception to this rule is the set of taxonomies discussed in the Classification of Instructional Programs (CIP) (U.S. Department of Education, 1990). This set of taxonomies was useful for addressing various issues associated with education data (see Chapter 5), and it also is useful for addressing issues relevant to training data. The manner in which we applied some of these taxonomies to education issues allows us to deal with issues related to training as well.
In fact, training within the context of O*NET is largely dealt with in consort with other descriptors. The amount of training required is subsumed under the amount of education required. An item dealing with the amount of training/education required is introduced in Chapter 5. In addition, the course major and course work items introduced in Chapter 5 partially address the issue of training type. Finally, an item type described in the "experience" section of this chapter is phrased so that it could also reflect how training affects the acquisition of certain skills.

One training issue not fully dealt with in other areas of our model is training type. That is, beyond an indication of general education setting, the O*NET should provide some more specific indication of the type of training needed to perform a job. The CIP provides a listing of types of training programs beyond the simple set of types addressed in the question on "amount of education" (see Chapter 5). As mentioned before, using taxonomies from the CIP is desirable in that CIP taxonomies are crosswalked to the current DOT and the OES job families. We decided, therefore, to use this taxonomy to develop a set of items on training type.

Examination of how training data are gathered in large organizations. We examined what large organizations do in terms of gathering training data in a job analysis survey. We have discussed our findings in some detail in Chapter 5. And, as previously mentioned, we developed approaches for gathering training data as part of our effort in gathering data for other descriptors.

One organizational approach for gathering training/education data that was not applied within Chapter 5 is the approach where organizations focus on specific courses offered within the organization, or ones that are specific to a certain job. This approach clearly addresses various training issues, but is not viable. The time and effort needed to gather data at that level of specificity make it impossible in the context of O*NET.

Develop brief, clear, easy to read items. We decided to use three approaches to gather training data. In general, the three approaches require that the respondents:

- indicate the highest level of specialized training that is required for the job
- indicate the amount of training/education that is required for the job (introduced in Chapter 5)
- indicate whether certain levels of skills are required at entry (introduced in the work experience section of this chapter).

To provide an indication of whether or not certain types of specialized training are required for the job, we developed a set of items that focus on the specialized training program types defined in the CIP. We asked about each training program type as part of the "level of education" item introduced in Chapter 5. The item is listed in Appendix C of Volume II.

One might ask why we did not ask for a listing (or provide a checklist) of subject areas for occupationally specific training programs. We did not do this because:

- the number of subject areas that would have to be listed would be too long
- even carefully developed occupation-specific training data may not reveal much beyond what could be determined from the job title and the use of other descriptors such as skills.

The important features of our training data collection are that:

- respondents are incumbents — they are most familiar with requirements
- most response formats are checklists or simple circling of options — open-ended formats are reserved for those occasions when a coding list would be too lengthy.
- taxonomies chosen for coding lists and checklists are widely used.

Licensure/Certification

As licensure/certification becomes more common in various occupations, the interest in information about these programs will naturally increase. According to a recent survey of DOT users (Westat, 1993), information about licensure/certification was viewed as "very important" by at least thirty percent of individuals in various user groups. Data from this study indicate that information about licensure/certification is particularly relevant for career vocational counseling and occupational information development/ dissemination.

Despite the obvious need for licensure/certification information in the O*NET, no research has been done to determine the best methods to collect this information. This is likely due to the apparently straightforward nature of the information. Indeed, a review of the methods used to collect licensure/certification data in organizations (e.g., AT&T) revealed little other than the use of an extensive list of possible licenses/certificates. Therefore, the best approach, given the lack of research on the topic, is to carefully define the information that is needed by various users, examine how licensure/certification data were collected in similar contexts (e.g., Canadian Job Classification System), and write items in simple English that could be understood by a variety of respondents.

In line with the uses identified in a recent Westat report (1993), it became clear that information about licensure/certification would be of greatest value if it described the requirements for entry and advancement in an occupation. We determined that users would be most interested in the :

- name of the license/certificate relevant to the occupation
- requirements of the license/certificate
- need for continuing education to retain the certificate
- degree to which the license/certificate is required/ considered desirable by
  - federal/state/local laws
  - employers
  - unions/guilds/professional associations
- degree to which the license/certificate is necessary to advance in the occupation.

The first three points above focus on identifying the name of the license/certificate relevant to the occupation, and then determining the basic requirements needed to achieve and retain licensure/certification. These data would be of obvious interest to career/vocational counselors. The last three points recognize that the importance of licensure/certification varies across occupations and geographic regions — sometimes they are required by law, while in other instances, they are merely useful in advancing in the occupation.

We developed the items so that incumbents would describe the licenses/certifications that were relevant to their jobs. This tactic allows us to capitalize on the first hand knowledge of the incumbent and allows for description of only those licenses/certificates that are relevant

In light of these considerations, we constructed items shown in Appendix C of Volume II to tap licensure issues. The characteristics of these items are summarized in Table 9-4.

One important issue with respect to licensure/certification is reciprocity across states and localities (Shimberg, Esser & Kruger, 1973). A state grants reciprocity for a license if individuals are allowed to practice in the state who hold a valid license from another state. Naturally, this is an important variable to consider as it may be of interest to users. However, this information varies across time and location. Data that we would collect across a limited sample of incumbents would not generalize. The best way to obtain this information would be to ask the states/localities directly. Therefore, we will not collect data on reciprocity through the surveys.

Table 9-4
Summary of Question Characteristics for Licensure/Certification Items

Number of Questions	Eight
Type of Rating	Placing a check to answer a yes/no question Filling in blanks where appropriate
Raters	Incumbents or supervisors
Reliability/validity	Reliability – insufficient data Validity – insufficient data Discrimination –probably good across career levels
Cost	Low given the low number of constructs; and the simple response format
Purposes	Career and vocational counseling; Vocational rehabilitation and counseling; Employment placement; and Human resource management

References

Ash, R. A., Johnson, J. C., Levine, E. L., & McDaniel, M. A. (1989). Job applicant and work experience evaluation in personnel selection. In K. M. Roland, & G. Ferris (Eds.), *Research in personnel and human resources management, Vol. 7.* JAI Press.

Campion, M., Gowing, M., Lancaster, A., & Pearlman, K. (1994). *United States Department of Labor Database of Occupational Titles reinvention project: DOT transition team final report.* Washington, DC: United States Office of Personnel Management.

Cascio, W.F., & Zammuto, R.F. (1987). *Societal trends and staffing policies.* Denver: University of Colorado.

Commission on Workforce Quality and Labor Market Efficiency. (1989). *Investing in people: A strategy to address America's workforce crisis.* Washington, DC: U.S. Department of Labor.

Commission on the Skills of the American Workforce. (1990). *America's choice: High skills or low wages.* Rochester, NY: National Center on Education and the Economy.

Dertouzos, M.L., Lester, R.K., & Solow, R.M. (1989). *Made in America: Regaining the reproductive edge.* Cambridge, MA: The MIT Press.

Fleishman, E.A., & Mumford, M.D. (1989). Individual attributes and training performance: Applications of abilities taxonomies in instructional systems design. In I.L. Goldstein (Ed.) *Frontiers of industrial and organizational psychology. Volume III: Training and career development* (pp. 183-255). San Francisco, CA: Josey-Bass.

Fullerton, H.N., Jr (1985). The 1995 Labor force: BLS' latest projections. *Monthly Labor Review, 117,* 17-25.

Goldstein, I.L., & Gilliam, P. (1990). Training system issues in the year 2000. *American Psychologist, 45,* 134-143.

Hough, L. M. (1984). Development and evaluation of the "accomplishment record" method of selecting and promoting professionals. *Journal of Applied Psychology, 69*, 135-146.

Hunter, J. E., & Hunter, R.F. (1984). The validity and utility of alternative predictors of job performance. *Psychological Bulletin, 96*, 72-98.

McDaniel, M. A., Schmidt, F. L., & Hunter, J. E. (1988). Job experience correlates of job performance. *Journal of Applied Psychology, 73*, 327-330.

Newton, W.M. (1993). *Skill standards, British style: Linking assessment and training in the United Kingdom.* (NOICC Occasional Paper 6). Washington, DC: National Occupational Information Coordinating Committee.

Peterson, N.G. (1992). *Methodology report.* Washington, DC: American Institutes for Research.

Secretary's Commission on Achieving Necessary Skills. (1992). *Learning a living: A blueprint for high performance.* Washington, DC: U.S. Department of Labor.

Secretary's Commission on Achieving Necessary Skills. (1991). *What work requires of schools.* Washington, DC: U.S. Department of Labor.

Shimberg, B., Esser, B.F., & Kruger, D.H. (1973). *Occupational licensing: Practices and policies.* Washington, DC: Public Affairs Press.

U.S. Congress, Office of Technology Assessment. (1990). *Worker training: Competing in the new international economy.* OTA-ITE-457. Washington, DC: U.S.Government Printing Office.

U.S. Department of Education (1990). *Classification of instructional programs.* Washington, D.C.: Author.

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington DC: Author.

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

Westat (1993). *DOT user survey: A report and analysis.* Rockville, MD: Westat, Inc.

546

SECTION IV

WORKER CHARACTERISTICS

Section IV
Worker Characteristics

In the three preceding sections we have focused on requirements for developed attributes relevant to performance across a variety of positions. More specifically, we have examined worker requirements (such as skills), occupational requirements (such as generalized work activities), and experience requirements (such as training and licensure).

In this section we will begin to look at potential descriptors of the work and the people doing the work that are somewhat less amenable to change as a function of people's work history. We refer to those attributes outside the worker's direct control as *characteristics*. In this section we will consider requisite worker characteristics.

Worker characteristics refer to relatively enduring characteristics of the worker that might influence both performance and the individual's capacity to acquire those knowledges and skills that are required for effective performances. The quintessential worker characteristics are, of course, abilities or those basic capacities that influence learning and skill acquisition across a variety of domains. The first chapter included in this section (Chapter 10) will specifically address the kinds of abilities that might be used to describe jobs including cognitive abilities, psychomotor abilities, physical abilities, and sensory abilities.

Abilities ideally reflect characteristics that set boundaries for maximal performance. A comprehensive description of relevant person characteristics, however, should also consider attributes shaping people's typical performance. One set of characteristics that are relevant to assessment of typical performance may be found in personality, or preferred work styles. Another set of characteristics bearing on typical performance may be found in people's interests, or occupational values. Accordingly, the two final chapters in this section (Chapters 11 and 12) will examine the kinds of occupational value and work style variables that might be used to describe people's jobs.

Chapter 10
Abilities
Table of Contents

Tables

Figures

Appendix

Chapter 10
Abilities

Edwin A. Fleishman, Leon I. Wetrogan,
Charles E. Uhlman, & Joanne C. Marshall-Mies
Management Research Institute, Inc.

Introduction

This chapter describes a comprehensive taxonomic system for describing and classifying jobs in terms of the abilities required to perform these jobs effectively. The taxonomic system is comprehensive in its coverage of the cognitive, psychomotor, physical, and sensory/perceptual domains of human abilities and is applicable to the full range of jobs found in the world economy. Specifically, the chapter provides the conceptual background of the ability classification (i.e., taxonomic) system, the developmental background of this taxonomy, and the development of the measurement system that utilizes the taxonomy in assessing the ability requirements of jobs. The system is evaluated in terms of its reliability, validity, and utility.

Definition of Ability

The term *ability* is commonly used in everyday language as well as in discussions among psychologists, educators, vocational counselors, human resource managers and planners, and other specialists. However, its exact meaning is seldom explicated. Most recently, Carroll (1993, p. 1-9) has discussed a number of issues with regard to defining the term *ability*. These issues include: In what sense does ability imply "potential?" Is ability a matter of degree? To what extent may ability vary within an individual and across different individuals? How general is ability (does it apply only to single performances, to some class of performances, or to all possible performances)? To what extent is an ability to be construed as a "trait" of an individual?

Many of these conceptual issues were dealt with in earlier work on taxonomic issues in describing human abilities (see, e.g., Fleishman, 1972, 1975, 1982).

Both Carroll and Fleishman define abilities as relatively enduring attributes of an individual's capability for performing a particular range of different tasks. Abilities are regarded as traits in that they exhibit some degree of stability over relatively long periods of time. It is recognized, however, that abilities may develop over time and with exposure to multiple situations (Snow & Lohman, 1984).

Recently, the term *competencies* has come into use to describe individual attributes related to quality of work performance (see e.g., Corts & Gowing, 1992; McClelland, 1973; Spencer, McClelland, & Spencer, 1994). A competency has been defined as "an underlying characteristic of an individual which is causally related to effective or superior performance in a job" (Boyatzis, 1982). This definition is, of course, consistent with our definition of ability. However, lists of competencies often contain a mixture of knowledges, skills, abilities, motivation, beliefs, values, and interests. In the extensive work supported by the Secretary's Commission on Achieving Necessary Skills (SCANS, 1992; Peterson, 1992), the term *competencies* was ultimately used to refer to "functional skills," which reflect what people in a wide range of jobs actually do at work (Peterson, 1992).

The distinction between abilities and skills is often made (see e.g., Bilodeau, 1966; Fleishman, 1966, 1972a). An ability is a general trait of an individual that is inferred from the relationships among performances of individuals observed across a range of different tasks. *Skills* are more dependent on learning and represent the product of training in particular tasks. Skills are more situational and tend to improve. The development of a given skill (e.g., airplane piloting) is predicated, in part, on the individual's possession of relevant underlying abilities (e.g., spatial orientation, multi-limb coordination). These underlying abilities are related to the rate of acquisition and final levels of performance that a person can achieve in particular skills (see Ackerman, 1988; Fleishman, 1966, 1967, 1972a).

Tasks have been defined in many ways. Elsewhere, Fleishman (1982) and Fleishman and Quaintance (1984) have described the different conceptual bases for defining tasks. Thus, R. B. Miller (1967) states, "A task is any set of activities, occurring at the same time, sharing some common purpose that is recognized by the task performer" (p. 11). Wheaton (1973) proposed that a task reflects an organized set of responses to a specified stimulus situation intended to bring about the attainment of a goal state. This definition of a task is similar to one proposed by Hackman (1968) and McCormick (1976) and, more recently, by Carroll (1993), who defines a task as "an activity in which a person engages in order to achieve a specified objective or result". Thus, there is a convergence among this set of definitions.

Of particular interest in the present project is the relation between tasks and abilities. Tasks can be described in terms of the abilities required to perform them. The performance of any task requires certain abilities, if performance is to be maximized. Tasks requiring the same ability or a similar group of abilities would be placed in the same category. The use of empirical information on the relationships among performances of individuals performing different tasks allows us to capitalize on knowledge we already possess concerning the basic underlying abilities (Carroll, 1993).

Structure of Human Abilities

Much of our knowledge about the identification of human abilities comes from programmatic factor analysis research. Critical questions have concerned the *generality* of the constructs used to describe individual differences in human abilities. As has been discussed elsewhere, constructs such as "mental abilities," "motor abilities," "problem solving ability," "decision making ability," and "agility" have turned out to be too broad; the tasks requiring by such broad categories are too diverse to yield high correlations between performances in these tasks. Factor analyses of the correlations among performances within these domains typically yield somewhat more narrowly defined abilities (see e.g., Carroll, 1993; Ekstrom, French, & Harmon, 1976; Guilford & Hoepfner, 1971; Fleishman, 1964, 1972). Similarly, expressions like "athletic ability" and "musical ability" are often used, but it is known that there are a number of separate constructs that better define several different abilities involved in the tasks comprising these broad activities. On the other hand, characterizing an individual as having the ability to "lift barbells of a given weight" or to "solve quadratic equations of a given complexity" yields information that is too specific and not very descriptive of an ability trait that extends to performance in a variety of tasks requiring the same underlying ability.

The ability categories proposed for O*NET largely come from factor analyses of the intercorrelations among performances on tasks within several broad domains of human performance (e.g., cognitive, psychomotor, physical, sensory-perceptual). The emphasis in this project is on abilities identified in programmatic research and on abilities replicated in many different studies. It is recognized that the study of human abilities has a long history and that a number of alternative factor analytic models and theories regarding the structure of human abilities have been proposed. Examples are found in the work of Spearman and Holzinger (Spearman, 1923; Holzinger & Swineford, 1939), Thurstone (1947), Guilford (1985), Vernon, (1961), Cattell and Horn (Cattell, 1971; Horn, 1988), Gustafsson (1988), among others.

Carroll (1993) has recently reviewed these programs and other historical developments in the factor analysis of human cognitive abilities. Structural issues often involve the presence and nature of a "general cognitive ability," the importance of ability factors found among sub-groups of performances relative to such a general ability, and the existence and nature of hierarchical structures that relate general and more narrow ability categories. Thus, Spearman's hierarchy emphasized a general factor ("g"); Cattell and Horn's work stressed broader group factors (e.g., fluid and crystallized intelligence); and the work of Thurstone and Guilford emphasized a larger number of more narrowly defined abilities spanning a more limited range of performances (e.g., numerical and verbal abilities, inductive reasoning).

It should be pointed out that hierarchical models investigated in previous work have been largely confined to performance in the cognitive areas of human performance. Carroll's (1993) recent review has proposed a hierarchical theory of cognitive abilities recognizing abilities classified at three strata: a) numerous, narrow first stratum factors; b) a smaller number of broader, second order factors; and c) a single general factor at stratum three. He has also shown the difficulties and limitations in designing and carrying out hierarchical factor analysis studies to adequately name and define general and second order factors and in matching these factors across studies.

In this chapter, the ability taxonomy adopted falls into the first stratum of Carroll's system. The abilities in the taxonomy cover a broad spectrum of performances likely to be found in the world of work and include cognitive, psychomotor, physical, and sensory-perceptual abilities. Most of the abilities at this level have been identified in programmatic research and replicated across many studies. Furthermore, operational definitions of each of these abilities have been developed, linkages of job tasks with each ability have been established, and a methodology has been developed for evaluating jobs in terms of their requirements for these abilities. And, for the most part, measures to assess each of these abilities have been developed and specified (see Fleishman & Reilly, 1992).

Criteria for an Ability Requirements Taxonomy

Earlier, in their book *Taxonomies of Human Performance: The Description of Human Tasks*, Fleishman and Quaintance (1984) reviewed the conceptual and methodological issues in developing taxonomies of human performance. Criteria for evaluating such systems were identified, with an emphasis on the utility of alternative classifications for describing human task performance for a variety of purposes. More recently, Fleishman and Mumford (1991) described the relevance of these issues to problems of describing and classifying jobs and evaluated the ability requirements approach and measurement system (Fleishman, 1975a, 1975b) by applying the evaluative criteria previously developed. The present chapter reviews the ability requirements approach in the context of developing the O*NET as a revision of the *Dictionary of Occupational Titles (DOT)* (U.S. Department of Labor, 1991).

To be optimally effective, any classification of descriptors must meet several criteria. The descriptors should be composed of constructs linking job task characteristics with the abilities required for effective task performance. The system for describing jobs should also be grounded in a programmatic research base and include a reliable measurement system demonstrating internal and external validity. The system should have demonstrated utility for integrating eclectic information into a useful data base. Use of the data base should improve predictions about human performance. Additionally, the system must be user-friendly in terms of format, accessibility, terminology, and time and effort requirements.

These criteria for a classification system describing ability requirements were originally proposed by Fleishman and Quaintance (1984). Although it is most likely true that no one system will meet all of the requirements for the O*NET, the Ability Requirements Taxonomy developed by Fleishman and his colleagues provides a foundation that meets several of the outlined criteria. The taxonomy has a research base spanning nearly 40 years and includes psychomotor, physical, cognitive, and sensory-perceptual constructs. The job analysis measurement system based on this taxonomy, called the *Fleishman-Job Analysis Scales (F-JAS)* (Fleishman, 1975b, 1992) now has a long history of use and evaluation for jobs in industry, state and federal government agencies, and military occupational specialties (for one review see Fleishman, 1988). The system has been successfully used in nationwide job analysis studies (e.g., Landy, 1992). To further facilitate their use in large-scale administration, these scales have undergone some modifications to suit the specific purposes of the O*NET.

Development of the Ability Requirements Taxonomy

Ability identification within a subarea of human task performance usually begins by administering representative tasks to a sample of subjects. The tasks are not chosen haphazardly, but rather are specifically designed to address certain inferences about the hypothesized ability categories underlying performance in these tasks. The correlations among the tasks are then computed and subsequently factor-analyzed to identify clusters of tasks requiring common abilities. This information then serves as a basis for additional hypothesis generation, and further studies are conducted to sharpen the categories' definitions and boundaries, as well as to identify the range of tasks encompassed by the category definitions.

Later studies often impose variations in the tasks to explore the relationships among the tasks and ability categories. Marker tests or reference measures are included to help identify task and ability parameters. The ultimate objective is to identify the most comprehensive, but parsimonious set of relatively independent ability categories that are the most useful and meaningful for describing human performance on the widest range of tasks within an ability domain. This approach is illustrated by Fleishman's programmatic work in the areas of physical and psychomotor task performance (for reviews, see Fleishman, 1964, 1972b). The initial steps involved detailed reviews of the relevant factor analytic literature for empirically-derived ability categories which might be very useful in describing human task performance (see e.g., Fleishman, 1953; Nicks & Fleishman, 1962). Subsequent research programs within each area involved a series of interlocking experimental and factor analytic studies involving hundreds of tasks. Particular task batteries were administered to 200-400 subjects for factor analytic study. Experimental-correlational studies were designed to introduce variations in the task requirements aimed at sharpening, limiting, or broadening initial factor definitions.

Experimental studies of the type described above have been conducted over many years, and this work has been described elsewhere in great detail (see e.g., Fleishman, 1954, 1956a, 1956b, 1958, 1964, 1966, 1967a, 1967b, 1972b; Fleishman & Ellison, 1962; Parker & Fleishman, 1960; Hempel & Fleishman, 1955; Fleishman & Reilly, 1992b; Meyers, Gebhardt, Crump, & Fleishman, 1993). In short, a total of 10 psychomotor and nine physical abilities were found to account for the preponderance of variance in performance on several hundred different kinds of tasks.

Under a project supported by the U.S. Defense Advanced Research Projects Agency, the taxonomy was expanded to include cognitive and sensory-perceptual categories (Theologus & Fleishman, 1973; Theologus, Romashko, & Fleishman, 1973; Fleishman, 1975b). The fundamental sources for these abilities were Thurstone's work in primary abilities (Thurstone, 1947), Guilford's structure of intellect model (Guilford, 1967), and work conducted at the Educational Testing Service (French, 1951; French, Ekstrom, & Price, 1963) research in the Air Force aptitude research program (Guilford, 1947) and more recent work (see below). Nineteen additional abilities were added, based on the criterion that each category had been identified in at least 10 studies.

Subsequently, the taxonomy was reviewed and refined to ensure comprehensive coverage of all ability domains. The physical, psychomotor, cognitive, and sensory-perceptual abilities were combined into a single list and definitions were written for each. This provisional list was reviewed by psychologists in a series of discussions and interviews. Feedback from the reviewers identified three areas needing further improvement: 1) some definitions were too vague; 2) additional examples of the ability categories were needed; and 3) the ability list was not comprehensive enough. Hence, an effort was made to clarify the definitions and include more task examples for each category. An expanded review of the experimental and measurement fields, together with more recent reviews (Horn, 1976; Carroll, 1976; Harmon, 1975; Peterson & Bownas, 1982), led to the inclusion of additional categories that seemed applicable to human task performance. Some of these, such as time sharing and selective attention, had not yet been widely studied. The resulting list of 52 abilities comprised the Ability Requirements Taxonomy that was incorporated into the *Manual for Ability Requirements Scales (MARS)* (Fleishman, 1975a,b) and in a later version called the Fleishman Job Analysis Survey *(F-JAS)*. Table 10-1 provides a list of these abilities. Complete

Table 10-1

Hierarchical Taxonomy of Ability Requirements

COGNITIVE ABILITIES

Verbal Abilities
1. Oral Comprehension
2. Written Comprehension
3. Oral Expression
4. Written Expression

Idea Generation and Reasoning Abilities
5. Fluency of Ideas
6. Originality
8. Problem Sensitivity
11. Deductive Reasoning
12. Inductive Reasoning
13. Information Ordering
14. Category Flexibility

Quantitative Abilities
9. Mathematical Reasoning
10. Number Facility

Memory
7. Memorization

Perceptual Abilities
15. Speed of Closure
16. Flexibility of Closure
19. Perceptual Speed

Spatial Abilities
17. Spatial Orientation
18. Visualization

Attentiveness
20. Selective Attention
21. Time Sharing

PSYCHOMOTOR ABILITIES

Fine Manipulative Abilities
27. Arm-Hand Steadiness
28. Manual Dexterity
29. Finger Dexterity

PSYCHOMOTOR ABILITIES (cont'd)

Control Movement Abilities
22. Control Precision
23. Multilimb Coordination
24. Response Orientation
25. Rate Control

Reaction Time and Speed Abilities
26. Reaction Time
30. Wrist-Finger Speed
31. Speed of Limb Movement

PHYSICAL ABILITIES

Physical Strength Abilities
32. Static Strength
33. Explosive Strength
34. Dynamic Strength
35. Trunk Strength

Endurance
40. Stamina

Flexibility, Balance, and Coordination
36. Extent Flexibility
37. Dynamic Flexibility
38. Gross Body Coordination
39. Gross Body Equilibrium

SENSORY ABILITIES

Visual Abilities
41. Near Vision
42. Far Vision
43. Visual Color Discrimination
44. Night Vision
45. Peripheral Vision
46. Depth Perception
47. Glare Sensitivity

Auditory and Speech Abilities
48. Hearing Sensitivity
49. Auditory Attention
50. Sound Localization
51. Speech Recognition
52. Speech Clarity

Adapted from Fleishman (1975b, 1992). Numbers for each ability represent the order in which the rating scales for each ability are presented in the F-JAS.

definitions are provided in the *Handbook of Human Abilities: Definitions, Measurements, and Job Task Requirements* (Fleishman & Reilly, 1992b) and the *Administrator's Guide for the Fleishman Job Analysis Survey (F-JAS)* (Fleishman & Reilly, 1992a). Appendix G in Volume II provides adaptations of these ability definitions for use in the present effort to revise the *DOT*.

Table 10-1 has arranged these first stratum ability constructs into a three stratum hierarchical system. At the most general level we have clustered the abilities into the four general domain categories represented: cognitive (21 abilities), psychomotor (10 abilities), physical (9 abilities), and sensory-perceptual (12 abilities) domains. Within each of these four domains, we have categorized the first stratum abilities into an intermediate (2nd) stratum.

The hierarchy is mainly provided as an aid in conceptualizing the 52 different first stratum abilities represented in the ability requirements taxonomy. The hierarchy is not meant to conform to the results of any particular hierarchical factor analysis. However, the hierarchy of *cognitive* abilities is consistent with some previous hierarchical models developed in the cognitive domain (see Carroll, 1993). The hierarchy within the *physical* ability domain is consistent with the conceptualization of Hogan (1991), although she eventually prefers to use the more analytical first stratum physical abilities (Fleishman, 1964) in the description of jobs. The *psychomotor* hierarchy is based on correlational information from Fleishman's studies (see 1972b), although no factor analysis of the correlations between primary ability factors has been carried out. Under the *sensory-perceptual* domain, the cluster of visual abilities separate from a cluster of auditory and speech abilities is consistent with recent reviews of these areas (Carroll, 1993).

Development of the Ability Requirements Measurement System

The next phase of the programmatic effort entailed developing a measurement system for evaluating the ability requirements levels of various jobs and job tasks using this ability taxonomy. Procedures that were followed in constructing the measurement rating format are described in detail in Fleishman (1975b), Fleishman and Mumford (1988, 1991), and Fleishman and Quaintance (1984). Initially, descriptions of three laboratory tasks and tasks from three jobs were presented to a panel of 18 psychologists specializing in human performance, psychometrics, and industrial psychology (Theologus & Fleishman, 1973; Theologus, Romashko, & Fleishman, 1973). Using the ability definitions and a rating scale format, the raters were asked to evaluate the level of each ability required for adequate task performance. Task ratings, when compared to task factor loadings on the ability categories from previous factor analytic studies, supported the feasibility of this procedure. Furthermore, relatively high interrater reliabilities were found. Follow-up interviews with the raters suggested that clearer instructions and more precise ability definitions might be further sources of improvement.

The appropriate revisions were made, and 32 psychometricians and 25 psychologists from varying specialties were presented with the tasks and ability category definitions. These judges were asked to rate each task with respect to 37 ability dimensions. Intraclass correlations were obtained from groups of 25, 15, and 5 raters, as well as from a single rater. It was found that 15 raters were needed to obtain reliability coefficients exceeding .70, when agreement for each task was assessed across raters. However, the raters again suggested the need for refinement to more behaviorally-oriented definitions of the abilities.

Hence, behaviorally-anchored rating scales were developed using the following procedures. Psychologists familiar with the abilities generated detailed behavioral descriptions for the high and low ends of each scale. These descriptions, along with the ability definitions, were presented to panels. Panel members generated examples of common familiar tasks requiring high, medium, and low levels of each ability. More than 1000 task examples were created. Next, these tasks were presented to groups that were asked to rate, on a 7-point scale, the level of each ability required to perform each task. Means and standard deviations of the ratings were calculated; then, tasks were selected as anchors for the high, medium, and low points of each scale based on their means and their low standard deviations about each mean.

The format of the ability requirements scales, for application to new jobs and tasks, involves presenting raters with a 7-point rating scale for each of the taxonomy's abilities. Above each scale is a definition of the ability; as noted previously, these definitions are the end product of numerous iterative changes and refinements based on research and rater feedback. The definition may include a table distinguishing the particular ability from other similar abilities. To further guide the rater, each scale contains "ability level requirements" explaining what is meant by high and low ratings. Finally, each scale contains empirically-derived behavioral

1. Oral Comprehension

This is the ability to listen and understand spoken words and sentences.

How Oral Comprehension Is Different From Other Abilities		
Oral Comprehension: Involves listening to and understanding words and sentences spoken by others.	vs.	*Written Comprehension:* Involves reading and understanding written words and sentences.
		Oral Expression and *Written Expression:* Involves speaking or writing words and sentences so others will understand.

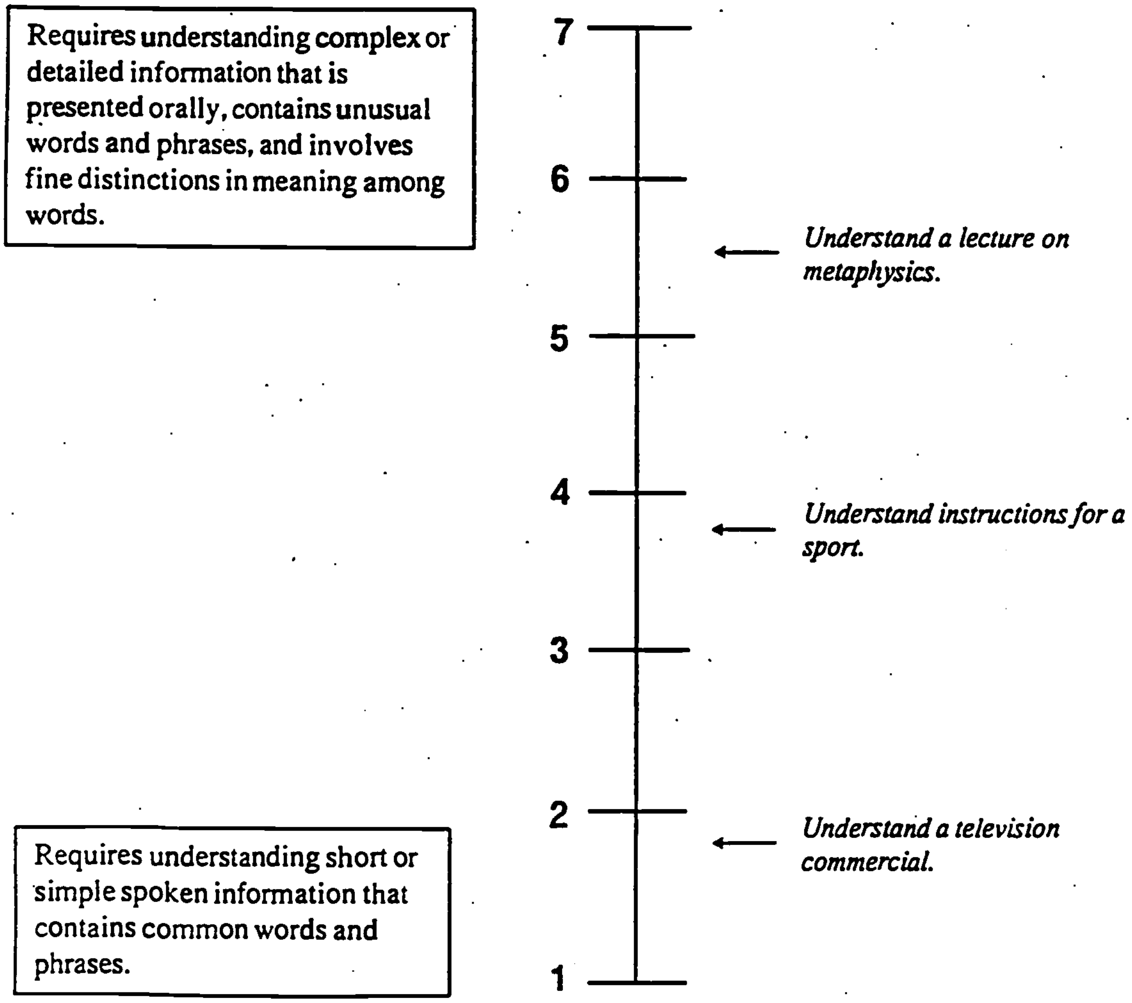


Figure 10-1

Example of the F-JAS Oral Comprehension Ability Rating Scale from Fleishman (1975a) and Fleishman (1992) anchors at high, intermediate, and low positions on the scale. It is important to stress that these anchors were empirically derived in prior studies. These anchors were chosen because of the high interrater agreement (low standard deviations) about their mean scale position and because they represent activities familiar to all raters. The rater's instruction is to evaluate the level of the ability requirement of the new job or task being rated on that ability scale. The rater proceeds from one ability to the next using this procedure. Figure 10-1 provides an example of a scale as it appears in the *F-JAS* (Fleishman, 1975a; 1992). (The complete set of 52 ability scales, as adapted for the O*NET, is contained in Appendix 10-A.)

The *F-JAS* scales have been used for describing the ability requirements of tasks, jobs, and job-dimensions; high interrater agreement has been demonstrated at each level (Fleishman, & Mumford, 1988, 1991). At the task level, subject matter experts (SMEs) rate each of the important job tasks on each ability. The entire job's ability profile is obtained by averaging ratings on each ability across all job tasks. Where job tasks have been clustered by common task requirements, ability ratings can be made across these more inclusive job dimensions. At the job level, the SMEs work from knowledge of the entire job and rate the level of each ability required for the total job.

Time required to rate the ability requirements at the job level is well under an hour, but may be several times longer at the task level (depending on the number of tasks). Data analysis time also is increased when ratings are obtained at the task level. However, reliability and validity of information obtained at the job level are high, as we will describe in a later section. The scales have been used at the job level in a nationwide occupational survey of public safety jobs (Landy, 1992) with reliable results.

For specialized uses, subparts of the *F-JAS* scales have been used. For example, the physical abilities and some sensory scales have been extensively used in studies of physically-demanding jobs (see e.g., Fleishman, 1975a, 1979, 1988; Hogan, Ogden, & Fleishman, 1978, 1979; Meyers, Gebhardt, Price, & Fleishman, 1981; Meyers, Gebhardt, & Fleishman, 1979; Romashko, Brumbach, Fleishman, & Hahn, 1974) and in studies linking medical standards to job requirements in such jobs (e.g., Hogan, Ogden, & Fleishman, 1978; Meyers, Jennings, & Fleishman, 1981). In studies of higher management levels (e.g., Friedman, Fleishman, & Fletcher, 1992) and for professional and technical personnel (Reilly & Zink, 1980), emphasis has been on use of the cognitive scales.

The recent research by Bayer (1992) has answered some additional questions regarding this methodology. In a carefully designed study, Bayer examined the effect of SME experience, scale rating format (anchors vs no anchors), job-level ratings (task, dimension, total job), and their interactions, on rating reliability and validity using the *F-JAS* system. Validity was assessed by use of a criterion group of experts in the jobs, who completed the *F-JAS* rating scales. Comparison of ratings made by incumbents indicated that the use of anchors produced superior reliabilities and the highest predictions of experts' ratings. Reliabilities were high for all groups. Overall, the results supported the use of whole-job ratings rather than the more time consuming task ratings. A major finding was the high correlation between whole-job ratings and a composite of the task ratings. The study also showed that the expertise of SMEs, within the range of experience studied (all SMEs had at least one year of experience), was not a major factor in the reliability, validity, or profile of requirements obtained. However, anchors were especially important in improving the match of less-experienced SMEs with those of the expert panel.

Evaluation of the Ability Requirements Taxonomy and Measurement System

As previously stated, the Ability Requirements Taxonomy and measurement system have been extensively evaluated. These evaluations have addressed three major issues: 1) the system's reliability; 2) the system's internal validity; and 3) the system's external validity. This section summarizes research evaluations in each of these three areas.

Reliability. First, the measurement system's reliability must be established. For each ability, rating scale judges estimate the level of the ability required to perform each task or job. One issue that must be addressed is the reliability with which judges assign ability levels to the tasks or jobs they are rating. A number of different kinds of reliability analyses have been carried out. These include degree of agreement among different raters on the level of a particular ability required for a given job or task. Another type of reliability concerns agreement among raters with respect to the profile of different abilities required for particular jobs or tasks. Another kind of reliability concerns agreement among different kinds of rater groups (e.g., incumbents, supervisors, job analysts). All three types of indices have been utilized to evaluate the reliability of the *F-JAS* scales.

A number of studies demonstrate that job incumbents' ratings of abilities, using the *F-JAS* scales across multiple tasks, typically producing reliability coefficients of .80 and above when 15 or more judges are used. Occupations studied include 15 civil service jobs in San Bernardino County (Hogan, Ogden, & Fleishman, 1978), court security officers (Myers, Jennings, & Fleishman, 1981), assorted Army military jobs (Myers, Gebhardt, Price, & Fleishman, 1981), electric power industry jobs (Cooper, Schemmer, Gebhardt, Marshall-Mies, & Fleishman, 1982), 31 Navy and Marine Corps jobs (Cooper, Schemmer, Fleishman, Yarkin-Levin, Harding, & McNelis, 1987), and managers in research and development companies (Friedman, Fleishman, & Fletcher, 1992). Driskell and Dittmar (1993) report interrater reliabilities of .89 to .97 using 32 incumbent supervisors from different matching occupational specialties when rating job activities on the ability scales.

Hogan, Ogden, and Fleishman (1978) investigated whether raters drawn from different backgrounds would evaluate the abilities required for task performance in a similar manner. The authors generated profiles of average ability ratings across tasks for job incumbents, supervisors, and job analysts. They calculated correlations among profiles obtained from the three groups of SMEs. Correlations of the profiles ranged from the .70s to the .90s when comparing the ability requirement ratings of incumbents, supervisors, and job analysts for the same jobs. Similarly, Romashko, Brumbach, Fleishman, and Hahn (1974) found a median correlation of .67 for incumbents and supervisors on New York City fire, police, and sanitation jobs. Romashko, Hahn and Brumbach (1976) found ability profiles for Philadelphia police from officers, supervisors, and job analysts correlated from .66 to .81. Zedeck (1975) found comparable correlations for ability ratings of telephone company jobs.

Reilly and Zink (1980) investigated whether systematic rating errors, such as halo effect, could account for interrater agreement of *F-JAS* scales. Three telephone company jobs were rated on 26 abilities by incumbents and supervisors. Their findings revealed substantial agreement across these job levels and experience. Additionally, they used Stanley coefficients (Stanley, 1961) to estimate trait independence and halo error. The results revealed a small halo effect, but raters were still able to distinguish reliably among the abilities. Similarly, Fogli (1988) found that ability requirements ratings made by a sample of supermarket clerks did not vary by rater characteristics like gender, age, job tenure, and educational level.

Two studies have investigated rating scale versus binary (yes/no) ratings (Fleishman & Stephenson, 1972; Malamud, Levine & Fleishman, 1980) in use of the ability requirements taxonomy. It was found that the rating scale format was needed to provide reliable quantitative distinctions within and between ability categories.

Internal Validity. The methods used to define the ability categories and to assign tasks to these categories provide the basis for more complex hypotheses related to the ability taxonomy's construct validity. In this section, we will describe evidence pertaining to the classification system's internal validity. This evidence includes both the relationships between categories and among behaviors within a category.

A necessary starting point is the system's comprehensiveness. In a series of panel meetings, Hogan, Ogden and Fleishman (1979) found that 80 percent of the tasks performed by warehouse workers could be assigned to one or more of the ability categories. Similar findings were obtained for Army officers (Mumford, Yarkin-Levin, Korotkin, Wallis, & Marshall-Mies, 1985), FBI special agents (Cooper, Schemmer, Jennings & Korotkin, 1983) and for New York City police officers (Landy, 1988).

More evidence for the ability requirements taxonomy's parsimony is found in the diverse range of jobs where it has successfully been used to describe tasks. As examples, Hogan et al. (1978) studied attorneys, accountants, mechanics, and equipment operators; Cooper et al. (1987) studied military pilots, cryptographers, and maintenance personnel; Mumford et al. (1985) studied military officers at various levels; Fleishman and Friedman (1990) surveyed a range of industrial managers; and Reilly and Zink (1980); and Fleishman, Buffardi, Morath, McCarthy, and Friedman (1993) examined craft and technical jobs. Fleishman (1988) and Fleishman and Mumford (1988) have reviewed in more detail the range of jobs for which the ability requirements scales have been useful in summarizing job tasks.

Internal validity implies that raters should be able to agree on the abilities that best summarize a particular kind of performance. In particular, within narrower performance domains, raters should still agree on the tasks assigned to different abilities. For example, several previous studies have focused on physically demanding jobs like corrections officers (Gebhardt & Weldon, 1982), various Army occupational specialties (Myers, Gebhardt, Price, & Fleishman, 1981), court security officers (Myers, Jennings, & Fleishman, 1981), telecommunications officers (Inn, Schulman, Ogden, & Sample, 1982), and pipeline repair and maintenance crews (Gebhardt, Cooper, Jennings, Crump, & Sample, 1983). Fleishman and Mumford (1988) note that for samples of 20 SMEs in these studies, intraclass agreement coefficients typically exceeded .80 and rarely fell below .70.

Another type of evidence related to a system's internal validity concerns the content and coherence of the tasks assigned to a category. The tasks within a category should offer substantively meaningful statements about the attributes or characteristics that account for their similarity. Fleishman and Mumford (1988, 1991) cite several studies that address the interpretability of task assignments to ability categories. For example, Hogan et al. (1978) identified the abilities needed by workers in several large grocery warehouses. Given the nature of warehouse work, it is not surprising that abilities like static strength (required for lifting, pushing, pulling, or carrying objects) and spatial visualization (necessary for stacking and fitting boxes of varying sizes onto pallets or trucks) received high ratings. Likewise, Cooper et al. (1987) found that Navy and Marine job tasks that required reading technical manuals were all rated highly on written comprehension; while tasks requiring troubleshooting and component alignment were rated highly on information ordering. And, Driskell and Dittman (1993) concluded, with Air Force jobs, that the ability profiles obtained with these scales were consistent with eye witness accounts of job activities.

The internal validity of the ability requirements taxonomy might also be investigated by clustering jobs according to their ability profiles. If the taxonomy produces meaningful inferences about performance requirements, one would expect that jobs making similar demands should cluster together. Fleishman and Hogan (1978) investigated the ability ratings for 15 civil service jobs in a California county. They found that jobs like firefighter and police officer clustered on similar ability profiles, as did accountant and clerk. Jobs like firefighter and social worker, however, displayed predictably discrepant profiles. Such evidence argues for the substantive meaningfulness of the taxonomy's category interrelationships. Most recently, the scales have been useful in clustering jobs in a large government agency with job families of similar ability profiles.

It should be noted that other investigators have also proposed taxonomies containing abilities intended to summarize task performance. These alternative ability classifications are exemplified by Primoff and Eyde (1988), Cunningham, Boese, Neeb, & Pass, (1983), Lopez

(1987), and Drauden (1988). These taxonomies also stress the importance of abilities included in the ability requirements taxonomy, such as memory, hearing, visual acuity, stamina, physical strength, numerical ability, oral expression, and written expression. Because these different worker-oriented classification schemes were built using different assumptions and different methodologies, the convergence in category content adds additional meaningfulness to the ability requirements taxonomy (Fleishman & Mumford, 1991; Cunningham, Powell, Wimpee, Wilson, & Ballentine, 1994). Another system using worker-oriented attributes, the Position Analysis Questionnaire (PAQ) (McCormick, Jeanneret, & Meecham, 1972), includes similar ability categories. In this connection, McCormick (1976) explicitly states that the PAQ drew on Fleishman's earlier ability taxonomy for ability categories.

Two recent studies provide more evidence bearing on this system's internal validity. Friedman, Fleishman, and Fletcher (1992) identified three primary dimensions describing the work activities of 117 research and development managers in nine organizations. These factors, derived from factor analyses of time spent ratings by managers of 244 job tasks, identified three job performance dimensions: strategic planning, project management, and supervising personnel. The amount of time spent by managers on job dimensions varied systematically by job level. Thirty managers later used the *F-JAS* scales (including experimental scales) to rate the degree to which 19 cognitive and interpersonal abilities were required for performing the three dimensions. Strategic planning required significantly higher levels of logical reasoning, fluency of ideas, originality, oral expression, oral defense, and resistance to premature judgment. Personnel supervision necessitated the highest level of social sensitivity. Project management received higher ratings on information ordering, oral fact-finding ability, problem sensitivity, and oral and written comprehension.

Myers, Gebhardt, Crump, and Fleishman (1993) conducted confirmatory and principal axis factor analyses on tests selected to cover a wide range of physical abilities. The results confirmed the six factors (i.e., static strength, explosive strength, dynamic strength, stamina, flexibility, and trunk strength) included in earlier studies of physical abilities (Fleishman, 1964) and showed that the factor structures extended to both men and women. The physical abilities were shown to be relevant to the study of occupational tasks and useful for predicting performance in physically demanding jobs.

External Validity. External validity addresses the issue of how well a classification system can be used to understand, describe, or predict forms of behavior outside the original classification scheme. Attempts to estimate the external validity of a taxonomy are likely to begin with simple generality tests extending the classification to new populations and situations (Fleishman & Mumford, 1991). Sometimes, the concern is to replicate the initial pattern of results and internal relationships in new circumstances; in other cases, known situational moderators or population characteristics will lead to anticipated changes in the system (Cronbach, 1971).

The preceding discussion has presented four types of studies that help demonstrate a taxonomy's generality. First, the ability requirements taxonomy has been found to generate summary descriptions of most tasks on a wide variety of jobs. Second, high interrater agreement has occurred across job settings. Also, the ratings used to assign job tasks to ability categories seem to generalize across rater types. Finally, tasks are assigned to abilities in a coherent, interpretable manner across job settings which differ markedly in performance requirements.

For example, three of the studies cited earlier provide direct evidence for the generality of conclusions derived from Fleishman's ability requirements taxonomy. Zedeck (1975) gathered ratings of the cognitive and physical abilities from repairmen in Sacramento and San Diego. He found substantial cross-site agreement ($r = .68$) in the ability profiles. Similarly, Hogan et al. (1978) profiled the cognitive, physical, and psychomotor abilities for warehouse jobs in three different cities. Mean ratings of the abilities by job incumbents revealed only one statistically significant ($p < .05$) difference, which was readily accounted for by a difference in the task demands at one of the sites. Cooper, Schemmer, Gebhardt, Marshall-Mies and Fleishman (1982) showed similar ability profiles obtained for the same jobs in a national multi-company study. Fleishman and Friedman (1990) collected generality evidence based on managers' ability profiles for three different performance dimensions -- project management, strategic planning, and personnel supervision in 15 research and development organizations. They demonstrated that the ability profiles changed in a meaningful way across managerial level. Two other studies are noteworthy in this regard. Gebhardt and Crump (1983) and Weldon (1983) collected ability requirement ratings on tasks performed by paramedics in two separate cities. Again, a virtually identical set of abilities was defined across locations.

A second category of external validity evidence includes the use of the ability requirements taxonomy to describe performance requirements. Here, ability categories map onto empirically-derived dimensions of task performance. Theologus and Fleishman (1973) had 79 judges rate descriptions of 37 tasks using the ability requirements scales. Additionally, 200 subjects performed the tasks. Ability ratings yielded descriptions of task performance similar to the quantitative analyses of observed performance differences. Hogan and Fleishman (1979) and Hogan, Ogden, Gebhardt, and Fleishman (1980) reported several studies which obtained ability requirement ratings for a number of job and recreational tasks. Additionally, the metabolic requirements of these tasks were independently determined. High positive correlations were found between independent ratings of the tasks' ability requirements and these metabolic requirements (Hogan & Fleishman, 1979; Hogan, Ogden, Gebhardt & Fleishman, 1980). In another study, Hogan, Ogden, Gebhardt and Fleishman (1979) reported a correlation of .88 between foot-pounds of work required by various material handling tasks and the tasks' physical ability requirements ratings. These studies therefore suggest that ability ratings are related to objective performance requirements.

A recent research program (Fleishman, Buffardi, Morath, McCarthy, & Friedman, 1993) utilized the ability requirement scales to describe the tasks in maintenance and operator jobs in the Air Force and in nuclear power plants. The objective was to examine if errors made in these tasks were related to the levels of different abilities required in performing the different tasks of these jobs. The studies showed that ability requirements, as measured by the *F-JAS* scales, were highly related to objective error rates in the Air Force jobs and to independently derived human error probability ratings on nuclear plant tasks. Certain ability requirements were found to be more highly related to error rates than others. Cross-validated multiple correlations of .60 and above were obtained between combinations of ability ratings and the error rate criteria. These studies provide additional evidence of the external validity of the *F-JAS* scales in predicting performance requirements, using error rates as performance criteria.

Landy (1988) indicates that related features of job activities, such as job knowledge requirements, should be related to ability requirements. Landy obtained 646 job knowledge items from a seven-test battery for promotion to fire captain. A group of industrial psychologists subsequently rated each item using the *F-JAS* (Fleishman, 1975a) ability requirements scales.

The abilities were found to "capture" the job knowledges held to summarize task performance.

A third body of external validity evidence involves the use of the ability requirements taxonomy to predict task performance. Theologus and Fleishman (1973) used six ability scales to obtain judges' ratings of 27 laboratory tasks. Additionally, 400 subjects performed the tasks. A multiple correlation of .64 was obtained between ability ratings and task performance. Myers, Gebhardt, Price, and Fleishman (1981) identified the physical abilities necessary to perform various Army tasks. Subsequently, job sample tests were developed to measure these constructs. Performance on the job sample tests correlated with performance on physical ability marker tests on the order of .50. Additionally, Hogan et al. (1978) used a job sample to simulate the order selection and loading operations in a large warehouse. Generic ability tests, selected on the basis of the ability requirements, yielded a multiple R of .45 in predicting performance on the job sample. Gebhardt and Schemmer (1985) found validities in the .80s for generic tests of abilities in the taxonomy against job samples of tasks performed by dock workers.

Thus, a major source of evidence regarding external validity as well as utility is the achievement of job-person matches in validity studies conducted on the basis of this job analysis system. Fleishman (1988) reviews the diverse jobs in the private and public sector where tests developed on the basis of ability profiles, which were derived from the *F-JAS*, have resulted in highly-valid selection tests. Fleishman and Mumford (1988) also summarize a series of studies in which ability requirements data were used to generate hypotheses about the marker tests that would predict performance. They report that measures of the physical abilities related to performance generally demonstrated multiple R's in the .50-.60 range against various indices of job performance.

Another issue related to predictive applications of the ability requirements taxonomy is test transportability. Because the taxonomy was intended to summarize tasks from a wide variety of settings, one might expect ability measures derived from the taxonomy to generalize across job settings requiring the same abilities. Schemmer and Cooper (1986), using craft occupations in the telecommunications industry, identified nine clusters of job families requiring the same abilities drawn from Fleishman's (1975b) taxonomy. An analysis of test transportability found that the same ability measures were likely to predict job performance across jobs within a cluster. Likewise, when there was a shift in task demands, different tests predicted performance in different job clusters.

Another recent study (Hauke, Costanza, Baughman, Mumford, Stone, Threlfal, & Fleishman, 1995) examined the utility of the *F-JAS* scales in the clustering of approximately 150 jobs in a large government agency into *job families*, based on the commonality of their ability and knowledge requirements. The results showed that a small number of job families could be developed using the clusters derived from the ability/knowledge profiles provided by incumbents who rated the level of abilities and knowledges required by their jobs using the *F-JAS*. These clusters formed the basis of a test validation project, relating test scores to employee performance in the core jobs within each job family.

In addition to the job analysis area, the ability requirements classification system has proven useful in organizing performance data in other areas of the human performance literature. For example, Levine, Romashko, and Fleishman (1973) applied the ability scales to vigilance tasks, involving the monitoring and detection of infrequent signals over time. They found that the diverse monitoring tasks in the literature could be divided into two major areas: those where the ability "flexibility of closure" was the major ability requirement, and those where "perceptual speed" was the major ability requirement. Additionally, the effect of such factors as type of stimulus signal and signal rate on signal detection depended on the primary ability underlying task performance.

These findings were later extended to the literature on drug and alcohol effects on performance. Levine, Kramer, and Levine (1975) found that tasks in these studies can be organized into those requiring the abilities of selective attention, control precision, or perceptual speed. In accordance with the inference that complex cognitive functions would be most affected by alcohol, it was found that selective attention and perceptual speed tasks exhibited more pronounced performance decrements than control precision tasks. Likewise, several studies have shown how the effect of particular drug dosage on task performance, including the time to reach the effect, the overall magnitude of the effect, and the time to recover, all were functions of the task's primary ability category (Elkin, Fleishman, Van Cott, Horowitz, & Freedle, 1965; Fleishman, 1975b; Fleishman, Elkin, & Baker, 1983; Baker, Geist, & Fleishman, 1967).

Another series of studies investigated how the patterns of required abilities for a task changed when variations of task characteristics were introduced. For example, Fleishman (1957) examined choice reaction performance under different conditions of display-control compatibility. He found that successive rotations of the display shifted the task's ability requirements from perceptual speed to spatial orientation to spatial visualization. Similar findings involving auditory perceptual tasks (Wheaton, Eisner, Mirabella, & Fleishman, 1976) and cognitive tasks such as concept formation and trouble shooting (Rose, Fingerman, Wheaton, Eisner, & Kramer, 1974; Fingerman, Eisner, Rose, Wheaton, & Cohen, 1975) have been reported. These studies show that variations in task characteristics do make a difference in the particular combinations of abilities required for effective performance, especially when one has control of the quality of the performance measures. Taken together these studies provide strong evidence for the construct validity of the ability requirements used as a basis for the job analysis measurement system.

The research of Bayer (1992), cited earlier, bears on the external validity of the *F-JAS* ability requirements rating methodology. For example, she found high multiple correlations between profiles based on ratings of individual job tasks with independently derived profiles based on total job ratings. A second source of external validity evidence was the high correlations between ability profiles obtained from job incumbents and those derived from ratings obtained from an ability "criterion panel" of experts.

A current feature of the system is the availability of a publication which links the ability definitions to representative examples of tasks and jobs requiring these abilities as well as to tests for assessing these abilities (Fleishman & Reilly, 1992).

Adaptation of the Ability Requirement Scales for the O*NET

Having described the developmental background and research support for the ability requirements taxonomy and measurement system, we now turn to some more recent developments. These developments were undertaken to further ensure the utility of the *F-JAS* measurement approach for large-scale administration, where less time may be available for completing the survey and where reading levels of job incumbents are of particular concern. Consequently, some ability definitions were revised to further reduce readability requirements. Additionally, a number of the task examples used to anchor the rating scales were revised to

32. Static Strength

The ability to exert maximum muscle force to lift, push, pull, or carry objects.

Level

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

Requires use of all the muscle force possible to lift, carry, push, or pull a very heavy object.	7	
		Lift 75-pound bags of cement onto a truck.
	6	
	5	
	4	
		Pull a 40-pound sack of fertilizer across the lawn.
	3	
	2	
		Push an empty shopping cart.
Requires use of a little muscle force to lift, carry, push, or pull a light object.	1	

NR Not relevant at all for performance on this job.

Importance

How important is this ability to performance on this job?

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

Figure 10-2

Example of Current Version of the Static Strength Ability Rating Scale include more occupationally-oriented tasks as well as tasks more likely to be familiar to raters regardless of their job.

New anchors were also developed to replace anchors that may possibly appear offensive or sensitive to certain cultural groups, as well as for those that may appear to require specialized experiences or knowledge. These revisions included replacing proper names, which may be unfamiliar to certain cultural groups or to incumbents with less education. It is important to note that these new anchors were empirically rescaled, and placed on each scale in accordance with their empirically-determined positions (from low to high levels of each ability requirement).

Attention was given to the few instances in the taxonomy where ability levels may not be in the vocabulary of lay persons. Thus, we attempted to coin alternatives for terms like "flexibility of closure." It was found that alternatives tried were misleading or no improvement (e.g., "pattern recognition" or "pattern completion" for "flexibility of closure" are misleading substitutes). The conclusion was that the definitions provided were clear enough and that it was unwise and misleading to use labels that provide the respondents with the wrong "set." There are many terms used by workers (e.g., "agility") which have no construct validity and no basis in research. An objective is to have the respondent go beyond the label and actually read the definition provided without assuming too much from a familiar label.

Finally, the original *F-JAS* (Fleishman, 1992b) ability scales were edited. The new format drops the tables which show how a particular ability is different from other abilities with which it might be confused. These tables were removed from the current scales to further reduce the reading time and reading level required to complete this section of the ratings. Despite these modifications, the essential characteristics of the scales were retained. These characteristics include: 1) the operational definitions of each ability; 2) clarifying definitions of high and low levels of each ability; and 3) generally recognizable task anchor examples located at different points on each scale using their empirically-derived positions. Appendix 10-A provides the task anchor examples used in the current version of each scale and the scale values obtained for each task anchor. Figure 10-2 provides an example of a current version of an ability rating scale for the ability static strength.

In accomplishing these adaptations of the *F-JAS* system, the comments of OAFC personnel during an initial pilot study with job incumbents were particularly helpful, as were preliminary data received from this administration. Comments from various user groups and from the Technical Review Committee were also helpful in adapting the materials. Particularly encouraging were the analyses of preliminary data from early field try-outs showing that the ability scales used had high interrater reliabilities (in the .70s), despite the small samples of incumbent raters. Use of more raters in operational administrations, as has been amply demonstrated, should raise these reliabilities into the .80 - .90 range. The additional adaptations made to these scales should also raise reliability levels.

It is important to note that the procedures used to adapt the *F-JAS* scales were consistent with the scaling methodology and the methods for deriving scale anchors originally developed by Fleishman and his associates (see e.g., Theologus, Romashko, & Fleishman 1973; Fleishman 1975b; Fleishman and Quaintance, 1984. Thus, the body of literature documenting the reliability and validity of this system remains applicable to the revised *F-JAS* ability requirements taxonomy and measurement system.

Conclusions

This chapter has reviewed the rationale and the empirical foundations of Fleishman's ability requirements taxonomy and its associated measurement system. A considerable body of empirical evidence supports the reliability, validity, and efficacy of these measurement scales. The Advisory Panel for the Dictionary of Occupational Titles (APDOT) has suggested that the revised *DOT* should play an integral rôle in the skills development of both the current and future labor force. To achieve this goal, the O*NET must contain complete information on the worker knowledges, skills, and abilities required by the domain of jobs.

As one component of the content model which is development of the O*NET, the ability taxonomy presented in this chapter provides a set of descriptors that organizes information about jobs in a way consistent with worker requirements. These constructs effectively link job task characteristics with the abilities required for effective job performance. Furthermore, studies of the taxonomy's <u>comprehensiveness</u> indicate the high proportion of job tasks captured by the taxonomy; this often exceeds 80%. The <u>parsimony</u> of the taxonomy is supported by the wide variety of jobs in which the same ability categories have proven useful in summarizing job tasks.

Considerable evidence supports the validity and utility of the requirements taxonomy and measurement system. This system has applications for:

- improving the job/person match in a wide variety of jobs
- identifying valid personnel selection procedures, assigning people to training
- developing job families
- setting performance standards
- linking job requirements to disability and medical standards
- developing databases of jobs and job tasks classified according to common ability requirements.

The *F-JAS* measurement system has been shown to be feasible for collecting job analysis information as a survey on a nationwide basis (see, e.g., Landy, 1992, and Cooper et al., 1982). The available evidence confirms the feasibility of administering the scales to describe and group jobs by asking incumbents to describe the ability requirements of their jobs at the job level, which is much more time efficient than collecting and describing jobs at the task level. It has also been shown that these scales can be utilized with high reliability and validity by job incumbents in a wide range of jobs, including these incumbents who are in jobs requiring lower levels of reading and cognitive capabilities. Additionally, the measurement system is convenient and "user friendly" in terms of format, accessibility, reading level, and time and effort demands. Consequently, this ability taxonomy should make a substantial contribution to the new O*NET.

References

Ackerman, P.L. (1988). Determinants of individual differences during skill acquisition: Cognitive abilities and information processing. *Journal of Experimental Psychology: General*, 117, 288-318.

Baker, W.J., Geist, A.M., & Fleishman, E.A. (1967). *Effects of cylert (magnesium-pemoline) on physiological, physical proficiency, and psychomotor performance measures.* Washington, DC : American Institutes for Research.

Bayer, A.H. (1992). F*actors affecting human judgments regarding the ability requirements of jobs.* Unpublished doctoral dissertation. Fairfax, VA: George Mason University, Department of Psychology.

Bilodeau, E. (Ed.) (1966). *Acquisition of skill.* New York: Academic Press.

Boyatzis, R.E. (1982). *The competent manager: A model for effective performance.* New York: Wiley-Interscience.

Carroll, J.B. (1976). Psychomotor tests as cognitive tasks: A new "structure of intellect". In L. Resnick (Ed.) , *The nature of intelligence* (pp. 27-56). Hillsdale, NJ: Lawrence Erlbaum.

Carroll, J.B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York: Cambridge University Press.

Cattell, R. B. (1971). *Abilities: Their structure, growth, and action.* Both: Houghton Mifflin. [Revised edition: Amsterdam: North-Holland, 1987.]

Cooper, M., Schemmer, F.M., Gebhardt, D.L., Marshall-Mies, J., & Fl :shman, E.A. (1982). *Development and validation of physical ability tests for jobs in the electric power industry* (ARRO Final Report #3056). Bethesda, MD: Advanced Research Resources Organization.

Cooper, M.A., Schemmer, F.M., Jennings, M., & Korotkin, AL. (1983). *Developing selection standards for Federal Bureau of Investigation special agents*. Bethesda, MD: Advanced Research Resources Organization.

Cooper, M.A., Schemmer, F.M., Fleishman, E.A., Yarkin-Levin, K., Harding, F.D., & McNelis, J. (1987). *Task analysis of Navy and Marine Corps occupations: Taxonomic basis for evaluating CW antidote/pretreatment drugs* (Tech. Rep. 3130. Bethesda, MD: Advanced Research Resources Organization.

Corts, D.B., & Gowing, M.K. (1992). *Dimensions of effective behavior: Executives, managers, and supervisors*. Washington, DC: U.S. Office of Personnel Management.

Cronbach, L.J. (1971). Test validation. In R. L. Thorndike (Ed.), *Educational measurement* (pp .443-507). Washington, DC : American Council on Education.

Cunningham, J.W., Boese, R.R., Neeb, R.W., & Pass, J.J. (1983). Systematically derived work dimensions: Factor analyses of the Occupation Analysis Inventory. *Journal of Applied Psychology, 68*, 232-252.

Cunningham, J.W., Powell, T.E., Wimpee, W.E., Wilson, M.A., & Ballentine, R.D. (1994). Ability requirement factors for general job elements. *Unpublished manuscript*. Raleigh, NC: North Carolina State University.

Drauden, G.M. (1988). Task inventory analysis in industry and the public sector. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 1051-1071). New York: Wiley.

Driskell, W.E., & Dittmar, M.J. (1993). *Methodology for identifying abilities for job classification*. Brooks Air Force Base, Texas: Armstrong Laboratory, Air Force Systems Command.

Ekstrom, R.B., French, J.W., & Harmon, H.H., with D. Dirmen (1976). *Manual for kit of factor- referenced cognitive tests*, 1976. Princeton, NJ: Educational Testing Service.

Elkin, E.H., Fleishman, E.A., Van Cott, H.P., Horowitz, H., & Freedle, R.O. (1965). *Effects of drugs on human performance: Research concepts, test development, and preliminary studies* (Report AIR-E-25-10/65-AR-1). Washington, DC: American Institutes for Research.

Fingerman, P.W., Eisner, E., Rose, A.M., Wheaton, G.W., & Cohen, F. (1975). *Methods for predicting job-ability requirements: III. Ability requirements as a function of changes in the characteristics of a concept identification task.* Washington, DC: American Institutes for Research.

Fleishman, E.A. (1953). Testing for psychomotor abilities by means of apparatus tests. *Psychological Bulletin*, 50, 241-262.

Fleishman, E.A. (1954). Dimensional analysis of psychomotor abilities. *Journal of Educational Psychology*, 48, 437-454.

Fleishman, E.A. (1956a). Psychomotor selection tests: Research and application in the United States Air Force. *Personnel Psychology*, 9, 449-467.

Fleishman, E.A. (1956b). Factorial analysis of complex psychomotor performance and related skills. *Journal of Applied Psychology*, 40, 96-104.

Fleishman, E.A. (1957). A comparative study of aptitude patterns in unskilled and skilled psychomotor performances. *Journal of Applied Psychology*, 40, 96-104.

Fleishman, E.A. (1958). Dimensional analysis of movement reactions. *Journal of Experimental Psychology*, 55, 438-453.

Fleishman, E.A. (1964). *The structure and measurement of physical fitness*. Englewood Cliffs, NJ: Prentice Hall.

Fleishman, E.A. (1966). Human abilities and the acquisition of skill. In E.A. Bilodeau (Ed.), *Acquisition of skill.* New York: Academic Press.

Fleishman, E.A. (1967a). Individual differences and motor learning. In R.M. Gagne (Ed.), *Learning and individual differences* (pp. 165-191). Columbus, OH: Charles Merrill.

Fleishman, E.A. (1967b). Development of a behavior taxonomy for describing human tasks: A correlational-experimental approach. *Journal of Applied Psychology*, 51, 1-10.

Fleishman, E.A. (1972a). On the relation between abilities, learning, and human performance. *American Psychologist*, 27, 1017-1032.

Fleishman, E.A. (1972b). Structure and measurement of psychomotor abilities. In R.N. Singer (Ed.), *The psychomotor domain*. Philadelphia, PA: Lea & Febinger.

Fleishman, E.A. (1975a). *Manual for the Ability Requirement Scales (MARS)*. Bethesda, MD: Management Research Institute.

Fleishman, E.A. (1975b). Toward a taxonomy of human performance. *American Psychologist*, 30, 1127-1149.

Fleishman, E.A. (1975c). *Physical abilities analysis manual.* Bethesda, MD: Management Research Institute.

Fleishman, E.A. (1979). Evaluating physical abilities required by jobs. *Personnel Administrator*, 21(6), 82-90.

Fleishman E.A. (1982). Systems for describing human tasks. *American Psychologist*, 37, 821-834.

Fleishman, E.A. (1988). Some new frontiers in personnel selection research. *Personnel Psychology, 41*, 679-701.

Fleishman, E.A. (1991). *The role of testing in Department of Labor/ETA training and emplcyment programs* (Final Rep., U.S. Department of Labor). Bethesda, MD: Management Research Institute.

Fleishman E.A. (1992). *Fleishman-Job Analysis Survey (F-JAS).* Palo Alto, CA: Consulting Psychologists Press.

Fleishman, E.A., Buffardi, L.C., Morath, R., McCarthy, P., & Friedman, L. (1993). *Development of a model to predict human error rates from ratings of task ability requirements* (Tech. Rep. CBCS 93-2, U.S. Nuclear Regulatory Commission). Fairfax, VA: George Mason University, Center for Behavioral and Cognitive Studies.

Fleishman, E.A., Eisner, Rose, Wheaton, & Cohen (1975)

Fleishman, E.A., Elkin, E.H., & Baker, W.J. (1983). *Effects of drugs on human performance: The effects of scopolomine on representative tests of human performance.* Bethesda, MD: Advanced Research Resources Organization.

Fleishman, E.A., & Ellison, G.D. (1962). A factor analysis of fine manipulative tests. *Journal of Applied Psychology*, 46, 96-105.

Fleishman, E.A., & Friedman, L. (1990). *Cognitive competencies related to management performance requirements in R&D organizations* (Tech. Rep.). Fairfax, VA: Center for Behavioral and Cognitive Studies, George Mason University.

Fleishman, E.A., & Hogan, J.C. (1978). *Taxonomic method for assessing the physical requirements of jobs: The physical abilities analysis approach* (Tech. Rep. 3012/R78-6) Bethesda, MD: Advanced Research Resources Organization.

Fleishman, E.A., & Mumford, M.D. (1988). Ability requirement scales. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government.* New York, NY: Wiley.

Fleishman, E.A., & Mumford, M.D. (1991). Evaluating classifications of job behavior: A construct validation of the ability requirement scales. *Personnel Psychology, 44 (3),* 523-575.

Fleishman, E.A., & Quaintance, M. (1984). *Taxonomies of human performance: The description of human tasks.* Orlando, FL: Academic Press.

Fleishman, E.A., & Reilly, M.E. (1992a). *Administrator's guide for the Fleishman-Job Analysis Survey (F-JAS).* Palo Alto, CA: Consulting Psychologists Press.

Fleishman E.A., & Reilly, M.E. (1992b). *Handbook of human abilities: Definitions, measurements, and job task requirements.* Palo Alto, CA: Consulting Psychologists Press.

Fleishman E.A., & Stephenson R.W. (1972). Development of a taxonomy of human performance: A review of the third year's progress. *JSAS Catalog of Selected Documents in Psychology, 2,* 39-40 (Ms. No. 112).

Fogli, L. (1988). Supermarket cashier. In Gael S (Ed.), *The job analysis handbook for business, government, and industry* (pp. 1215-1228). New York: Wiley.

Friedman, L., Fleishman, E.A., & Fletcher, J. (1992). Cognitive and interpersonal abilities related to the primary activities of R&D managers. *Journal of Engineering and Technology Management,* 9, 211-242.

French, J.W. (1951). The description of aptitude and achievement tests in terms of rotated factors. *Psychometric Monographs, No. 5.*

French, J.W., Ekstrom, R.B., & Price, R.. (1963). *Kit of reference tests for cognitive factors.* Princeton, NJ: Educational Testing Service.

Gebhardt, D.L., & Crump, C.E. (1983). *Development of physical performance selection tests for paramedics in the city of Los Angeles* (Tech. Rep.). Bethesda, MD: Advanced Research Resources Organization.

Gebhardt, D.L., & Schemmer, F.M. (1985). *Development and validation of selection tests for longshoremen and marine clerks* (ARRO Project #3113). Bethesda, MD: Advanced Research Resources Organization.

Gebhardt, D.L., & Weldon L.J. (1982). *Development and validation of physical performance tests for correctional officers* (Final Report 3080). Bethesda, MD: Advanced Research Resources Organization.

Gebhardt, D.L., Cooper, M.A., Jennings, M.C., Crump, C., & Sample, R.A. (1983). *Development and validation of selection tests for a natural gas company* (Final Report 30789). Bethesda, MD: Advanced Research Resources Organization.

Guilford, J.P. (1947). *Printed classification tests.* U.S. Army Air Force Psychology Research Program (Report #5). Washington, DC: U.S. Government Printing Office.

Guilford, J.P. (1967). *The nature of human intelligence.* New York: McGraw-Hill.

Guilford, J.P. (1985). The structure-of-intellect model. In B.B. Wolman (Ed.), *Handbook of intelligence: Theories, measurements, and applications* (pp. 225-266). New York: Wiley.

Guilford, J.P., & Hoepfner, R. (1971). *The analysis of intelligence.* New York: McGraw-Hill.

Gustafsson, J.E. (1988). Hierarchical models of individual differences in cognitive abilities. In R. J. Sternberg (Ed.), *Advances in the psychology of human intelligence*, Vol. 4 (pp. 35-71). Hillsdale, NJ: Erlbaum.

Hackman, J.R. (1968). Tasks and task performance in research on stress. In J.E. McGrath (Ed.), *Social and psychological factors in stress.* New York: Holt, Rinehart, & Winston.

Harmon, H.H. (1975). *Final report of research on assessing human abilities.* (PR-75-20). Princeton, NJ: Educational Testing Service..

Hauke, M., Costanza, D.P., Baughman, W., Mumford, M.D., Stone, L., Threlfal, K.V., & Fleishman, E.A. (1995). *Developing job families on the basis of ability and knowledge requirement profiles.* Bethesda, MD: Management Research Institute, Inc.

Hempel, W.E., Jr., & Fleishman, E.A. (1955). A factor analysis of physical proficiency and manipulative skills. *Journal of Applied Psychology*, 39, 12-16.

Hogan, J.C. (1991). Structure of physical performance in occupational tasks. *Journal of Applied Psychology*, 76, 495-507.

Hogan, J.C., & Fleishman, E.A. (1979). An index of the physical effort required in human task performance. *Journal of Applied Psychology, 64,* 197-204.

Hogan, J,C., Ogden, G.D., & Fleishman, E.A. (1978). *Assessing the physical requirements in selected benchmark jobs* (Final Report 3012). Bethesda, MD: Advanced Research Resources Organization.

Hogan, J.C., Ogden, G.D., & Fleishman, E.A. (1978). *Assessing physical requirements for establishing medical standards in selected benchmark jobs* (Technical Report R78-8). Bethesda, MD: Advanced Research Resources Organization.

Hogan, J.C.., Ogden, G.D., & Fleishman, E.A. (1979). *The development and validation of tests for the order selector job at Certified Grocers of California, Ltd.* Bethesda, MD: Advanced Research Resources Organization.

Hogan, J.C., Ogden, G.D., Gebhardt, D.L., & Fleishman, E.A. (1979). An index of physical effort required in human task performance. *Journal of Applied Psychology*, 65, 672-679.

Holzinger, K. J., & Swineford, F. (1939). A study in factor analysis: The stability of a bi-factor solution. *Supplementary Education Monographs*, No. 48. Chicago: Department of Education, University of Chicago.

Horn, J.L. (1976). Human abilities: A review of research and theories in the early 1970's. In M.R. Rosenzweig & L.W. Porter (Eds.), *Annual review of psychology (v. 27)*. Palo Alto, CA: Annual Review.

Horn, J.L. (1988). Thinking about human abilities. In J.R. Nesselroade, & R.B. Cattell (Eds.), *Handbook of multivariate experimental psychology*, Second edition (pp. 645-685). New York, NY: Plenum.

Inn, A., Schulman, D.R., Ogden, G.D., & Sample, R.A. (1982). *Physical ability requirements of Bell System jobs* (Final Report 3057/R82-1). Bethesda, MD: Advanced Research Resources Organization.

Landy, F.J. (1988). Selection procedure development and usage. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 271-287). New York: Wiley.

Landy, F.J. (1992). *Alternatives to chronological age in determining standards of suitability for public safety jobs.* (Vols. 1 & 2) (Tech. Rep.). State College, PA: The Pennsylvania State University, Center for Applied Behavioral Sciences.

Levine, J.M., Kramer, G.G., & Levine, E.N. (1975). Effects of alcohol on human performance: an integration of research findings based on an abilities classification. *Journal of Applied Psychology, 60*, 285-293.

Levine, J.M., Romashko, T., & Fleishman, E.A. (1973). Evaluations of an abilities classification system for integrating and generalizing findings about human performance: The vigilance area. *Journal of Applied Psychology, 58,* 147-149.

Lopez, F.M. (1987). Threshold traits analysis. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 880-901). New York: Wiley.

Malamud, S.M., Levine, J.M., & Fleishman, E.A., (1980). Identifying ability requirements by decision flow diagrams. *Human Factors,* 22, 57-68.

McClelland, D.C. (1973). Testing for competence rather than intelligence. *American Psychologist, 28,* 1-14.

McCormick, E.J. (1976). Job and task analysis. In M. D. Dunnette (Ed.), *Handbook of industrial and organizational psychology* (pp. 651-696). Chicago, IL: Rand-McNally.

McCormick, E.J., Jeanneret, P.R., & Mecham, R. C. (1972). A study of job characteristics and job dimensions as based on the Position Analysis Questionnaire (PAQ). *Journal of Applied Psychology, 56,* 347-368.

Miller, R.B. (1967). Task taxonomy: Science or technology? In W.T. Singleton, R.S. Easterly, & D.C. Whitfield (Eds.), *The human operator in complex systems.* London: Taylor de Frances.

Mumford, M.D., Yarkin-Levin, K., Korotkin, A.C., Wallis, M.R., & Marshall-Mies, J. (1985). *Characteristics relevant to performance as an Army leader: Knowledges, skills, abilities, other characteristics, and generic skills* (Tech. Rep.). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Myers, D.C., Gebhardt, D.L., Crump, C.E., & Fleishman, E.A. (1993). The dimensions of human physical performance: Factor analyses of strength, stamina, flexibility, and body composition measures. *Human Performance, 6,* 309-344.

Myers, D.C., Gebhardt, D.L., & Fleishman, E.A. (1979). *Development of physical performance standards for Army jobs* (ARRO Final Report 3045/R79-10). Washington, DC: Advanced Research Resources Organization.

Myers, D.C., Gebhardt, D.L., Price, S.J., & Fleishman, E.A. (1981). *Development of physical performance standards for Army jobs: Validation of the physical abilities analysis methodology* (ARRO Final Report 3045/R81-2). Washington, DC: Advanced Research Resources Organization.

Myers, D.C., Jennings, M.C., & Fleishman, E.A. (1981). *Development of job-related medical standards and physical tests for court security officer jobs* (Final Report 3062). Bethesda, MD: Advanced Research Resources Organization.

Nicks, D.C., & Fleishman, E.A. (1962). What do physical tests measure? A review of factor analytic studies. *Educational and Psychological Measurement*, 22, 77-96.

Parker, J.R., & Fleishman, E.A. (1960). Ability factors and component performance measures as predictors of complex tracking behavior. *Psychological Monographs*, 74 (No. 503).

Peterson, N.G. (1992). *Methodology for identifying SCANS competencies and foundation skills.* Washington, DC: American Institutes for Research.

Peterson, N. G., & Bownas, D. A. (1982). Skill, task structure, and performance acquisition. In M. D. Dunnette & E. A. Fleishman (Eds.), *Human performance and productivity: Human capability assessment.* Hillsdale, NJ: Lawrence Erlbaum.

Primoff, E.S., & Eyde, S.D. (1988). Job element analysis. In S. Gael (Ed.), *The job analysis handbook for business, government, and industry* (pp. 807-824). New York: Wiley.

Reilly, R.R., & Zink, D.L. (1980). *Analysis of three outside craft jobs* (AT&T Research Report). New York: American Telephone and Telegraph Co.

Romashko, T., Brumbach, G.B., Fleishman, E.A., & Hahn, C.P. (1974). *Development of a procedure to validate physical tests* (Tech. Rep.). Washington, DC: American Institutes for Research.

Romashko, T., Hahn, C.P., & Brumbach, G.B. (1976). *The prototype development of job-related physical testing for Philadelphia policeman selection* (Tech. Rep.). Washington, DC: American Institutes for Research.

Rose, A., Fingerman, P., Wheaton, G., Eisner, E., & Kramer, G. (1974). *Methods for predicting job ability requirements. II: Ability requirements as a function of changes in the characteristics of an electronic fault-finding task.* Washington, DC: American Institutes for Research.

Secretary's Commission on Achieving Necessary Skills (SCANS) (1992). *Skills and tasks for jobs: A SCANS report for America 2000.* Washington, DC: U.S. Department of Labor.

Schemmer, F.M., & Cooper, M.A (1986). *Test transportability study for technician jobs in the telephone industry.* Bethesda, MD: Advanced Research Resources Organization.

Snow, R.E., & Lohman, D.F. (1984). Toward a theory of cognitive aptitude for learning and instruction. *Journal of Educational Psychology, 76,* 347-376.

Spearman, C. (1923). *The abilities of man: Their nature and measurement.* New York: Macmillan. [Reprinted: New York: AMS Publishers, 1981]

Spencer, L.M., McClelland, D.C., & Spencer, S. (1994). *Competency assessment methods: History and state of the art.* Boston: Hay McBer Research Press.

Stanley, J.C. (1961). Analysis of unreplicated three-way classifications, with applications to rater bias and trait independence. *Psychometrika, 26,* 205-219.

Theologus, G.C., & Fleishman, E.A. (1973). Development of a taxonomy of human performance: Validation study for ability scales for classifying human tasks. *JSAS Catalog of Selected Documents in Psychology*, 3, 29 (Ms. No. 326).

Theologus, G.C., Romashko, T., & Fleishman, E.A. (1973). Development of a taxonomy of human performance: Validation study of ability scales for classifying human tasks: *JSAS Catalog of Selected Documents in Psychology*, 3, 25-26 (Ms. No. 321).

Thurstone, L.L. (1947). *Multiple factor analysis: A development and expansion of* The Vectors of Mind. Chicago, IL: University Chicago Press.

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington DC: Author.

Vernon, P.E.,(1961). *The structure of human abilities*. London: Methuen. [2nd edition, 1961]

Weldon, L. (1983). *Recommendations for physical ability testing and medical guidelines for the city of Pittsburgh* (Final Report 3075). Bethesda, MD: Advanced Research Resources Organization.

Wheaton, G.R. (1973). Development of a taxonomy of human performance. *JSAS Catalog of Selected Documents in Psychology, 3*, 22-23 (Ms. No. 317).

Wheaton, G.R.., Eisner, E., Mirabella, A., & Fleishman, E.A. (1976). Ability requirements as a function of changes in the characteristics of an auditory signal identification task. *Journal of Applied Psychology*, 61, 663-676.

Zedeck, S. (1975). *Validation of physical abilities tests for AT&T craft positions: Program report with special emphasis on detailed job analyses* (Tech. Rep. 5). New York: American Telephone and Telegraph Co.

Appendix 10-A

*Scale Values of Tasks Representing Different Levels on Each Ability Requirement Scale**

Selected ability-task items		Scale Value
1.	Oral Comprehension	
	Understand a lecture on advanced physics.	5.5
	Understand a coach's oral instructions for a sport.	3.8
	Understand a television commercial.	1.8
2.	Written Comprehension	
	Understand an instruction book on repairing a missile guidance system.	6.4
	Understand an apartment lease.	4.2
	Understand signs on the highway.	1.7
3.	Oral Expression	
	Explain advanced principles of genetics to college freshmen.	6.4
	Give directions to a lost motorist.	3.8
	Cancel newspaper delivery by phone.	1.8
4.	Written Expression	
	Write an advanced economics textbook.	6.5
	Write a job recommendation for a subordinate.	3.8
	Write a note to remind someone to take something out of the freezer to thaw.	1.2
5.	Fluency of Ideas	
	Name all the possible strategies for a particular military battle.	5.8
	Think of as many ideas as possible for the name of a new research firm.	3.6
	Name four different uses for a screwdriver.	1.5
6.	Originality	
	Invent a new type of a man-made fiber.	6.5
	Redesign job tasks to be more interesting for employees.	4.5
	Use a credit card to open a locked door.	1.9
7.	Memorization	
	Recite the Gettysburg Address after studying it for 15 minutes.	5.9
	Recite the first names of the five people you just met.	4.0
	Remember the number on your bus to be sure you get back on the right one.	1.2
8.	Problem Sensitivity	
	Recognize an illness at an early stage of a disease when there are only a few symptoms.	5.6
	Recognize from the mood of prisoners that a prison riot is likely to occur.	3.9
	Recognize that an unplugged lamp won't work.	1.3

Appendix 10-A (continued)
*Scale Values of Tasks Representing Different Levels on Each Ability Requirement Scale**

9. Mathematical Reasoning

Determine mathematics to simulate a space craft landing on the moon.	5.8
Decide how to calculate profits to determine the size of Christmas bonuses.	4.2
Decide how much 10 oranges will cost when they are priced at 2 for 29 cents.	1.4

10. Number Facility

Manually calculate the flight path of an aircraft, taking into account speed, fuel, wind, and altitude.	6.5
Compute the interest payment that should be generated from an investment.	4.6
Balance a checkbook.	2.9
Add 2 and 7.	1.2

11. Deductive Reasoning

Design an aircraft wing using the principles of aerodynamics.	6.2
Decide what factors to consider in selecting stocks.	4.9
Know that, due to the law of gravity, a stalled car can coast down the hill.	1.6

12. Inductive Reasoning

Diagnose a disease using the results of many different lab tests.	6.0
Determine the prime suspect based on evidence gathered at a crime scene.	4.5
Determine clothing to wear based on the weather report.	1.5

13. Information Ordering

Assemble a nuclear warhead.	6.2
Mix chemicals according to a specific sequence so they do not become toxic.	4.8
Follow the correct steps to change a tire.	2.4
Put things in numerical order.	1.3

14. Category Flexibility

Classify man-made fibers in terms of their strength, cost, flexibility, melting points, etc.	5.9
Classify flowers according to size, color, smell and uses.	3.4
Sort nails in a toolbox on the basis of length.	1.7

15. Speed of Closure

Interpret the patterns on the weather radarscope to decide if the weather is changing.	5.1
Make sense out of strange handwriting.	4.0
Recognize a song after hearing only the first few notes.	2.6

Appendix 10-A (continued)
*Scale Values of Tasks Representing Different Levels on Each Ability Requirement Scale**

16.	Flexibility of Closure	
	Identify camouflaged tanks while flying in a high speed airplane.	6.0
	Look for a golf ball in the rough.	4.1
	Tune in a radio weather station in a noisy truck.	2.0
17.	Spatial Orientation	
	Navigate an ocean voyage using only the position of the sun and the stars.	6.5
	Find your way through a familiar room when the lights are out without bumping into anything.	3.4
	Use the floor plan to locate a store in a shopping mall.	2.0
18.	Visualization	
	Anticipate opponent's as well as your own future moves in a chess game.	5.8
	Follow a diagram to assemble a metal storage cabinet.	4.0
	Imagine how to put paper in the typewriter so the letterhead comes out at the top.	1.5
19.	Perceptual Speed	
	Inspect electrical parts for defects as they flow by on a fast-moving assembly line.	5.3
	Read five temperature gauges in 10 seconds to make sure each temperature is within safe limits.	4.0
	Sort mail according to zip codes.	2.5
20.	Selective Attention	
	Study a technical manual in a noisy boiler room.	6.0
	Monitor security TV screens for intruders throughout the night shift.	4.0
	Answer a business call with coworkers talking nearby.	1.8
21.	Time Sharing	
	Monitor radar and radio transmissions to keep track of aircraft during periods of heavy traffic.	6.2
	Watch the actions of several team members while coaching a player on on the sidelines.	4.8
	Watch street signs while driving at 30 miles per hour.	3.3
	Listen to music while filing papers.	1.8
22.	Control Precision	
	Drill a tooth.	6.0
	Adjust farm tractor controls.	3.8
	Adjust a room light with a dimmer switch.	1.5

Appendix 10-A (continued)

*Scale Values of Tasks Representing Different Levels on Each Ability Requirement Scale**

23. Multilimb Coordination

Play the drum set in a jazz band.	5.8
Operate a forklift truck in a warehouse.	4.1
Row a boat.	2.5

24. Response Orientation

In a spacecraft which is out of control, react quickly to each malfunction with the correct control movements.	6.7
Hit either the automobile brake or gas pedal in a skid situation.	5.0
When the doorbell and telephone ring at the same time, quickly select which to answer first.	2.0

25. Rate Control

Operate aircraft controls used to land a jet on an aircraft carrier in rough weather.	6.5
Shoot a duck in flight.	4.8
Keep up with a car you are following when the speed of that car changes.	3.6
Ride a bicycle alongside a jogger.	2.4

26. Reaction Time

Hit the brake when a pedestrian steps in front of the car.	6.0
Throw a switch when a red warning light goes on.	4.0
Start to slow down the car when a traffic light turns yellow.	2.1

27. Arm-Hand Steadiness

Cut facets in diamonds.	6.3
Thread a needle.	4.1
Light a candle.	1.5

28. Manual Dexterity

Use surgical instruments to perform open-heart surgery.	6.9
Package oranges in crates as quickly as possible.	4.1
Screw a light bulb into a lamp socket.	1.2

29. Finger Dexterity

Quickly put together the inner workings of a small wrist watch.	6.5
Attach small knobs to stereo equipment on an assembly line.	4.2
Put coins in a parking meter.	1.5

30. Wrist-Finger Speed

Type a document at the speed of 90 words per minute.	6.0
Carve roast beef in a cafeteria.	3.3
Use a manual pencil sharpener.	2.0

Appendix 10-A (continued)
*Scale Values of Tasks Representing Different Levels on Each Ability Requirement Scale**

31.	<u>Speed of Limb Movement</u>	
	Throw punches in a boxing match.	6.0
	Swat a fly with a fly swatter.	4.2
	Saw through a thin piece of wood.	2.3
32.	<u>Static Strength</u>	
	Lift 75-pound bags of cement onto a truck.	6.3
	Pull a 40-pound sack of fertilizer across the lawn.	3.9
	Push an empty shopping cart.	1.2
33.	<u>Explosive Strength</u>	
	Propel (throw) a shot-put in a track meet.	6.5
	Run up a flight of stairs with fire equipment.	5.5
	Jump onto a 3-foot high platform.	4.0
	Hit a nail with a hammer.	2.2
34.	<u>Dynamic Strength</u>	
	Perform a gymnastics routine using the rings.	6.8
	Climb a 48-foot long extension ladder.	4.8
	Use pruning shears to trim a bush.	1.5
35.	<u>Trunk Strength</u>	
	Do 100 sit-ups.	6.5
	Shovel snow for a half-hour to clear a walkway.	4.0
	Sit up in an office chair.	1.5
36.	<u>Extent Flexibility</u>	
	Work under a car dashboard to repair the heater.	5.8
	Reach for a box on a high warehouse shelf.	3.5
	Reach for a microphone in a patrol car.	1.8
37.	<u>Dynamic Flexibility</u>	
	Maneuver a kayak through swift rapids.	6.1
	Perform a dance routine as part of a cheerleading squad.	4.6
	Hand pick a bushel of apples from a tree.	2.0
38.	<u>Gross Body Coordination</u>	
	Perform a ballet dance.	6.3
	Swim the length of the pool.	4.0
	Get in and out of a truck.	1.5

39.	Gross Body Equilibrium	
	Walk on narrow beams in high-rise construction.	5.8
	Walk on ice across a pond.	4.1
	Stand on a ladder.	2.0
40.	Stamina	
	Run a 10 mile race.	6.0
	Climb 6 flights of stairs.	4.0
	Walk a quarter of a mile to deliver a letter.	1.2
41.	Near Vision	
	Detect minor defects in a diamond.	6.2
	Read the fine print of a legal document.	4.8
	Read dials on the car dashboard.	2.8
42.	Far Vision	
	Detect differences in ocean vessels on the horizon.	6.8
	Focus a slide projector.	3.9
	Read a roadside billboard.	2.5
43.	Visual Color Discrimination	
	Paint a color portrait from a living subject.	6.2
	Trace an electrical circuit which is marked by various colored wires.	3.8
	Separate laundry into colors and whites.	1.2
44.	Night Vision	
	Find your way through the woods on a moonless night.	6.1
	Take notes during a slide presentation.	4.5
	Read street signs when driving at dusk (just after the sun sets).	1.8
45.	Peripheral Vision	
	When piloting a plane in air combat, notice friendly and enemy aircraft.	5.5
	Be aware of the location of your teammates while dribbling a basketball.	4.2
	Keep in step while marching in a military formation.	2.0
46.	Depth Perception	
	Throw a long pass to a teammate who is surrounded by opponents.	5.8
	Operate a crane to move materials from a truck bed to the ground.	4.2
	Merge a car into traffic on a city street.	2.0

Appendix 10-A (continued)
Scale Values of Tasks Representing Different Levels on Each Ability Requirement Scale*

47. Glare Sensitivity

Snow ski in bright sunlight.	6.0
See boats on the horizon when sailing.	4.8
Drive on a familiar roadway on a cloudy day.	

48. Hearing Sensitivity

Tune an orchestra.	6.1
Diagnose what is wrong with a car engine from its sound.	4.5
Notice when the hourly watch alarm goes off.	1.5

49. Auditory Attention

Listen to instructions from a coworker in a noisy saw mill.	6.0
Listen for your flight announcement at an airport.	4.8
Listen to a lecture while people are whispering nearby.	2.0

50. Sound Localization

Determine the directions of an emergency vehicle from the sound of its siren.	6.5
Find a ringing telephone in an unfamiliar apartment.	3.8
Listen to a stereo to determine which speaker is working.	2.0

51. Speech Recognition

Understand a speech presented by someone with a strong foreign accent.	5.8
Identify a former customer's voice over the telephone.	4.0
Recognize the voice of a coworker.	1.5

52. Speech Clarity

Give a lecture to a large audience.	5.8
Make announcements over the loud speaker at a sports event.	3.5
Call the numbers in a bingo game.	1.4

*Adapted from Fleishman (1975a;1992) and Fleishman and Quaintance, (1984).

Chapter 11
Occupational Values and Interests
Table of Contents

Tables

Chapter 11
Occupational Values and Interests

Christopher E. Sager
American Institutes for Research

This chapter has two primary goals. The first is to establish interests and occupational values as valuable parts of the new Occupation Information Network (O*NET) that is being developed to replace the Dictionary of Occupational Titles (DOT; U.S. Department of Labor, 1991). The second goal is to explain and justify the methods developed to represent interests and occupational values in this new descriptive system.

Background

The measurement of vocational interests and values is grounded in the effort to match people to jobs. It is an enduring proposition that performance is a function of ability and motivation. As pointed out by Hakel (1986) and Dawis (1991), understanding interests and values is part of understanding motivation. The idea is that individuals who are motivated will perform well, and that interests and values are important parts of motivation. Maximizing performance, however, is not the only reason for trying to achieve good matches between people and jobs. Borgen, Weiss, Tinsley, Dawis, and Lofquist (1968) point to the theory that satisfaction is dependent on the agreement between individual needs and environmental characteristics. This all leads to the hypothesis that job performance and job satisfaction are at least partially dependent on the extent to which the job matches a person's interests and values. Therefore, if the goals of O*NET include the description of occupations for the purpose of person-job-matching, then occupational interests and values are potentially an important part of the content model.

What are occupational interests and values? For the purposes of this chapter, they will be defined as a collection of constructs including occupational interests, values, and preferences that are "... stable dispositions distilled from affective evaluations of numberless life experiences" (Dawis, 1991, p. 833). Dawis points out that the differences among these constructs are subtle and that the definitions of the constructs themselves are not firmly delineated. However, generally speaking, interests are tendencies that vary in strength and duration and are related to attention, experience, and satisfaction. Values and interests differ in that interests tend to refer to the like or dislike of activities, while values refer to an evaluation of the importance of activities and other characteristics of work environments. However, this is not a clear distinction because likes and dislikes could be evaluated in terms of importance and evaluations of importance could be made relative to likes and dislikes (Dawis, 1991). Finally, preference deals with choices among options. For example, choosing one job over another is the expression of a occupational preference.

At this point it is important to note that the goal of this project is to describe occupations not people. That is, we are currently on the job side of the person-job-matching effort. The problem is that the domain of interests has traditionally focused on the measurement of people. Here the focus is on measuring occupations in terms of their potential to satisfy people's occupational interests and values.

Interests. Taxonomies of interests primarily stem from the analysis of responses to largely empirically developed interest measures. In research and practice the two most commonly used measures are the Strong Interest Inventory (SII; Hansen & Campbell, 1985) and the Kuder Occupational Interest Survey (KOIS; Kuder, 1977). They are both structured self-report instruments.

The SII includes 325 items. Most of the items include three response options: "like," "indifferent," and "dislike." The items cover seven areas:

- occupations
- school subjects
- activities (e.g., repairing electrical wiring, making statistical charts, & interviewing clients)
- leisure activities,
- types of people (e.g., highway construction workers, high school students, & babies)

- preference between two activities (the response is on the "attractiveness" dimension)
- your characteristics (the response is on the "extent to which the statement describes me" dimension).

The items contribute to three sets of scores. The first set of scores is based on Holland's six-factor taxonomy of occupational interests; the SII refers to them as "General Occupational Themes." The other two sets of scores are on the "Basic Interest" and "Occupational" scales. The former refers to particular domains (e.g., agriculture, science, teaching, etc.) and the latter refers to 207 particular occupations (e.g., Army Officer, Nurse, Travel Agent, etc.) The Occupational scale scores are relative to male or female respondents in those occupations. The General Occupational Theme, Basic Interest, and Occupational scales are arranged in a hierarchy with Themes at the top and occupations at the bottom. Table 11-1 contains the titles of Themes and a brief description of each; the descriptions are based on selected language from the *Manual for the Strong Interest Inventory* (Hansen & Campbell, 1985). It is important to note that (a) the SII has a long empirical tradition that began in 1927 with the development of the Strong Vocational Interest Inventory (Dawis, 1991), and (b) the SII compares respondents' scores to the responses made by incumbents in each of a large number of occupations. It is equally important to note, however, that the method by which scores are obtained involves a 325-item instrument that focuses on person measurement. Basically, the method used by the developers of the SII to describe an occupation is the administration of the whole SII to a large number of incumbents in that occupation.

Table 11-1
Titles and Descriptions of the Strong Interest Inventory General Occupational Themes (i.e., Holland taxonomy of personality/interests)[*]

Theme	Description
Realistic	People scoring high here usually are rugged, robust, practical, physically strong; they usually have good physical skills, but sometimes have trouble expressing themselves or in communicating their feelings to others.
Investigative	This theme centers around science and scientific activities. Extremes of this type are task-oriented; they are not particularly interested in working around other people.
Artistic	The extreme type here is artistically oriented, and likes to work in artistic settings that offer many opportunities for self-expression.
Social	The pure type here is sociable, responsible, humanistic, and concerned with the welfare of others.
Enterprising	The extreme type of this theme has a great facility with words, especially in selling, dominating, and leading; frequently these people are in sales work.
Conventional	Extremes of this type prefer the highly ordered activities, both verbal and numerical, that characterize office work.

Note: [*] This table contains the titles of the General Themes from the SII that are based on Holland's taxonomy and a brief description of each; the descriptions contain only a part of language used to describe them on pages 14 and 15 of the *Manual for the Strong Interest Inventory* (Hansen & Campbell, 1985).

Other instruments that produce scores on the six Holland factors include the (a) Vocational Preference Inventory [VPI; 160 items], (b) Self-Directed Search [SDS Form R; 84 occupation items], and (c) ACT Interest Inventory, Unisex Edition [UNIACT, 90 items] (Dawis, 1991; Holland, 1994).

The KOIS includes 100 items. Each item presents three activities that are known to sixth graders. The respondent is required to indicate the most and least preferred activity. Responses to this survey are scored in terms of the similarity of an individual's responses to the responses of members of a number of criterion groups. Respondents receive scores indicating the similarity of their responses to the responses of individuals in a number of groups (i.e., 40 occupations for females, 79 occupations for males, 19 college majors for females, and 29 college majors for males). The KOIS is similar to the SII in that the instrument (a) includes a large number of items, (b) focuses on person measurement, and (c) bases descriptions of occupations on responses to the instrument from a large number of respondents. Factor analyses of the KOIS items have been performed (Kuder, 1977; Zytowski, 1976); the resulting factors/dimensions are compared to the results of other factor analyses in Dawis (1991). The dimensions include areas like Mechanical, Persuasive, Outdoor, Mathematic-Numeric, and Art.

Certain characteristics of the SII, the KOIS, and other similar interest measures make them unattractive for use in the new O*NET. One of these characteristics is that the instruments are person based; they are designed to measure people not occupations. Another problematic characteristic is that their method of job description depends on administering large numbers of items to large numbers of incumbents in each occupation being described. But still, the description is not a description of the occupation; it is a description of a sample of individuals in that occupation. Furthermore, measuring interests and generating occupational descriptions in this matter are very resource intensive undertakings. Finally, the approach taken in developing these instruments and their associated taxonomies assumes a fixed occupational structure; this assumption may be problematic in a rapidly changing labor market. That is, if a new occupation emerges, a large number of individuals with a reasonable amount of tenure in that occupation need to be sampled to discover which items that differentiate occupation from other occupations.

Examination of Holland's factors indicates that they are measuring personality based constructs. For example, individuals scoring high on Investigative are described as, "... not being interested in working around other people," and individuals scoring high on Social are described as people who, "... like attention and seek situations that allow them to be near the center of the group" (Hansen & Campbell, 1985, p. 14). Tokar and Swanson (1995) address this issue by comparing responses to Holland's SDS instrument and Costa and McCrae's (1992) measure of the Big-Five personality factors (i.e., NEO Five-Factor Inventory [Form S]). Based on this investigation the authors concluded that the Big-Five dimensions of Openness and Extraversion reasonably discriminated among the Holland types for males and that the personality dimensions of Openness, Extraversion, and Agreeableness did the same for females. Other researchers have categorized the Holland types into the personality domain

Table 11-2

The 21 Reinforcers Measured by the MJDQ and their Associated Need Reinforcer Statements[*]

Reinforcer	Reinforcer Statement Each statement begins with "Workers on this job ..."
1. Ability Utilization	make use of their individual abilities.
2. Achievement	get a feeling of accomplishment.
3. Activity	are busy all the time.
4. Advancement	have opportunities for advancement.
5. Authority	tell other workers what to do.
6. Company Policies	have a company which administers its policies fairly.
7. Compensation	are well paid in comparison to other workers.
8. Co-workers	have co-workers who are easy to make friends with.
9. Creativity	try out their own ideas.
10. Independence	do their work alone.
11. Moral Values	do work without feeling that it is morally wrong.
12. Recognition	receive recognition for the work they do.
13. Responsibility	make decisions on their own.
14. Security	have steady employment.
15. Social Service	have work where they do things for other people.
16. Social Status	have the position of "somebody" in the community.
17. Supervision - human relations	have bosses who back up their workers (with top management).
18. Supervision - technical	have bosses who train their workers well.
19. Variety	have something different to do every day.
20. Working Conditions	have good working conditions.
21. Autonomy	plan their work with little supervision.

Note: [*] The reinforcers are from page 41 and the statements are from Appendix A of *A Psychological Theory of Work Adjustment* by Dawis and Lofquist (1984). An earlier version of the MJDQ is presented in The Measurement of Occupational Reinforcer Patterns by Borgen, Weiss, Tinsley, Dawis, and Lofquist (1968).

(e.g., Hogan, 1991). Personality constructs are covered by another part of the content model (see Chapter 12: Work Styles); therefore, including Holland's six types in the content model raises the question of redundancy across domains. However, researchers suggest that the overlap between Holland's constructs and conventional personality instruments is not complete (e.g., Dawis, 1991; Tokar & Swanson, 1995). Therefore, describing occupations according to Holland's types may provide information about occupations beyond that provided by the descriptors in the Work Styles portion of O*NET's content model.

It also is important to note that (a) Holland's types are prominent in the theoretical and applied vocational and career counseling literatures, and (b) there is favorable evidence concerning the validity of the Holland taxonomy (e.g., Gottfredson & Holland, 1989; Prediger & Vansickle, 1992; Tokar & Swanson, 1995; Tracey & Rounds, 1992). For example, the General Occupational Theme scale scores for the Strong-Campbell Interest Inventory (an earlier version of the SII) showed two-week, thirty-day, and three-year test-retest reliabilities in the .85 to .93, .84 to .91, and .78 to .87 ranges, respectively (Hansen & Campbell, 1985). The same authors review studies that show strong convergent validity between the General Occupational Theme scores from earlier versions of the SII and other interest measures including the VPI and Edwards Personal Preference Schedule. Additionally, Varca and Shaffer (as cited by Hansen & Campbell, 1985) show that adolescents and adults picked avocational activities that were congruent with their General Occupational Theme types.

Values. There are a number of measures of occupational values that are person based; that is, the instruments are designed to identify the characteristics of work environments that are important to the individual. Examples of these instruments include the Values Scale (VS) and the Minnesota Importance Questionnaire (MIQ). The difficulty again is that, like most interest measures, these instruments are designed to measure people not occupations (Dawis, 1991).

An exception is the Minnesota Job Description Questionnaire (MJDQ; Dawis & Lofquist, 1984). This instrument is designed to describe occupations in terms of their occupational reinforcer patterns (ORPs). Respondents are required to describe their jobs in terms of 21 need-reinforcers that occupations can potentially offer. These reinforcers are listed in Table 11-2. The MJDQ presents the respondent with a reinforcer statement associated with each need-reinforcer. These statements, also listed in Table 11-2, are presented to the respondent in sets of five according to a multiple rank-order format. After this instrument is administered to a number of individuals in an occupation an ORP can be generated for that occupation that describes it in terms of the, "... relative presence or absence of reinforcers in the occupation" (Dawis & Lofquist, 1984, p. 40). That is, the ORP is the occupation's profile of scores on the 21 reinforcers.

The MJDQ is an attractive measure for a number of reasons. One is that this instrument is specifically designed to measure occupations. The MJDQ literally asks the respondents to make judgments relative to their jobs. This keeps the instrument in the realm of measuring characteristics of occupations that people may value and away from the indirect situation of measuring the interests or values of people who are in the occupations.

Another attractive characteristic of this instrument is that it is well suited to purpose of matching people to jobs/occupations. This point is convincingly made by the Minnesota Information Questionnaire (MIQ; Dawis & Lofquist, 1984). The ranked form of the MIQ asks the respondent to rank order sets of five statements in terms of the relative importance of the statements in an "ideal" job. The statements are the same as those used for describing jobs in the MJDQ. This situation allows for the comparison of an occupation's ORP to an individual's responses to the MIQ. A final attractive characteristic of the MJDQ and the MIQ is that this matching system is not as tied to existing occupations as are the matching systems associated with other instruments.

Are the constructs measured by the MJDQ worth including in the content model, especially relative to the constructs measured by the instruments representing other parts of the content model? As mentioned above, the MJDQ measures 21 reinforcers in terms of their relative presence in occupations, and the MIQ measures these same reinforcers from the individual's perspective. Dawis (1991) reviews studies that have factor analyzed responses to the MIQ and presents a six-dimension higher order taxonomy of work values. The titles and definitions of these values are presented on page 849 of Dawis (1991) and are shown here:

Achievement:	The importance of an environment that encourages accomplishment
Comfort:	The importance of an environment that is comfortable and not stressful

Table 11-3

*The 21 Reinforcers from the Minnesota Information Questionnaire and their Associated Higher Order Dimensions**

Higher Order Dimension	Reinforcer
Achievement	Ability Utilization
	Achievement
Comfort	Activity
	Independence
	Variety
	Compensation
	Security
	Working Conditions
Status	Advancement
	Recognition
	Authority
	Social Status
Altruism	Co-workers
	Social Service
	Moral Values
Safety	Company Policies
	Supervision, Human Relations
	Supervision, Technical
Autonomy	Creativity
	Responsibility
	Autonomy

Note: * The information in this table is abstracted from a table on page 849 of Dawis (1991).

Status:	The importance of an environment that provides recognition and prestige
Altruism:	The importance of an environment that fosters harmony and service to others
Safety:	The importance of an environment that is predicable and stable
Autonomy:	The importance of an environment that stimulates initiative.

Table 11-3 shows which of the 21 reinforcers are associated with each work value. Dawis also compares these 21 reinforcers to the constructs measured by four other instruments that measure work related values. This comparison shows that the 21 reinforcers address all of the domains covered by these instruments. Comparison of these constructs with those measured by the other parts of the content model suggests that the 21 reinforcers would constitute a unique contribution to the description of occupations.

Borgen, Weiss, Tinsley, Dawis, and Lofquist (1968) investigated the reliability and validity of the ranked version of the MJDQ. Their study included 81 occupations. For each occupation two ORPs were created, each based on half of the respondents completing the questionnaire for that particular occupation. The within occupation correlations between the groups ranged from 0.78 to .98 with a median correlation of .91. The authors concluded that for sufficiently stable results a minimum of 20 respondents per occupation is required. It is important to note that other systems (e.g., SII and KOIS) need to collect information from a larger number of incumbents per occupation. The authors also make a strong concurrent validity argument. First, they show that each reinforcer scale score shows significant mean differences across the 81 occupations. That is, each of the individual scales shows variation across occupations. Second, a cluster analysis was performed on the ORPs for each occupation. The resulting clusters differed considerably in terms of their patterns of scores, and the clusters were judged to represent meaningful groups of occupations.

In the research discussed in the previous paragraph the respondents were supervisors. Will entry-level workers be able to understand the items in the MJDQ? Weiss, Dawis, England, and Lofquist (1964) showed that the statements in the MIQ are at a 5th grade readability level. Furthermore, the manual for the MIQ discusses the successful use of this instrument with a number of populations that include vocational/technical school students, high-school students, and 8th graders (Gay, Weiss, Hendel, Dawis, and Lofquist, 1971). Recall that the MIQ uses the same set of 21 statements as the MJDQ.

Recommended Methods and Taxonomies

From the discussions above we can derive a number of desirable characteristics for interest and value descriptors to be included in the content model. The descriptors should:

- support the effort to describe occupations and match people to jobs that are consistent with their interests and values
- include constructs that are not overly redundant with other parts of the content model
- be obtainable by methods that are not too resource intensive.

Dawis (1991) reviewed the evidence relating to the validity of measures of interests and values. This review reinforces the assertion that measures of values discriminate among occupations. However, there are more data supporting the inference that measures of interest predict later occupational membership than there are data supporting this inference for measures of values. In terms of predicting future job satisfaction, the evidence for interests is mixed, while the evidence linking measures of occupational values to job satisfaction is stronger. Dawis' review, coupled with the research discussed above and with the motivation to ensure that O*NET adequately covers the domain of occupational interests and values, leads to the recommendation that the content model include vocational interest and value descriptors. Furthermore, in light of the evidence discussed above, the recommendation is to cover interests with Holland's six types and values with a variation of the MJDQ.

Holland's Types. There is a fairly detailed research literature associated with describing occupations according to the Holland types (e.g., Gottfredson & Holland, 1989). As indicated above, in a good deal of this research the description of each occupation depends on large numbers of individuals in that occupation completing relatively long instruments. This approach is too resource intensive for use in O*NET.

Research on description of occupation has, however, produced evidence that occupations can meaningfully be described according to the Holland types with "High-point" codes

(Gottfredson & Holland, 1989; Prediger & Vansickle 1992; Tracey & Rounds, 1992). High-point codes are a description of an occupation in terms of the first one, two, or three Holland types that the occupation fits. The codes are presented in the form of the first letter of each of the relevant Holland types (i.e., R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; and C = Conventional). The letters in the High-point code are presented in order of there importance. For example, Prediger and Vansickle (1992) assign the occupation Natural Resources Manager a three letter High-point code of CER. This means that Natural Resources Manager is primarily described as a Conventional occupation, secondarily as an Enterprising occupation, and as having some Realistic aspects.

There are two methods of generating High-point codes for O*NET occupations, other than administering relatively long questionnaires to large numbers of individuals in each occupation. One approach would be to take advantage of the *Dictionary of Holland Occupational Codes* (Gottfredson & Holland, 1989). This book contains a three-letter High-point code for every DOT occupation. The codes were generated by (a) applying discriminant analysis to 189 DOT occupations (that had already been assigned codes) and their associated DOT occupational analysis data and (b) using the resulting classificatory functions to assign High-point codes to the remaining DOT occupations.

Gottfredson and Holland refer to a number of studies that support the validity of these codes. One example is a comparison between their High-point codes and the *Guide for Occupational Exploration* (GOE; U.S. Department of Labor, 1979) categories.. Employment Service occupational analysts assigned the DOT occupations to 12 GOE categories. These categories represent 11 interest dimensions and 1 category for occupations that require physical performance. The U.S. Department of Labor also mapped the 12 GOE categories onto the six Holland types. This allowed an examination of the extent to which occupations assigned by classificatory function to a particular Holland category were assigned by occupational analysts to the associated GOE category. The occupational analysts assigned 76.8 percent of the DOT occupations into the predicted categories.

The High-point codes for the 12 099 DOT occupations in the *Dictionary of Holland Occupational Codes* could be used to generate High-point codes for O*NET occupations. The O*NET occupations are based on the Occupational Employment Statistics (OES; Bureau of Labor Statistics [BLS], 1992) system; it categorizes all of the jobs in the United States into approximately 950 occupations. BLS has developed a crosswalk that sorts the DOT occupations into the OES/O*NET occupations. High-point codes could be generated for each O*NET occupation by determining the modal High-point code associated with the DOT occupations sorted into each O*NET occupation. This is a relatively straightforward procedure that could be supplemented by the judgments of Occupational Analysis Field Center (OAFC) staff.

A second approach to generating High-point codes for the O*NET occupations could be based directly on occupational analyst judgments. Descriptions of each occupation could be generated using the data collected from all of the questionnaires described in this report. OAFC staff would be required to use these descriptions and descriptions of the Holland types to assign High-point codes to the O*NET occupations. This essentially is the methodology employed in the development of the GOE.

The method that is actually used to generate Holland High-point codes for the O*NET occupations will likely be a variation on or combination of the two approaches described above. It also is relevant to note that use of either of these approaches may depend on obtaining permission to use copyrighted material.

Occupational Values. The MJDQ matches O*NET's need; however, one difficulty remains. Both the paired comparison form and the multiple rank-order form of the MJDQ require the respondent to make a large number of judgments. One reason for requiring a respondent to make judgments about reinforcers in comparison to other reinforcers is to prevent a positive response bias. That is, without forced comparisons there is the possibility that respondents would indicate that all of the reinforcers are present in their occupation. Another reason for forced comparisons is the fear of a halo effect associated with job satisfaction. For example, if the respondents are not forced to favor some reinforcers over others, respondents who are satisfied with their jobs might indicate that all of the reinforcers are present while respondents who are not satisfied with their jobs might indicate that none of the reinforcers is present. However, given the number of questionnaires and items being included in the content model, the judgment is that there is not sufficient space to include the MJDQ in either of its current forms (i.e., paired comparison or multiple rank-order).

For the purpose of the try-out study of the draft questionnaires, the 21 "Workers on this job ..." statements from the MJDQ were presented to respondents in a format that required them to rate the extent to which they agreed that each statement described their job. The statements were taken directly from the version of the MJDQ that is presented in Dawis and Lofquist (1984). The ratings were made on a 7-point Amount of Agreement scale. In the try-out study, the interrater agreement value is $r = 0.36$ based on two respondents per occupation across eight occupations. This is considered a satisfactory level of interrater agreement, especially considering that during the prototype data collection the questionnaire will be completed by between 25 and 33 incumbents per occupation.

The try-out results were also examined to address the possibility of a positive response bias or a halo effect associated with job satisfaction. The mean ratings on the 21 scales across all respondents ranged from 4.12 to 6.06. This suggests that the responses were negatively skewed. However, the standard deviations ranged from 0.90 to 1.96. This suggests that while the mean ratings were high there was a fair amount of variation in the ratings. To address the possibility of a halo effect associated with job satisfaction the responses to the 21 items were examined within each respondent . Evidence in support of such a general satisfaction effect would consist of individual respondents showing a lack of variation in their responses across the 21 ratings. Such an effect was not observed.

After the try-out this questionnaire was revised. There are three substantive changes:

1. The 7-point Amount of Agreement scale was changed to a 5-point amount of agreement scale.

2. Items 5, 6, 8, 11, 16, 17, and 18 were modified. Most of these modifications involved modernization of language, however, a few represent attempts to simplify language (see Table 11-4).

3. The title of the questionnaire was changed from "Interests" to "Occupational Values" to more accurately reflect the construct it assesses.

Table 11-4
Proposed Modifications to Minnesota Job Description Questionnaire (MJDQ) Reinforcer Statements

Reinforcer	Each statement begins with "Workers on this job ..."	
	Current Language	Modification
5. Authority	tell other workers what to do.	give directions and instructions to others.
6. Company Policies	have a company which administers its policies fairly.	are treated fairly by the company.
8. Co-workers	have co-workers who are easy to make friends with.	have co-workers who are easy to get along with.
11. Moral Values	do work without feeling that it is morally wrong.	are never pressured to do things that go against their sense of right and wrong.
16. Social Status	have the position of "somebody" in the community.	are looked up to by others in their company and their community.
17. Supervision - human relations	have bosses who back up their workers (with top management).	have supervisors who back up their workers with management.
18. Supervision - technical	have bosses who train their workers well.	have supervisors who train their workers well.

Summary. Taxonomies of vocational interests and vocational values will be included in O*NET's content model. The interests will be covered by Holland three-letter High-point codes for each occupation. The recommendation is to obtain these codes by either adapting the *Dictionary of Holland Occupational Codes* to the O*NET occupations, or by requiring job analysts to directly assign High-point codes based on occupational analysis data, or by some combination of these two approaches. Values will be assessed by a 21-item questionnaire titled "Occupational Values" that will require incumbents to rate their occupations in terms of the presence of 21 reinforcers. This questionnaire is a modification of the MJDQ (Dawis & Lofquist, 1984) and is Appendix H of Volume II.

Inclusion of an interest and an occupational values taxonomy is supported by Dawis' (1991) observation that interests and values differ in terms of the important criteria they predict. Interests generally out perform values as predictors of occupational membership, occupational tenure, and occupational change while values are generally superior to interests as predictors of job satisfaction. Finally, it is relevant to note that both kinds of constructs exhibit overlap with two sections of the Office of Personnel Management's (OPM) Clerical and Technical Employees job analysis survey (OPM, 1993). The items in the job satisfaction and job preference sections of that survey show substantial overlap with the 21 reinforcers and some overlap with Holland's types.

Potential Applications

The information collected to complete this portion of the content model will be useful in a variety of ways. As discussed earlier, the measurement of interests and values is firmly grounded in efforts to match people to jobs, with particular emphasis on helping people find occupations that will be satisfying. This point is supported by the person-assessing questionnaires that have been developed to match the two sets of descriptors recommended in this chapter. These person measures are frequently used in vocational counseling. This squarely places the constructs measured by the proposed methods in the career, vocational, and vocational rehabilitation counseling domains. In fact the primary use of vocational interest and value information has been and will likely continue to be helping people make vocational choices (Dawis, 1991; Holland, 1976). Thus, the Holland High-point codes and occupation reinforcer scales will play key roles in efforts to match individuals to jobs, particularly in the early stages of an individual's interaction with the world of work.

Aside from this traditional application of vocational interest and value measures, the O*NET information collected in this domain might prove useful in addressing a number of other issues. For example, normative data bearing on preferred types of occupations according to Holland's taxonomy and preferred reinforcers according to the Occupational Values questionnaire might provide employers with an understanding of what, generally, people expect from their work. Along similar lines, the kinds of environmental characteristics sought by members of an occupation might tell counselors and policymakers a lot about the motives and values associated with movement into certain occupations including high wage, high skill positions.

References

Borgen, F.H., Weiss, D.J., Tinsley, H.E.A., Dawis, R.V., & Lofquist, L.H. (1968). The measurement of occupational reinforcer patterns. *Minnesota Studies in Vocational Rehabilitation, XXV*. Minneapolis: University of Minnesota.

Bureau of Labor Statistics. (1992). *Occupational employment statistics: Dictionary of occupations, 1988-1993*. Washington, DC: Author.

Costa, P.T., Jr., & McCrae, R.R. (1992). *NEO-PI-R professional manual*. Odessa, FL: Psychological Assessment Resources.

Dawis, R.V. (1991). Vocational interests, values, and preferences. In M. D. Dunnette and L. M. Hough (Eds.), *Handbook of industrial and organizational psychology, Vol. 2 of 2nd Edition*. Palo Alto, CA: Consulting Psychologists Press.

Dawis, R.V., & Lofquist, L.H. (1984). *A psychological theory of work adjustment: An individual-differences model and its applications*. Minneapolis: University of Minnesota Press.

Gay, E.G., Weiss, D.J., Hendel, D.D., Dawis, R.V., & Lofquist, L.H. (1971). Manual for the Minnesota importance questionnaire. *Minnesota Studies in Vocational Rehabilitation, XXVIII*. Minneapolis: University of Minnesota.

Gottfredson, G.D., & Holland, J.L. (1989). *Dictionary of Holland occupational codes, 2nd edition*. Odessa, FL: Psychological Assessment Resources.

Hakel, D.T. (1986). Personnel selection and placement. *Annual Review of Psychology, 37*, 351-380.

Hansen, J.C., & Campbell, D.P. (1985). *Manual for the Strong interest inventory: Form T325 of the Strong vocational interest blanks*. Palo Alto, CA: Consulting Psychologists Press.

Hogan, R.T. (1991). Personality and personality measurement. In M. D. Dunnette and L. M. Hough (Eds.), *Handbook of industrial and organizational psychology, Vol. 2 of 2nd Edition*. Palo Alto, CA: Consulting Psychologists Press.

Holland, J.L. (1976). Vocational preferences. In M. D. Dunnette (Ed.), *Handbook of industrial and organizational psychology*. Chicago: Rand McNally.

Holland, J.L. (1994). *Self-directed search assessment booklet: A guide to educational and career planning*. Odessa, FL: Psychological Assessment Resources.

Kuder, G.F. (1977). *Activity interests and occupational choice*. Chicago: Science Research Associates.

Office of Personnel Management. (1993). *Clerical/technical multipurpose occupational analysis survey*. Washington D.C.: Author.

Prediger, D.J., & Vansickle, T.R. (1992). Locating occupations on Holland's Hexagon: Beyond RIASEC. *Journal of Vocational Behavior, 40*, 111-128.

Tokar, D.M., & Swanson, J.L. (1995). Evaluation of the correspondence between Holland's vocational personality typology and the five-factor model of personality. *Journal of Vocational Behavior, 46*, 89-108.

Tracey, T.J., & Rounds, J. (1992). Evaluating the RIASEC circumplex using high-point codes. *Journal of Vocational Behavior, 41*, 295-311.

U.S. Department of Labor. (1979). *Guide for occupational exploration*. Washington, DC: Author.

U.S. Department of Labor. (1991). *Dictionary of occupational titles* (4th ed.). Washington D.C.: Author.

Weiss, D.J., Dawis, R.V., England, G.W., and Lofquist, L.H. (1964). The measurement of vocational needs. *Minnesota Studies in Vocational Rehabilitation, XVI*. Minneapolis: University of Minnesota.

Zytowski, D.G. (1976). Predictive validity of the Kuder occupational interest survey: A 12- to 19-year follow-up. *Journal of Counseling Psychology, 23*, 221-233.

Chapter 12

Work Styles

Table of Contents

Appendices

Chapter 12
Work Styles

Walter C. Borman, Amy Schwartz McKee,
& Robert J. Schneider
Personnel Decisions Research Institute, Inc.

The purpose of this paper is twofold: first, we describe methodology used to develop a taxonomy of work styles to be used in the O*NET; and second, we explain and justify the content of that taxonomy. The general goal of this effort was to identify a comprehensive yet reasonably small number of personal characteristics that describe the important interpersonal and work style requirements in jobs and occupations in the United States economy. The domain of interest is limited to those personal characteristics that are work-related (i.e., required for performing jobs). Accordingly, clinically-oriented constructs were not considered.

Development of the Work Styles Taxonomy

Review of existing taxonomies. We first reviewed several taxonomies that have been used in an industrial/organizational psychology context, mostly in the area of personnel selection. The point of departure for building our taxonomy was the five-factor model (FFM) (e.g., Barrick & Mount, 1991; Goldberg, 1993). Factor analyses of self-ratings (e.g., Goldberg, 1981) and peer-ratings under several conditions (Goldberg, 1990; Norman, 1963; Tupes & Christal, 1961, 1992) have often resulted in a 5-factor solution, usually characterized by these or similar construct labels: Surgency, Agreeableness, Emotional Stability, Conscientiousness, and Intellectance. The weight of evidence supporting the existence of these five factors strongly argued for considering this dimension system carefully when developing our taxonomy.

A second personality taxonomy we paid considerable attention to was R. Hogan's (e.g., R. Hogan, 1982). This is because the Hogan Personality Inventory (HPI; R. Hogan & J. Hogan, 1992), which measures the constructs in R. Hogan's taxonomy, was explicitly developed to predict job performance. R. Hogan (1982) has suggested that Surgency contains two elements that are sufficiently independent to warrant separate measurement. He calls these elements Ascendance and Sociability. His other dimensions correspond reasonably well with the FFM: Adjustment, Likability, Self-Control, and Intellectance.

Third, work on the Assessment of Background and Life Experiences (ABLE; see Hough, in press) in the US Army's Project A was considered in developing our dimensions for the work styles domain. That research was also focused on the prediction of job performance. The ABLE constructs are: Achievement, Physical Condition, Agreeableness/Likability, Adjustment, Potency, Dependability, and Locus of Control. These dimensions correspond in part to the Big Five, but Surgency is subdivided into Potency and Achievement, Intellectance is not represented in the ABLE, and two additional dimensions outside of the FFM are evident (Physical Condition and Locus of Control).

Fourth, we referred to the constructs measured in the Occupational Personality Questionnaire (OPQ; Saville & Holdsworth, 1990). The OPQ scales were not derived from the FFM. Instead, they were developed deductively to operationalize constructs directly relevant to the working population. The constructs are grouped into three broad areas: relationships with people, thinking style, and feelings/emotions.

Finally, a fifth category system that guided our efforts deserves a more complete description. Guion (1992) and his colleagues have been developing a job analysis questionnaire specifically intended to measure personality requirements of jobs. Part of their research in this domain involves identifying constructs that differentiate personality requirements across jobs.

In our judgment, this is exactly what the work styles taxonomy in the content model should reflect. That is, what are the work style constructs that differentiate among jobs?
Guion and his colleagues still are in the process of inventory development. After that work is completed, the goal is to evaluate the validity of the inventory by first using it to identify work style requirements in several jobs and then determining how well work style test scores corresponding to the required traits predict job performance. If the job analysis inventory is to

be useful for selection, it should identify as work style requirements traits that prove to be good predictors of performance.

As mentioned, because our objectives are very similar to some of the objectives in the Guion et al. research program, we considered this work very carefully in building our taxonomy of work styles. Their analyses to date have resulted in a 12-dimension system. The dimensions are: General Leadership, Interest in Negotiation, Achievement Striving, Friendly Disposition, Sensitivity to Interests of Others, Cooperative or Collaborative Work Tendency, General Trustworthiness, Adherence to a Work Ethic, Thoroughness and Attentiveness to Detail, Emotional Stability, Desire to Generate Ideas, and Tendency to Think Things Through.

Review of factor analytic and other correlational data relating to personality structure. In addition to our review of the taxonomies discussed above, we examined factor analytic and correlational data that provided evidence about the structure of work styles by indicating the relationships among work style constructs. Such data, together with consideration of taxonomic work, helped us to (a) decide on an appropriate number of first-level constructs, (b) place second-level constructs under the appropriate first-level constructs, (c) assess the relative independence of various constructs, and (d) better understand the nature of the constructs in our taxonomy.

We drew on a variety of research studies to help determine an appropriate number of first-level constructs. Research on the FFM (e.g., Goldberg, 1990; McCrae & Costa, 1987; Tupes & Christal, 1961, 1992) provided strong indications regarding highest-order constructs that should be included in our taxonomy. R. Hogan's (1982; see also R. Hogan and J. Hogan, 1992) 6-factor taxonomy and Hough's (1992) 9-factor taxonomy were also useful.

We were able to draw on a variety of work to assist us in defining second-level constructs. This included FFM facet-level research (Costa & McCrae, in press; Costa, McCrae & Dye, 1991); R. Hogan and J. Hogan's (1992) homogeneous item composites (HICs), which are facets of their six broad constructs; the second-level personality constructs in Tellegen's (1982) taxonomy; certain constructs in Gough's (1987) California Psychological Inventory; and the constructs measured by the Occupational Personality Questionnaire. The job requirements-based facets of the Big Five suggested by Guion (1992) also informed our selection of second-level constructs, as did Fleishman and Gilbert's (1994) social/interpersonal characteristics taxonomy and Mumford's (1994) social skills taxonomy, which were prepared in connection with the content model.

Work by Mumford (1994) is important for our taxonomy for an additional reason. He has argued that his personality factors include concepts related to learning. More specifically, some of Mumford's constructs address motivation and other concepts facilitating learning and adaptability to a changing environment. Because learning and adaptability are becoming more and more critical for employees in modern organizations, operating in a rapidly changing global environment, it will be important for us to attend to Mumford's (1994) personality constructs.

We also relied on factor analytic and other correlational research to verify that certain constructs we believed were distinct were in fact relatively independent. For example, we confirmed the relative independence of Achievement and Social Influence by referring to Tellegen and Waller (in press), and established the relative independence of our Practical Intelligence construct from mental ability by referring to McCrae and Costa (1987).

Finally, we clarified the content of the constructs in our taxonomy by reviewing a variety of work. This review included examination of definitions of closely related constructs included in various other taxonomies (e.g., Costa, McCrae & Dye, 1991; Gough, 1987; R. Hogan & J. Hogan, 1992; Hough, 1992; Tellegen, 1982; Tellegen & Waller, in press; Wiggins, Trapnell, & Phillips, 1988); examination of factor solutions relating to personality structure (e.g., Goldberg, 1990; McCrae & Costa, 1987); and review of critical discussions regarding the nature of certain constructs (e.g., Barrick & Mount, 1991; Goldberg, 1993; McCrae & Costa, 1987).

Establishment of job-relatedness. In developing our taxonomy of work styles, we also emphasized constructs that have been empirically shown to correlate with important job behaviors or related criteria. Accordingly, we examined literature reviews, meta-analyses, and relevant criterion-related validity evidence to identify work style constructs that relate to job behaviors. This work is discussed next.

In an early paper, Ghiselli (1973) suggested that the reason personality tests did not seem to predict job performance very well was that correlations between performance and personality scales that had no conceptual relation with criteria were often included in evaluating average personality-job performance relationships. An example is when scores on each scale of an inventory and performance on the job are correlated even when some of the scales would not be expected to have any relationship with performance. This was often the case, for example, with studies reviewed by Guion and Gottier (1965) in their influential review. Thus, Ghiselli first reviewed literature and identified those personality-performance links where a reasonable conceptual argument could be made for a correlation between the two. Then he averaged *those* correlations, ignoring all of the other personality-performance correlations he hypothesized would *not* yield significant relations. Results of this review were more positive than previous reviews and the prevailing opinion about personality in a personnel selection context. A median correlation of $r = .26$ was found across the seven occupational categories he included.

The use of personality and criterion taxonomies to summarize criterion-related validity studies has resulted in a steady accumulation of findings clearly indicating the relevance of personality constructs to job-related criteria. For example, Kamp and Hough (1986) summarized studies that related the ABLE constructs described earlier to a variety of organizationally relevant criteria, including training, job proficiency, job involvement/withdrawal, and delinquency (e.g., substance abuse). Kamp and Hough (1986) reported reasonably good validities against these criteria for five different personality constructs.

Barrick and Mount (1991), using the FFM to categorize personality constructs, and Hough (1992), using her nine-construct expansion of the FFM, reported meta-analytic findings that further supported the relevance of personality to the workplace. Barrick and Mount's (1991) paper was noteworthy for its identification of Conscientiousness as a consistent correlate of important work-related criteria across a variety of occupations (estimated true validity = .22). In their meta-analysis, other relationships between Big Five personality constructs and performance were considerably lower. By contrast, Hough's (1992) results showed the relevance of each of the nine personality variables in her taxonomy to at least one criterion construct.

R. Hogan (1991) conducted a broad review of the role of personality in I/O psychology. Part of this review included a summary of a major research program studying personality in a personnel selection context. Bentz (1985) studied the performance of thousands of managers and executives in a large retail company over a 20-year period. Among the predictor measures was the Guilford-Zimmerman Temperament Survey (GZTS). Bentz found that several scales from the GZTS were moderately but consistently related to several important performance criteria, including performance ratings, compensation, and promotability. He concluded that personality is an important predictor of both managerial performance and advancement.

Finally, R. Hogan (1991) pointed to his own research with the HPI (R. Hogan, 1986). He, J. Hogan, and colleagues have successfully used the HPI to predict performance in numerous samples and in many different jobs. More recent research involving the HPI summarized in R. Hogan and J. Hogan (1992) indicates that HPI scales corresponding to each of the Big Five correlated significantly and meaningfully with a variety of job-related criteria. These and other results were carefully examined as we attempted to identify appropriate constructs for our taxonomy of work styles.

Hierarchical structure of the taxonomy. The work style taxonomy is comprised of seven first-level constructs and 17 second-level constructs. The taxonomy is arranged hierarchically, with the second-level constructs reflecting a finer-grained definition of the first-level constructs. For example, Conscientiousness (first-level) has as its second-level constructs, Dependability, Attention to Detail, and Integrity. Appendix 12-A presents the seven first-level constructs, including a construct label and definition, the most relevant citations, and level scale anchors describing high, medium, and low personality requirements for that construct. Appendix 12-B presents the same kind of information for the 17 second-level constructs. Appendix 12-C shows how each of the constructs is linked to taxonomies described above. This table should be useful, especially, for the next discussion.

Summary. The current taxonomy was developed using existing models and theories of work styles, empirical studies of work style variables as predictors of job performance, meta-analyses of these studies' results, and factor analyses and other correlational studies that illuminate the structure of work styles. Only job-related personality factors were included in this taxonomy, and job-relatedness was generally established based on empirical research. Taxonomy construction was guided by the question, "What are the work style requirements of jobs?" Work style constructs are named and defined to be aligned with job requirements.

In the sections that follow, we more specifically describe the rationale for each of the constructs in our taxonomy. This section is organized into seven subsections, one for each of the first-level constructs. Within each subsection, the rationale for each second-level construct is provided, as well.

Explanation and Justification of Taxonomy Content

Achievement orientation. Achievement Orientation has been a core construct in personality theory and research for many years. It is perhaps the most intensively studied of Murray's (1938) needs, and is also included in the California Psychological Inventory, the Occupational Personality Questionnaire, the Multidimensional Personality Questionnaire (Tellegen, 1982), and the ABLE (Hough, 1992), among other questionnaires. Achievement Orientation is also represented in Fleishman and Gilbert's (1994) taxonomy of social/interpersonal characteristics.

In the FFM, Achievement Orientation is included in the Conscientiousness factor (e.g., Costa, McCrae, & Dye, 1991; Goldberg, 1990; McCrae & Costa, 1987). In the Digman and Takemoto-Chock (1981) FFM, the factor is even labeled Will to Achieve, reflecting the importance of the achievement element. Hough's (1992) view is that Achievement and Dependability are confounded in the FFM, and she explicitly differentiates those constructs in her taxonomy. Within R. Hogan and J. Hogan's (1992) taxonomy, aspects of Achievement Orientation can be found in the Competitive homogeneous item composite (HIC) in their Ambition factor and in the Mastery HIC within the Prudence factor. Guion's (1992) work with the personality related job analysis questionnaire identified an Achievement Striving factor, as did Fleishman and Gilbert's (1994) social/interpersonal characteristics taxonomy. In sum, Achievement Orientation is prominently reflected in personality taxonomies and inventories.

The construct involves striving for competence in one's work, working hard and valuing hard work, persisting in the face of obstacles, setting high standards and wanting to get ahead (e.g., Costa, McCrae, & Dye, 1991; R. Hogan and J. Hogan, 1992; Hough, 1992; Tellegen & Waller, in press). Thus, in our judgment, Achievement Orientation might be decomposed into three subconstructs for the second-level taxonomy: Achievement/Effort, Persistence, and Initiative. Achievement/Effort reflects setting high standards, establishing tough goals, and expending considerable effort, parts of Achievement Orientation. Persistence refers to the element of not giving up and overcoming even formidable obstacles in getting the job done.

Initiative represents the notion of a willingness to take on new or additional work responsibilities and challenges.

We note that Achievement Orientation may be more instrumental to worker success than it has been in the past. Given the increasingly competitive global economy, workers who are not driven to achieve will be tolerated to a lesser extent than in previous years. We further note that Initiative has become particularly important in organizations. As layers of management are cut through downsizing and organizations provide greater autonomy, Initiative will be crucial to employee success.

There is a great deal of evidence linking Achievement Orientation and related constructs to job-relevant criteria. A meta-analysis reported by Hough (1992) shows that Achievement correlates substantially with Job Proficiency (mean uncorrected $r = .15$), Training Success (mean uncorrected $r = .21$), Commendable Behavior (mean uncorrected $r = .33$), and Law Abiding Behavior (mean uncorrected $r = .42$). In a military population, Hough, Eaton, Dunnette, Kamp, and McCloy (1990) reported correlations of $r = .23$, .18, and .21 (all $p < .01$) between Work Orientation (a facet of Achievement) and Effort & Leadership, Personal Discipline, and Physical Fitness/Military Bearing, respectively. Day and Silverman (1989) found that a construct they called "Orientation Towards Work," derived from Personality Research Form (PRF; Jackson, 1974) scales ([Achievement + Endurance] - Play), was a good predictor of the job performance of accountants. Finally, R. Hogan and J. Hogan (1992) summarized a study in which the HPI was administered to 48 bomb disposal technicians. They reported a correlation of $r = .26$ (no p-value provided) between the Competitive HIC from the HPI and supervisory ratings of job performance.

Social influence. The second first-level construct, Social Influence, closely corresponds to one of the two dimensions of the interpersonal circumplex, which has a long history in personality psychology (Kiesler, 1983; Leary, 1957; Wiggins, 1979; Wiggins, Trapnell, & Phillips, 1988). It is represented in R. Hogan and J. Hogan's (1992) taxonomy as part of Ambition, in Hough's (1992) taxonomy as Potency, in Fleishman and Gilbert's (1994) taxonomy as Persuasion and Energy/Assertiveness, in Mumford's (1994) taxonomy as Persuasion, and in Tellegen's (1982) taxonomy as Social Potency. In addition, it is reflected in

Gough's (1987) Dominance scale and the Persuasive scale of the OPQ. The Social Influence construct is also partly reflected in Guion's (1992) Leadership Orientation facet.

Despite past theoretical linkages between Achievement and Social Influence (e.g., Murray, 1938), the two constructs correlate only about .20 to .30 (Tellegen & Waller, in press). Similarly, Social Influence is distinct from, though moderately related to, Affiliation (R. Hogan & J. Hogan, 1992), which is represented in this taxonomy as part of a construct labeled Interpersonal Orientation. Our feeling is that there are elements of striving and wanting to lead inherent in Social Influence that are not present in Affiliation (Tellegen & Waller, in press; Wiggins, 1991). Affiliation is more inherently communal, involving working well with other people.

The way our taxonomy is configured, Social Influence contains components of interpersonal impact, persuasiveness, and energy. Individuals high on Social Influence enjoy leadership roles, and are correspondingly forceful and decisive. Accordingly, Energy and Leadership Orientation were identified as second-level constructs in this domain. Although it seems reasonable to suggest that Energy facilitates Leadership Orientation, the two subconstructs are also distinct. Leadership Orientation is an inherently social construct, whereas Energy is a temperament construct.

Common sense suggests that Social Influence should be associated with success in a variety of work settings and the evidence supports that observation. Meta-analytic results reported by Hough (1992) show that Potency correlates substantially with criteria coded into categories labeled Sales Effectiveness, Creativity, Effort, and Law Abiding Behavior (mean uncorrected *r*s = .25, .21, .17, and .29, respectively). Hough (1992) also reports an uncorrected mean correlation of .18 between Potency and Job Proficiency for managers and executives (based on 67 correlations and a total sample in excess of 10,000). Based on research with the ABLE, Hough et al. (1990) reported that Dominance and Energy Level, which are second-level facets of Potency, correlated $r = .15$ and $r = .22$ (both $p < .01$), respectively, with an Effort and Leadership performance dimension (both correlations are uncorrected). Hough et al. (1990) also found an uncorrected correlation of $r = .14$ ($p < .01$) between Energy Level and a Personal Discipline performance criterion, and uncorrected correlations of .18 and .25 (both *p*

< .01) between Dominance and Energy Level, respectively, and Physical Fitness/Military Bearing.

In a longitudinal study, Dodd, Wollowick, and McNamara (1970) showed a significant and increasing relationship between the Ascendancy scale of the Gordon Personal Profile (Gordon, 1963), conceptually very similar to Social Influence, and salary for maintenance technicians in a large manufacturing company. For employees who took the Gordon Personal Profile between 1959 and 1961, the correlation ranged from $r = .09$ (n.s.) in 1963 to $r = .24$ ($p < .01$) in 1968, showing an increasing trend throughout the decade of the 1960s. Robertson and Kinder (1993), in their meta-analysis, reported a low but consistent correlation between the Persuasive scale of the OPQ and the criterion Communication Skill (mean $r = .15$).

Finally, R. Hogan and J. Hogan (1992) describe two studies that provide additional support for the criterion-related validity of the Social Influence construct. In one study (R. Hogan, J. Hogan & Griffith, 1985), the HPI Ambition scale correlated $r = .30$ ($p < .01$) with managerial level in a large trucking company. In the other study (Merrill, 1992), the HPI Ambition scale correlated $r = .35$ ($p < .01$) with amount of advertising revenue generated by advertising sales representatives.

Interpersonal orientation. The third construct, Interpersonal Orientation, has elements of Agreeableness and Sociability, although it is weighted more toward the former concept. Regarding the FFM, this construct aligns well with Sociability. Both Fleishman and Gilbert (1994) and Mumford (1994) offer several constructs related to Interpersonal Orientation and its second-level constructs, Cooperative, Caring, and Social. Fleishman and Gilbert suggest Agreeableness, Social Sensitivity, and Sociability, which correspond closely to the meanings of our subconstructs. Also related to our subconstructs are Coordination, Social Perceptiveness, and Engagement, which appear in Mumford's taxonomy.

Hough's (1992) taxonomy includes two personality constructs that suggested the Interpersonal Orientation construct: Affiliation and Agreeableness/Likability. Tellegen's (1982) Social Closeness scale captures aspects of both Affiliation and Agreeableness and thus is quite similar to our Interpersonal Orientation construct. Guion (1992) offers the general dimensions Friendly Disposition, Sensitivity to Others, and Cooperative Work Tendency. These dimensions correspond very closely to the Interpersonal Orientation second-level constructs in the present taxonomy. Our second-level constructs are similarly reflected in several HICs in the HPI (Easy to Live With, Caring, Sensitive, and Likes People), and in several facets of the Big Five measured by the NEO-PI-R (Costa & McCrae, 1992): Compliance, Altruism, Warmth, and Gregarious.

Thus, the Interpersonal Orientation construct, as we have configured it, contains elements of displaying a cooperative attitude toward others on the job, being sensitive to coworkers' needs, and preferring to work with others rather than alone. Our three second-level constructs, Cooperative, Caring, and Social, respectively represent these facets of Interpersonal Orientation. Interpersonal Orientation will be very important to the increasing numbers of individuals who work on teams. Uncooperative, insensitive people who prefer to work alone will have a difficult time in a workplace that, more and more, spawns tasks and projects requiring interdependent work.

Constructs related to Interpersonal Orientation have been shown to relate to important job performance criteria. Hough's (1992) meta-analysis showed Agreeableness to be a valid predictor of a teamwork dimension (mean uncorrected $r = .17$). Moreover, Hough (1992) found that Agreeableness was substantially associated with job proficiency for health care workers (mean uncorrected $r = .19$).

Gellatly, Paunonen, Meyer, Jackson, and Goffin (1991) investigated personality-performance relations in a sample of 114 mangers in a large food service organization. They reported that a personality factor labeled Accommodating and Helpful correlated significantly with supervisory ratings of (a) customer, client, and public relations performance, and (b) administration and accounting practices (*rs* = .26 and .22, respectively).

Finally, R. Hogan and J. Hogan (1992) summarized several studies supporting the job-relatedness of the Interpersonal Orientation factor. For example, Merrill (1992) found that the HPI Sociability scale correlated $r = .51$ ($p < .01$) with advertising revenue generated by advertising sales representatives ($N = 67$). In another study, Muchinsky (1987) administered the HPI to 102 customer service representatives in a telecommunications company. The HPI

Likability and Sociability scales correlated $r = .18$ and .21, respectively (both $p < .05$), with supervisory ratings of work quality.

Adjustment. An Adjustment construct appears in virtually every major personality taxonomy. The FFM includes a factor usually labeled Neuroticism (e.g., McCrae & Costa, 1987) or Emotional Stability (e.g., Goldberg, 1990). Both Hough's (1992) and R. Hogan and J. Hogan's (1992) taxonomies include a construct called Adjustment, and Tellegen's (1982) taxonomy includes a construct closely related to Neuroticism that he has labeled Negative Emotionality.

Adjustment involves being calm, composed, and rational even when confronted with stressful situations. The well-adjusted individual also displays an evenness of mood and is adaptable to even rapidly changing work situations. The three second-level constructs, Self-Control, Stress Tolerance, and Adaptability/Flexibility, reflect these elements of Adjustment.

Self-Control involves restraining the social expression of negative emotion. It corresponds fairly closely with Tellegen's (1982) Aggression construct, R. Hogan and J. Hogan's (1992) Even-Tempered HIC, Costa, McCrae, & Dye's (1991) Hostility facet of Big Five Neuroticism, Gough's (1987) Self Control scale, and the Emotional Control scale from the OPQ. Stress Tolerance is defined as the ability to control negative emotion when exposed to stressors which, in turn, affects people's ability to function effectively. This second-level construct is closely related to Tellegen's (1982) Stress Reaction construct, R. Hogan and J. Hogan's (1992) Calmness HIC, Costa, McCrae, & Dye's (1991) Vulnerability facet of Big Five Neuroticism, and the Worrying and Relaxed scales from the OPQ. In addition, Fleishman and Gilbert (1994) describe a Self Control construct that involves the degree to which self-control, composure, and rationality are maintained in the presence of irritating or stressful stimuli. Despite its label, Fleishman and Gilbert's (1994) Self-Control construct corresponds closely to the Stress Tolerance construct in our taxonomy.

Adaptability/Flexibility was suggested by the Change Orientated scale of the OPQ, R. Hogan and J. Hogan's (1992) Experience Seeking HIC, Costa, McCrae, & Dye's (1991) Actions facet of Big Five Openness to Experience, Fleishman and Gilbert's (1994) and Mumford's (1994) Behavioral Flexibility constructs, and Gough's (1987) Flexibility scale. Adaptability/Flexibility is not usually included in the description of Adjustment and related constructs. Nevertheless, it seems most appropriately included there. In our taxonomy, Adaptability/Flexibility involves less the curiosity, broad interests, love of novelty, and open-mindedness that characterize the FFM Openness to Experience/Intellectance factor (McCrae & Costa, 1987; Goldberg, 1990) than the capacity to cope with stress that is inherent in exposure to a frequently changing work environment. This construct is related to Stress Tolerance; however, it involves tolerating a special kind of stress: the stress caused by exposure to change. It therefore seemed reasonable to distinguish the two constructs. This distinction also makes sense in light of the increasingly dynamic nature of the workplace that external business conditions and rapidly advancing technology are causing. The work environments of the immediate future are clearly going to favor workers who are adaptable.

Adjustment has been linked to several job-related criteria. Hough's (1992) meta-analysis shows that Adjustment relates to criteria such as Irresponsible Behavior (mean uncorrected r = -.15), Sales Effectiveness (mean uncorrected r = .18), Teamwork (mean uncorrected r = .13), Effort (mean uncorrected r = .16), Commendable Behavior (mean uncorrected r = .15), and Law Abiding Behavior (mean uncorrected r = .41). Likewise, Hough et al. (1990) reported that the ABLE's Emotional Stability scale correlated significantly with the performance criteria, Effort & Leadership, Physical Fitness & Military Bearing, and Personal Discipline (uncorrected rs = .17, .16, and .12, respectively; all $p < .01$).

Finally, R. Hogan and J. Hogan (1992) described a study by J. Hogan, Arneson, R. Hogan, and Jones (1986) that involved investigation of personality-performance relations in a sample of 175 therapists working in a hospital for the developmentally disabled. The HPI Adjustment scale correlated r = -.25 ($p < .01$) with number of compensable injuries reported during the previous two years, and r = -.16 ($p < .02$) with number of days compensated for injury during the previous two years.

Conscientiousness. Although the label Conscientiousness is taken from the FFM, we exclude Achievement related content from our Conscientiousness construct. Therefore, Conscientiousness, as defined in this taxonomy, corresponds more closely to Hough's (1992) Dependability construct than to FFM Conscientiousness. Our Conscientiousness construct is also similar to R. Hogan and J. Hogan's Prudence construct, although Prudence also contains some Achievement-related content. Thus, our definition of Conscientiousness includes the elements of being careful, planful, dependable, and disciplined, as well as honest, trustworthy, and accepting of authority. Out of this definition emerge our three second-level constructs, Dependability, Attention to Detail, and Integrity.

Several researchers have proposed second-level dimensions relevant to our Conscientiousness construct (Costa & McCrae, in press; Costa, McCrae, & Dye, 1991; Fleishman & Gilbert, 1994; Gough, 1987; Guion, 1992; R. Hogan & J. Hogan, 1992; Saville & Holdsworth, 1990). For example, Costa, McCrae, and Dye (1991; see also Costa & McCrae, in press) proposed the following dimensions: Dutifulness, defined as strict adherence to standards of conduct; Order, defined as the tendency to keep one's environment tidy and well organized; and Deliberation, defined as being cautious, planful, and thoughtful. These correspond reasonably closely, respectively, with our Integrity, Attention to Detail, and Dependability. R. Hogan and J. Hogan (1992) include the following HICs under their Prudence dimension: Moralistic, defined as adhering strictly to conventional values (our Dependability); and Impulse Control, defined as a tendency to avoid negative behavior (our Integrity, although there are aspects of our Self-Control here, as well). Further, our second-level constructs map almost perfectly onto three of Guion's (1992) dimensions identified by their research team in developing their job analysis questionnaire: General Trustworthiness (Integrity), Adherence to a Work Ethic (Dependability), and Thoroughness & Attentiveness to Details (Attention to Detail).

All of these facets of Conscientiousness are important to many jobs. Employee Integrity (which includes, but is not limited to, our Integrity subconstruct — see Ones, Schmidt, & Viswesvaran, 1994) has become especially important in light of the billions of dollars that American businesses annually lose to employee theft (Camara & Schneider, 1994). Concern over theft and other dishonest behavior is of particular concern in jobs "in which employees have access to cash or merchandise or perform security functions" (Camara & Schneider, 1994, p. 112).

There are substantial data linking Conscientiousness to job performance. Barrick and Mount's (1991) meta-analysis showed that Big Five Conscientiousness correlated substantially with job performance across criteria and occupations (estimated true validity = .22). In subsequent studies, Barrick and Mount (1993) and Barrick, Mount and Strauss (1993) found sizable correlations between Conscientiousness and job performance in samples of civilian managers working in military installations and sales representatives. In the Barrick et al. (1993) study, it was interesting to note that Conscientiousness correlated higher with supervisory ratings of job performance than did the Wonderlic Personnel Test, a test of mental ability (r = .29, p < .01, versus r = .22, p < .05).

In meta-analyses reported by Hough (1992), Dependability correlated substantially with Commendable Behavior (mean uncorrected r = .23), Irresponsible Behavior (mean uncorrected r = -.24), Teamwork (mean uncorrected r = .17), and Law Abiding Behavior (mean uncorrected r = .58). Scales related to Dependability were also shown to correlate substantially and significantly with the following performance criteria in Project A: Effort & Leadership, Personal Discipline, and Physical Fitness/Military Bearing (Hough et al., 1990).

R. Hogan and J. Hogan (1992) summarized a study by R. Hogan, Jacobson, J. Hogan, and Thompson (1987). In that study, the HPI was administered to 79 service dispatchers who handle telephone complaints from customers regarding computer equipment malfunctions. The investigators found that the HPI Prudence scale correlated r = -.40 (p < .01) and r = -.24 (p = .02) with hours absent and error rates, respectively. They also found that Prudence correlated r = .22 (p = .02) with supervisory ratings of Conscientiousness.

Finally, in a recent meta-analysis, Ones, Viswesvaran, and Schmidt (1993) found that measures of Integrity showed a mean corrected correlation of .40 with overall job performance in studies using applicant samples and predictive designs. Part of the Integrity construct in the Ones et al. (1993) meta-analysis is similar to our second-level construct of Integrity, although it is considerably broader (Ones, Schmidt, & Viswesvaran, 1994).

Independence. Independence is represented in the personality taxonomies of Gough (1987), Hough (1992), and Fleishman and Gilbert (1994). Gough (1987; see also Kamp & Gough, 1986) calls the construct Masculinity and Hough (1992) refers to it as Rugged Individualism. Fleishman and Gilbert (1994) propose a construct of Self-Sufficiency, which is also related to Independence. Hough's (1992) Rugged Individualism refers to "decisive, action-oriented, independent, and rather unsentimental" behavior, and this is the essence of our definition of the construct. The construct seems sufficiently focused that we elected not to define any second-level constructs.

It should be noted that Independence can be approximated by a combination of FFM Neuroticism and Agreeableness, which are represented in our taxonomy as Adjustment and Interpersonal Orientation (Hofstee, de Raad, & Goldberg, 1992; McCrae, Costa, & Piedmont, 1993). We chose, however, to include Independence as a separate construct. It has good face validity as an important work styles requirement for some jobs.

The relevance of Independence to the workplace has been empirically established. For example, Hough (1992) found that Rugged Individualism correlated substantially with the performance criterion, Combat Effectiveness — i.e., "survival in combat, reaction to life-threatening situations" (p. 151) (mean uncorrected validity = .25). Also, Day and Silverman (1989) found that a construct they labeled "Orientation Towards Direction From Others" correlated significantly with a criterion labeled Work Ethic (willingness to work long hours and complete assigned tasks) (partial r, controlling for cognitive ability = -.27, $p < .05$).

There appears to be a trend toward individualism in organizational life, or at least "collaborative individualism" (Limerick & Cunnington, 1993). As this trend continues, Independence should become increasingly relevant to success in the workplace. It seems reasonable, however, to suggest that extreme levels of Independence may be counterproductive — particularly in large organizations, where the ability to fit into teams and groups is also increasingly crucial (e.g., Lawler, 1993).

Practical intelligence. Our Practical Intelligence construct has its roots in the FFM construct that has been variously labeled Openness to Experience (McCrae & Costa, 1987), Culture (Norman, 1963; Tupes & Christal, 1961/1992), Intellect (Goldberg, 1990), and Intellectance (R. Hogan & J. Hogan, 1992; Hough, 1992). There have been greater disagreements over the appropriate interpretation of this factor than over any of the other FFM constructs. The crux of the disagreement has been whether the construct should be primarily defined by characteristics such as originality, imagination, breadth of interests, and daring (McCrae & Costa, 1987), which is an Openness to Experience/Culture interpretation, or by intelligence and intellectuality (e.g., Goldberg, 1990). Goldberg (1993) suggested that the Intellect interpretation of the factor is more appropriate. He pointed out that Cattell, whose early work is largely responsible for our current understanding of the FFM (e.g., Cattell, 1943, 1945, 1946, 1947), omitted variables relating to Intellect in his early research in favor of using an intelligence test. This, according to Goldberg (1993), directly led to subsequent interpretations of the factor as Culture (e.g., Norman, 1963; Tupes & Christal, 1961/1992). In Goldberg's research, the Intellect factor is defined by variables such as intellectuality, depth, insight, intelligence, and creativity.

Our Practical Intelligence construct is closer to Goldberg's (1990) Intellect construct than to other researchers' versions of this elusive factor. We acknowledge that the construct also contains some content related to Culture, but these elements have been de-emphasized, primarily because they seem less relevant to jobs and the workplace.

It is important to note that our Practical Intelligence factor is distinct from cognitive ability. McCrae and Costa (1987) report correlations of approximately $r = .30$ between Openness to Experience and intelligence. It is possible that the more Intellect-based versions of the factor overlap with intelligence to a somewhat greater extent than the Culture/Openness to Experience versions, but the discriminant validity of Practical Intelligence is unlikely to be a problem.

The second-level constructs associated with Practical Intelligence are Innovative and Analytical. In selecting these subconstructs, we were influenced by Guion's (1992) constructs Desire to Generate Ideas and Tendency to Think Things Through. The OPQ constructs Innovative and Critical, and Fleishman and Gilbert's (1994) Openness to Experience also suggested these second-level constructs.

Constructs related to Practical Intelligence have been empirically linked to a wide variety of positive work related outcomes. For example, Barrick and Mount's (1991) meta-analysis showed that Openness to Experience correlated with success in training (estimated true validity = .25), a finding that is consistent with research cited in R. Hogan and J. Hogan (1992) relating to their Intellectance construct. Evidence reported by Hough (1992) indicates that Practical Intelligence is also associated with criteria that go beyond success in training. Her results show that her Intellectance construct is associated with Technical Proficiency (mean uncorrected $r = .16$), Irresponsible Behavior (mean uncorrected $r = -.15$), Sales Effectiveness (mean uncorrected $r = .15$), and Commendable Behavior (mean uncorrected $r = .24$).

Practical Intelligence is another construct that should become increasingly important in the workplace. To remain competitive in today's business environment, organizations often encourage employees at all levels to question the status quo and to propose and implement innovations derived from such questioning. Practical Intelligence — and especially the Innovative second-level construct — is far more important now than it was in the era of the conforming organization man (Whyte, 1956).

Summary. In this section, we have described and provided literature support for the two-level taxonomy of work style variables that we have developed for the content model. We have firmly embedded the majority of our constructs in existing, well-respected work style taxonomies. Constructs at both levels are intended to be relevant to jobs and the workplace. They are work-style related job performance requirements. In addition, we have provided considerable empirical evidence that many of these constructs substantially relate to performance and other job relevant criteria. Finally, we believe that the taxonomy is comprehensive, within the constraints of parsimony and job-relatedness. The constructs should be useful in describing important work style requirements in jobs. The questionnaire based on these constructs is Appendix I in Volume II.

Applications

In addition to explaining the theoretical and literature-driven rationale for this taxonomy, it is important to describe some potential applications that might evolve from having work styles descriptors in the O*NET. We see at least three applications for this part of the database:

- Personnel selection
- Counseling
- Self job search.

Personnel selection. Employers will, of course, want to attract and hire workers with the requisite skills, abilities, and experience for jobs. However, it may also be important for some jobs to select individuals according to certain work style requirements. Evidence suggests that work style measures can predict performance and other organizationally relevant criteria. For example, the Barrick and Mount (1991) meta-analysis showed strong support for a conscientiousness construct consistently predicting job performance. Kamp and Hough

(1986) cite many personality correlates of important criteria such as job involvement/withdrawal, job proficiency, and delinquency or problem behavior on the job. Accordingly, it may be useful for employers to use the work styles taxonomy to help make selection decisions.

Notice that what will be required to use the taxonomy in this manner is work styles-requirement data for the target job(s) and work style scores for applicants derived from testing, self-report, or some other method. Then, the employer can essentially match the work style requirements with applicants' scores on these constructs, again, to help make selection decisions. As examples, some dynamic, rapidly changing jobs may have special requirements in the areas of adaptability and stress tolerance, certain inspection jobs might require high levels of detail orientation, and many sales jobs will require high degrees of persistence and independence. Again, these work style requirements should be useful for identifying good applicant-job matches.

Counseling. The work style descriptors should also be useful for counseling prospective employees, at the high school, college, or post-school levels. Most such counseling efforts are focused on matching persons to occupations based on skills, abilities, and vocational interests, but for many occupations and jobs, attention paid to work style should help the counseling process. The examples used above are relevant for a counseling application, as well. A substantial number of occupations and jobs have special work style or temperament requirements, and the counselor can provide more complete guidance by including a consideration of these requirements and how the counselee fits with them.

Self job search. Parallel to the counseling application, an individual could use the work style descriptors in the O*NET to aid in his or her job or occupation search. The work style requirements for various jobs/occupations will be available in the database, and the person doing the search will be able to review these requirements as part of his/her search process.

References

Barrick, M.R., & Mount, M.K. (1991). The big five personality dimensions and job performance: A meta-analysis. *Personnel Psychology, 44*, 1-26.

Barrick, M.R., & Mount, M.K. (1993). Autonomy as a moderator of the relationships between the Big Five personality dimensions and job performance. *Journal of Applied Psychology, 78*, 111-118.

Barrick, M.R., Mount, M.K., & Strauss, J.P. (1993). Conscientiousness and performance of sales representatives: Test of the mediating effects of goal setting. *Journal of Applied Psychology, 78*, 715-722.

Bentz, V.J. (1985). *A view from the top: A 30-year perspective of research devoted to the discovery, description, and prediction of executive behavior.* Paper presented at the annual meeting of the American Psychological Association, Los Angeles.

Camara, W.J., & Schneider, D.L. (1994). Integrity tests: Facts and unresolved issues. *American Psychologist, 49*, 112-119.

Cattell, R.B. (1943). The description of personality: Basic traits resolved into clusters. *Journal of Abnormal and Social Psychology, 38*, 476-506.

Cattell, R.B. (1945). The description of personality: Principles and findings in a factor analysis. *American Journal of Psychology, 58*, 69-90.

Cattell, R.B. (1946). *The description and measurement of personality*. Yonkers, NY: World Book.

Cattell, R.B. (1947). Confirmation and clarification of primary personality factors. *Psychometrika, 12*, 197-220.

Costa, P.T., & McCrae, R.R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources, Inc.

Costa, P.T., & McCrae, R.R. (in press). Domains and facets: Hierarchical personality assessment using the revised NEO Personality Inventory. *Journal of Personality Assessment*.

Costa, P.T., McCrae, R.R., & Dye, D.A. (1991). Facet scales for Agreeableness and Conscientiousness: A revision of the NEO Personality Inventory. *Personality and Individual Differences, 12*, 887-898.

Day, D.V., & Silverman, S.B. (1989). Personality and job performance: Evidence of incremental validity. *Personnel Psychology, 42*, 25-36.

Digman, J.M., & Takemoto-Chock, N.K. (1981). Factors in the natural language of personality: Re-analysis, comparison, and interpretation of six major studies. *Multivariate Behavioral Research, 16*, 149-170.

Dodd, W.E., Wollowick, H.B., & McNamara, W.J. (1970). Task difficulty as a moderator of long-range prediction. *Journal of Applied Psychology, 54*, 265-270.

Fleishman, E.A., & Gilbert, J.A. (1994). *A taxonomy of social/interpersonal characteristics for describing worker requirements for the new occupational classification system*. Unpublished working paper, Management Research Institute, Inc., Bethesda, MD.

Gellatly, I.R., Paunonen, S.V., Myer, J.P., Jackson, D.N., & Goffin, R.D. (1991). Personality, vocational interest, and cognitive predictors of managerial job performance and satisfaction. *Personality and Individual Differences, 12*, 221-231.

Ghiselli, E.E. (1973). The validity of aptitude tests in personnel selection. *Personnel Psychology, 26*, 461-477.

Goldberg, L.R. (1981). Language and individual differences: The search for universals in personality lexicons. In L. Wheeler (Ed.), *Review of Personality and Social Psychology* (Vol. 2, pp. 141-165). Beverly Hills, CA: Sage.

Goldberg, L.R. (1990). An alternative "description of personality:" The big five factor structure. *Journal of Personality and Social Psychology, 59*, 1216-1229.

Goldberg, L.R. (1993). The structure of phenotypic personality traits. *American Psychologist, 48*, 26-34.

Gordon, L.V. (1963). *Gordon Personal Profile (Revised manual)*. New York: Harcourt, Brace and World.

Gough, H.G. (1987). *Manual: The California Psychological Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Guion, R.M. (1992, April). *Matching position requirements and personality*. In L. M. Hough (chair), symposium conducted at the 7th annual meeting of the Society for Industrial and Organizational Psychology, Montreal, Canada.

Guion, R.M., & Gottier, R.F. (1965). Validity of personality measures in personnel selection. *Personnel Psychology, 18*, 135-164.

Hofstee, W.K.B., de Raad, B., & Goldberg, L.R. (1992). Integration of the Big Five and circumplex approaches to trait structure. *Journal of Personality and Social Psychology, 63*, 146-163.

Hogan, J., Arneson, S., Hogan, R., & Jones, S. (1986). *Development and validation of personnel selection procedures for the job of habilitation therapist.* Tulsa: Hogan Selection Systems.

Hogan, R. (1982). Socioanalytic theory of personality. In M. M. Page (Ed.), *1982 Nebraska Symposium on Motivation: Personality-current theory and research* (pp. 55-89). Lincoln: University of Nebraska Press.

Hogan, R. (1986). *Manual for the Hogan Personality Inventory*. Minneapolis, MN: National Computer Systems.

Hogan, R. (1991). Personality and personality measurement. In M.D. Dunnette & L.M. Hough (Eds.), *Handbook of Industrial and Organizational Psychology*. (2nd ed., vol. 2, pp. 327-398). Palo Alto, CA: Consulting Psychologists Press.

Hogan, R. & Hogan, J. (1992). *Manual for the Hogan Personality Inventory*. Tulsa, OK: Hogan Assessment Systems, Inc.

Hogan, R., Hogan, J., & Griffith, S. (1985). *Development and validation of a management potential inventory*. Tulsa, OK: The University of Tulsa.

Hogan, R., Jacobson, G., Hogan, J., & Thompson, B. (1987). *Development and validation of a service operations dispatcher selection inventory*. Tulsa: Hogan Assessment Systems.

Hough, L.M. (1992). The "big five" personality variables -- construct confusion: Description versus prediction. *Human Performance, 5*, 139-155.

Hough, L.M. (in press). Development of "Assessment of Background and Life Experiences" (ABLE): A temperament inventory. In J. P. Campbell (Ed.), *Exploring the limits: Performance improvement through personnel selection and differential job assignments.*

Hough, L.M., Eaton, N.K., Dunnette, M.D., Kamp, J.D., & McCloy, R.A. (1990). Criterion-related validities of personality constructs and the effect of response distortion on those validities [Monograph]. *Journal of Applied Psychology, 75*, 581-595.

Jackson, D.N. (1974). *Personality Research Form manual* (2nd ed.). Port Huron, MI: Research Psychologists Press.

Kamp, J.D., & Gough, H.G. (1986, August). *The Big Five personality factors from an assessment context.* Paper presented at the 94th Annual Convention of the American Psychological Association, Washington, DC.

Kamp, J.D., & Hough, L.M. (1986). Utility of personality assessment: A review and integration of the literature. In L.M. Hough (Ed.), *Utility of temperament, biodata, and interest assessment for predicting job performance: A review and integration of the literature* (ARI Research Note No. 88-02, pp. 1-90). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Kiesler, D.J. (1983). The 1982 interpersonal circle: A taxonomy for complementarity in human transactions. *Psychological Review, 90,* 185-214.

Lawler, E.E. (1993). Creating the high-involvement organization. In Galbraith, J.R., Lawler, E.E., and Associates (Eds.), *Organizing for the future: The new logic for managing complex organizations* (pp. 172-193). San Francisco: Jossey-Bass.

Leary, T. (1957). *Interpersonal diagnosis of personality.* New York: Ronald Press.

Limerick, D., & Cunnington, B. (1993). *Managing the new organization: A blueprint for networks and strategic alliances.* San Francisco: Jossey-Bass.

McCrae, R.R., & Costa, P.T., Jr. (1987). Validation of the five factor model across instruments and observers. *Journal of Personality and Social Psychology, 52,* 81-90.

McCrae, R.R., & Costa, P.T., Jr., & Piedmont, R.L. (1993). Folk concepts, natural language, and psychological constructs: The California Psychological Inventory and the five-factor model. *Journal of Personality, 61,* 1-26.

Merrill, D. (1992). *Validation of personality scales for sales selection.* Friendship, ME: The Maine Idea.

Muchinsky, P. (1987). *Validation documentation for the development of personnel selection test batteries for telecommunications service jobs.* Ames: Iowa State University.

Mumford, M.D. (1994). *Draft taxonomies of skills.* Working paper, American Institutes for Research, Washington, DC.

Murray, H.A. (1938). *Explorations in personality.* New York: Oxford.

Norman, W.T. (1963). Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. *Journal of Abnormal and Social Psychology, 66*, 574-583.

Ones, D.S., Schmidt, F.L., & Viswesvaran, C. (1994, April). *Do broader personality variables predict job performance with higher validity?* Paper presented in R. Page (Chair), Personality and job performance: Big Five versus specific traits. Symposium conducted at the ninth annual conference of the Society for Industrial and Organizational Psychology, Nashville, Tennessee.

Ones, D.S., Viswesvaran, C., & Schmidt, F.L. (1993). Comprehensive meta-analysis of integrity test validities: Findings and implications for personnel selection and theories of job performance [Monograph]. *Journal of Applied Psychology, 78*, 679-703.

Robertson, I.T., & Kinder, A. (1993). Personality and job competencies: The criterion-related validity of some personality variables. *Journal of Occupational and Organizational Psychology, 66*, 225-244.

Saville, P., & Holdsworth, R. (1990). *Occupational Personality Questionnaire manual.* Esher, Surrey: Saville & Holdsworth.

Tellegen, A. (1982). *Brief manual for the Multidimensional Personality Questionnaire.* Unpublished manuscript, University of Minnesota, Department of Psychology, Minneapolis.

Tellegen, A., & Waller, N.G. (in press). Exploring personality through test construction: Development of the Multidimensional Personality Questionnaire. In S.R. Briggs, & J. M. Cheek (Eds.), *Personality measures: Development and evaluation (Vol. 1).* Greenwich, CT: JAI Press.

Tupes, E.C., & Christal, R.E. (1992). Recurrent personality factors based on trait ratings. *Journal of Personality, 60,* 225-251. (Original technical report released 1961)

Whyte, W.H. (1956). *The organization man.* New York: Simon and Schuster.

Wiggins, J.S. (1979). A psychological taxonomy of trait-descriptive terms: The interpersonal domain. *Journal of Personality and Social Psychology, 37,* 395-412.

Wiggins, J.S. (1991). Agency and communion as conceptual coordinates for the understanding and measurement of interpersonal behavior. In W. M. Grove and D. Cicchetti (Eds.), *Thinking clearly about psychology: Essays in honor of Paul Everett Meehl (Vol. 2, pp. 89-113).* Minneapolis: University of Minnesota Press.

Wiggins, J.S., Trapnell, P., & Phillips, N. (1988). Psychometric and geometric characteristics of the Revised Interpersonal Adjective Scales (IAS-R). *Multivariate Behavioral Research, 23,* 517-530.

Appendix 12-A

Higher Order Descriptors of Work Styles

Construct Label	Definition	Citations	SCANS Scales	Level Scale Anchors
I. Achievement Orientation	Job requires personal goal setting, trying to succeed at those goals, and striving to be competent in own work.	Digman & Takemoto-Chock (1981) Fleishman & Gilbert (1994) Gough (1987) Guion (1992) R. Hogan & J. Hogan (1992) Hough (1992) Saville & Holdsworth (1990) Tellegen (1982)	Responsibility Self-Management	*High* — Requires setting very high standards, concentrating on and persisting in challenging tasks, and being driven by a need for success. *Medium* — Requires setting high standards, trying to do a good job, concentrating on and persisting in routine tasks, and a moderate level of need for success. *Low* — Does not necessarily require high standards in work, or an undue amount of effort or persistence.
II. Social Influence	Job requires having an impact on others in the organization, and displaying energy and leadership.	Fleishman & Gilbert (1994) Gough (1987) Guion (1992) R. Hogan & J. Hogan (1992) Hough (1992) Mumford (1994) Saville & Holdsworth (1990) Tellegen (1982) Wiggins, Trapnell, & Phillips (1988)	Social Self-Esteem	*High* — Requires being very energetic, and strongly preferring to lead and influence others. *Medium* — Requires being moderately outgoing and energetic, and having some preference to lead and influence others. *Low* — Rarely requires outgoing, energetic, or influential behavior.

Appendix 12-A

Higher Order Descriptors of Work Styles (Continued)

Construct Label	Definition	Citations	SCANS Scales	Level Scale Anchors
III. Interpersonal Orientation	Job requires being pleasant, cooperative, sensitive to others, easy to get along with, and having a preference for associating with other organization members.	Fleishman & Gilbert (1994) Guion (1992) R. Hogan & J. Hogan (1992) Hough (1992) McCrae & Costa (1987) Mumford (1994) Tellegen (1982) Wiggins, Trapnell, & Phillips (1988)	Social	*High* — Requires very friendly, helpful, and non-confrontational behavior. *Medium* — Requires moderately friendly, helpful, and non-confrontational behavior. *Low* — Requires comparatively little friendly, helpful, or non-confrontational behavior.
IV. Adjustment	Job requires maturity, poise, flexibility, and restraint to cope with pressure, stress, criticism, setbacks, personal and work-related problems, etc.	Fleishman & Gilbert (1994) Goldberg (1990) Gough (1987) Guion (1992) R. Hogan & J. Hogan (1992) Hough (1992) McCrae & Costa (1987) Mumford (1994) Saville & Holdsworth (1990) Tellegen (1982)	Self-Esteem Self-Management	*High* — Requires being very calm and adaptable, maintaining composure, and avoiding overly emotional behavior. *Medium* — Requires being generally calm and adaptable, attempting to maintain composure, and avoiding overly emotional behavior. *Low* — Does not necessarily require being calm or maintaining composure.

Appendix 12-A

Higher Order Descriptors of Work Styles (Continued)

Construct Label	Definition	Citations	SCANS Scales	Level Scale Anchors
V. Conscientiousness	Job requires dependability, commitment to doing the job correctly and carefully, and being trustworthy, accountable, and attentive to details.	Goldberg (1990) R. Hogan & J. Hogan (1992) Hough (1992) McCrae & Costa (1987) Saville & Holdsworth (1990)	Responsibility Integrity/Honesty Self-Management	*High* — Requires being highly responsible, dependable, and trustworthy on the job. *Medium* — Requires being moderately responsible, dependable, and trustworthy on the job. *Low* — Does not necessarily require much dependability on the job.
VI. Independence	Job requires being autonomous, following own way of doing things, guiding oneself with little or no supervision, and depending mainly on oneself to get things done.	Fleishman & Gilbert (1994) Gough (1987) Hough (1992) Kamp & Gough (1986)	Self-Management	*High* — Requires a very high level of autonomy, with little or no dependence on others, to get job done. *Medium* — Requires a moderate level of autonomy, with some dependence on others, to get job done. *Low* — Does not require working on own to get job done.
VII. Practical Intelligence	Job requires generating useful ideas and thinking things through logically.	Goldberg (1990) R. Hogan & J. Hogan (1992) Hough (1992) McCrae & Costa (1987) Norman (1963) Tupes & Christal (1961/1992)	Reasoning Creative Thinking	*High* — Requires consistently generating high quality, very useful, work-related ideas and being very logical and effective in thinking through job and work issues and problems. *Medium* — Requires generally coming up with useful, work-related ideas and usually being logical and effective in thinking through job and work issues and problems. *Low* — Does not necessarily require generating useful, work-related ideas or having to logically think through job and work issues and problems.

Appendix 12-B

Lower Order Descriptors of Work Styles

Construct Label	Definition	Citations	Level Scale Anchors
I A. Achievement/ Effort	Job requires establishing and maintaining personally challenging achievement goals, and exerting effort toward task mastery.	Costa, McCrae, & Dye (1991) Guion (1992) R. Hogan & J. Hogan (1992)	*High* — Requires continual extensive effort toward achievement of work goals. *Medium* — Requires sustained effort toward achievement of work goals. *Low* — Requires only moderate levels of effort toward achievement of work goals.
I B. Persistence	Job requires persistence in the face of obstacles on the job.	Costa, McCrae, & Dye (1991) R. Hogan & J. Hogan (1992)	*High* — Requires high levels of persistence when work becomes difficult. *Medium* — Requires moderate levels of persistence on the job. *Low* — Requires little persistence on the job; few obstacles are encountered.
I C. Initiative	Job requires being willing to take on job responsibilities and challenges.	Robertson & Kinder (1993)	*High* — Requires volunteering to take on new or additional work responsibilities and challenges. *Medium* — Requires some willingness to take on new work responsibilities and challenges. *Low* — Requires little interest in new work responsibilities or challenges; responsibilities are structured and stable.
II A. Energy	Job requires the energy and stamina to accomplish work tasks.	Costa, McCrae, & Dye (1991)	*High* — Requires very high levels of energy to get tasks done. *Medium* — Requires moderate levels of energy to get tasks done. *Low* — Requires little energy to get tasks done; job is not very physically or mentally demanding.

Appendix 12-B

Lower Order Descriptors of Work Styles (Continued)

Construct Label	Definition	Citations	Level Scale Anchors
II B. Leadership Orientation	Job requires a willingness to lead, take charge, and offer opinions and direction.	Costa, McCrae, & Dye (1991) Guion (1992) R. Hogan & J. Hogan (1992) Tellegen (1982)	*High* — Requires a strong preference for making decisions, and leading or directing other organization members. *Medium* — Requires some preference for making decisions, and leading or directing other organization members. *Low* —Requires little or no leader decision making.
III A. Cooperative	Job requires being pleasant with others on the job and displaying a good-natured, cooperative attitude that encourages people to work together.	Costa, McCrae, & Dye (1991) Fleishman & Gilbert (1994) Guion (1992) R. Hogan & J. Hogan (1992) Hough (1992) Mumford (1994)	*High* — Requires working very smoothly and cooperatively with others on the job. *Medium* — Requires generally working smoothly and cooperatively with others on the job. *Low* — Requires little interaction with others.
III B. Caring	Job requires being sensitive to others' needs and feelings, and being understanding and helpful on the job.	Costa, McCrae, & Dye (1991) Fleishman & Gilbert (1994) Gough (1987) Guion (1992) R. Hogan & J. Hogan (1992) Mumford (1994) Saville & Holdsworth (1990)	*High* — Requires very high levels of sensitivity to others' needs and feelings, and consistent caring and support for others on the job. *Medium* — Requires high levels of sensitivity, caring, and support toward others on the job. *Low* — Requires sensitivity, caring, and support toward others on the job, but this is not a highly important trait for this job.

Appendix 12-B

Lower Order Descriptors of Work Styles (Continued)

Construct Label	Definition	Citations	Level Scale Anchors
III C. Social	Job requires preferring to work with others rather than alone and being personally connected with others on the job.	Costa, McCrae, & Dye (1991) Fleishman & Gilbert (1994) Gough (1987) Guion (1992) R. Hogan & J. Hogan (1992) Hough (1992) Mumford (1994) Saville & Holdsworth (1990)	*High* — Requires a high degree of participation and working closely with other organization members. *Medium* — Requires a moderate degree of participation and, at times, working closely with other organization members. *Low* — Requires little participation with other organization members; usually works alone.
IV A. Self-Control	Job requires maintaining composure, keeping emotions in check even in very difficult situations, controlling anger, and avoiding aggressive behavior.	Costa, McCrae, & Dye (1991) Gough (1987) R. Hogan & J. Hogan (1992) McCrae & Costa (1987) Saville & Holdsworth (1990) Tellegen (1982)	*High* — Requires a very high degree of self-control and behaving in a non-threatening manner. *Medium* — Requires a high degree of self-control. *Low* — This job does not usually involve situations that challenge self-control.

Appendix 12-B

Lower Order Descriptors of Work Styles (Continued)

Construct Label	Definition	Citations	Level Scale Anchors
IV B. Stress Tolerance	Job requires accepting criticism, and dealing calmly and effectively with high stress situations.	Costa, McCrae, & Dye (1991) Fleishman & Gilbert (1994) R. Hogan & J. Hogan (1992) Saville & Holdsworth (1990) Tellegen (1982)	*High* — Requires being extremely calm and tolerant of stress imposed by other people or by circumstances. *Medium* — Requires being moderately calm and tolerant of stress imposed by other people or by circumstances. *Low* — This job does not involve much stress.
IV C. Adaptability/ Flexibility	Job requires being open to change (positive or negative) and to considerable variety in the workplace.	Costa, McCrae, & Dye (1991) Fleishman & Gilbert (1994) Gough (1987) R. Hogan & J. Hogan (1992) Mumford (1994) Saville & Holdsworth (1990)	*High* — Requires being highly flexible and adaptable, even to rapidly changing work situations. *Medium* — Requires being moderately flexible and adaptable to changing work situations. *Low* — Rarely requires being flexible to changing work situations; this job and work setting are usually stable.
V A. Dependability	Job requires being reliable, responsible, and dependable, and fulfilling obligations.	Costa, McCrae, & Dye (1991) Fleishman & Gilbert (1994) Gough (1987) Guion (1992) R. Hogan & J. Hogan (1992)	*High* — Requires the highest levels of responsibility and dependability in fulfilling job and work obligations. *Medium* — Requires considerable responsibility and dependability in fulfilling job and work obligations. *Low* — Requires responsibility and dependability, but if work is not done, it can be transferred to others.

Appendix 12-B

Lower Order Descriptors of Work Styles (Continued)

Construct Label	Definition	Citations	Level Scale Anchors
V B. Attention to Detail	Job requires being careful about detail and thorough in completing work tasks.	Costa, McCrae, & Dye (1991) Guion (1992) Saville & Holdsworth (1990)	*High*—Requires a very high degree of care and thoroughness in handling details on the job. *Medium*—Requires a high degree of care and attention to detail in handling job duties. *Low*—Requires attention to detail in handling job duties, but this is not a highly important trait for this job.
V C. Integrity	Job requires being honest and avoiding unethical behavior.	Costa, McCrae, & Dye (1991) Fleishman & Gilbert (1994) Guion (1992) R. Hogan & J. Hogan (1992)	*High*—Requires the highest levels of integrity and a willingness to abide by a strict code of ethics or behavior. *Medium*—Requires a great deal of integrity and abiding by a standard code of ethics and behavior. *Low*—Job does not generally require ethical choices or abiding by a code of ethics.
VI. Independence	Job requires developing own ways of doing things, guiding oneself with little or no supervision, and depending mainly on oneself to get things done.	Fleishman & Gilbert (1994) Gough (1987) Hough (1992) Kamp & Gough (1986)	*High*—Requires a very high level of autonomy, with little or no dependence on others, to get job done. *Medium*—Requires a moderate level of autonomy, with some dependence on others, to get job done. *Low*—Does not work alone; requires working with others to get the job done.
VII A. Innovate	Job requires creativity and alternative thinking to come up with new ideas for and answers to work-related problems.	Fleishman & Gilbert (1994) Guion (1992) R. Hogan & J. Hogan (1992) Saville & Holdsworth (1990)	*High* — Requires a lot of creative thinking and coming up with new ideas related to work, addressing job and work issues and problems, etc. *Medium* — Requires moderate levels of creative thinking and coming up with ideas related to work, addressing job and work issues and problems, etc. *Low* — Work requires little or no creative thinking.

Appendix 12-B

Lower Order Descriptors of Work Styles (Continued)

Construct Label	Definition	Citations	Level Scale Anchors
VII B. Analytical	Job requires analyzing information, and using logic to address work or job issues and problems.	Costa, McCrae, & Dye (1991) Guion (1992) Saville & Holdsworth (1990)	*High* — Requires being very good at analyzing complex issues, data, or problems related to work and consistently coming up with high quality, useful information. *Medium* — Requires being generally good at analyzing complex issues, data, or problems related to work and coming up with high quality, useful information. *Low* — Job does not require analyzing complex information

Appendix 12-C

Crosswalk Relating Content Model Work Style Taxonomy to Personality Taxonomies

Content Model Constructs	Five-Factor Model	R. Hogan & J. Hogan (1992)	Hough (1992)	Guion (1992)	Fleishman & Gilbert (1994)	Mumford (1994)	Tellegen (1982)	Interpersonal Circle (e.g., Wiggins, Trapnell, & Phillips, 1988)	Gough (1987)	Saville & Holdsworth (1990)
I. Achievement Orientation	Surgency		Achievement		Achievement Striving		Achievement		Achievement via Conformance and Achievement via Independence	Achieving
A. Achievement/Effort	Achievement Striving (Facet)	Mastery (HIC)		Achievement Striving						
B. Persistence	Self-Discipline (Facet)	Competitive (HIC)								
C. Initiative										
II. Social Influence	Surgency	Ambition	Potency		Energy/ Assertiveness Persuasion	Persuasion	Social Potency	Assured-Dominant	Dominance	Persuasive
A. Energy	Activity (Facet)		Potency							
B. Leadership Orientation	Assertiveness (Facet)	Leadership (HIC)		General Leadership			Social Potency			
III. Interpersonal Orientation	Agreeableness	Likability/ Sociability	Agreeableness/ Likability				Social Closeness	Warm-Agreeable		
A. Cooperative	Compliance (Facet)	Easy to Live With (HIC)		Cooperative	Agreeableness	Coordination				
B. Caring	Altruism (Facet)	Caring (HIC) Sensitive (HIC)		Sensitivity	Social Sensitivity	Coordination Social Perceptiveness			Empathy	Caring

Appendix 12-C

Crosswalk Relating Content Model Work Style Taxonomy to Personality Taxonomies (Continued)

Content Model Constructs	Five-Factor Model	R. Hogan & J. Hogan (1992)	Hough (1992)	Guion (1992)	Fleishman & Gilbert (1994)	Mumford (1994)	Tellegen (1982)	Interpersonal Circle (e.g., Wiggins, Trapnell, & Phillips, 1988)	Gough (1987)	Saville & Holdsworth (1990)
C. Social	Warmth (Facet) Gregarious (Facet)	Likes People (HIC)	Affiliation	Friendly Disposition	Sociability	Engagement			Sociability	Outgoing, Affiliative, Socially Confident
IV. Adjustment	Emotional Stability	Adjustment	Adjustment	Emotional Stability			Negative Emotionality			
A. Self Control	Hostility (Facet)	Even Tempered (HIC)					Aggression		Self Control	Emotional Control
B. Stress Tolerance	Vulnerability (Facet)	Calmness (HIC)			Self Control		Stress Reaction			Worrying, Relaxed
C. Adaptability/ Flexibility	Actions (Facet)	Experience Seeking (HIC)			Behavioral Flexibility	Behavioral Flexibility			Flexibility	Change Orientated
V. Conscientiousness	Conscientiousness	Prudence	Dependability							Conscientious
A. Dependability	Deliberation (Facet)	Moralistic (HIC)		Work Ethic	Dependability				Responsibility	
B. Attention to Detail	Order (Facet)			Attention to Detail						Detail Conscious
C. Integrity	Dutifulness (Facet)	Impulse Control (HIC)		General Trustworthiness	Social Conformity					
VI. Independence			Rugged Individualism		Self-Sufficiency				Masculinity/ Femininity	
VII. Practical Intelligence	Intellectance	Intellectance	Intellectance							
A. Innovate		Generate Ideas (HIC)		Ability to Generate Ideas	Openness to Experience					Innovative

Appendix 12-C

Crosswalk Relating Content Model Work Style Taxonomy to Personality Taxonomies (Continued)

Content Model Constructs	Five-Factor Model	R. Hogan & J. Hogan (1992)	Hough (1992)	Guion (1992)	Fleishman & Gilbert (1994)	Mumford (1994)	Tellegen (1982)	Interpersonal Circle (e.g., Wiggins, Trapnell, & Phillips, 1988)	Gough (1987)	Saville & Holdsworth (1990)
B. Analytical	Ideas (Facet)			Tendency to Think Things Through						Critical

SECTION V

OCCUPATION CHARACTERISTICS

Section V
Occupation Characteristics

In this section, we describe the broader environmental forces that affect jobs. In Section II, we examined the characteristics of the immediate work environment and the organization in which the employee works. In this section, we describe the broader context, particularly economic, in which the organization functions.

This section contains a single chapter, which focuses on characteristics of the labor market. Among the aspects of the labor market that are considered in this chapter are industry, employment opportunities, job scarcity, and pay. This chapter not only describes the types of information about the labor market that must be included in the O*NET but also identifies sources for this information.

Chapter 13
Occupation Characteristics
Table of Contents

Table

Figures

Appendix

Chapter 13
Occupation Characteristics

Lloyd Feldman, Frank Bennici,
& Regina Yudd
Westat, Inc.

Background

In its final report (U.S. Department of Labor [DOL], 1993), the Advisory Panel for the Dictionary of Occupational Titles (APDOT; DOL, 1991) recommended construction of an occupational database that would be "reinvented to reflect the changing nature of work in the global economy." Specifically, APDOT recommended a "content model" that would serve as a framework for the Department of Labor in identifying the information that would be included in a new occupational database. The model provides for a single coherent, integrated system in which information for individual occupations would be organized under four basic headings: worker attributes; work context; work content and outcomes; and labor market context. APDOT viewed the labor market context component as including "descriptors related to the broader economic and labor market setting in which jobs are performed, as well as information regarding how these factors affect jobs."

The labor market context component of the content model — which is the subject of this report — would represent a new ingredient for the DOT. While, in the past, crosswalks have been developed between the Dictionary and other classification systems used in various sources of labor market information (LMI), information about the labor market for specific occupations was not included in the DOT. The classification system of the new database will, as recommended by APDOT, be more compatible with the classification systems of other sources of occupational information, including labor market information. This will enhance the feasibility of accessing and incorporating labor market information for occupations in the new database.

The desirability of linking occupational and labor market information in an integrated system was underscored by the results of a survey of current DOT users recently conducted for DOL (Westat, 1993). A majority of the users surveyed — 58% — felt that it would be very important, in their work, to be able to link labor market information, such as employment and wage data, with occupational information; an additional 30% indicated that it would be moderately important.

In this chapter, we propose the specifications — descriptors and data sources — for the labor market context component of the content model. Before turning to the specifications, we will note several of our working assumptions about the parameters of the labor market context component of the new database and outline the methodology we followed in our research.

Working Assumptions. In developing the labor market context component of the model, we adopted the following working assumptions:

- <u>The labor market context component is not intended to constitute a new LMI data collection system</u> but, rather, to very selectively tap and summarize data from existing sources of LMI and to link this information with the occupational information contained in the other sections of the content model. This contrasts with the other three components of the model which will require new data collection from establishments or individuals for the descriptors in those components.

- <u>Information for certain descriptors will be available for only a limited number of occupations</u>. We decided to include certain descriptors in this component which we felt would contribute to an understanding of the labor market context for individual occupations, although data for these descriptors are only available for a limited number of occupations. An alternative would have been to include only those descriptors for which data are available for virtually all occupations.

- <u>While our research focused on databases comprised of federally-collected data because of their accessibility and value as national indicators, we also recognized the importance of linking the new occupational database to state and</u>

local LMI databases. For many categories of users, the most valuable labor market context information will be information that is state and local in nature and is compiled by state governments rather than by the federal government. Later in this chapter, we discuss these state LMI databases and how they can be linked to the new occupational database. Collection and analysis of national, state and local LMI represent a division of labor between the federal government — primarily the Bureau of Labor Statistics (BLS) — and state employment security agencies (SESAs) in conjunction with the National Occupational Coordinating Committee (NOICC)/ State Occupational Coordinating Committee (SOICC) network. This division of responsibility is discussed in greater detail in Figure 13-1.

The Bureau of Labor Statistics (BLS) is the principal federal data-gathering agency in the broad field of labor economics. Most of the BLS's data come from voluntary responses to surveys of businesses or households conducted by BLS staff, by the Bureau of the Census (on a contract basis), or in conjunction with cooperating state and federal agencies.

BLS works cooperatively with the state employment security agencies (SESAs) to collect, analyze, and disseminate labor market information (LMI). BLS provides funding to the states for these purposes and requires states to adhere to strict guidelines and schedules. Typically, state LMI divisions within the SESAs carry out the BLS contract work.

The SESAs also collect, analyze, and disseminate their own state and local labor information. In this effort, they are assisted by the State Occupational Coordinating Committees (SOICCs) which, under the leadership of the staff of the National Occupational Information Coordinating Committee (NOICC) (a statutory federal interagency information coordinating committee), have developed computerized, multi-source state occupational LMI databases.

In addition to federal funding from BLS, the SESAs receive funds from the Employment and Training Administration (ETA) of the U.S. Department of Labor (DOL) to maintain administrative databases for DOL programs such as the unemployment insurance and Employment Service programs.

Figure 13-1
Structure of LMI Data Gathering, Analysis, and Dissemination in the United States

- We also recognized the possibility of linking non-government LMI databases to the new occupational database but inventorying these sources was beyond the scope of this current effort. For example, labor supply and wage data are available from various trade and professional associations.

- Data in the labor market context component will require far more frequent updating than will data in other components of the content model. While all elements of the content model will need to be updated over time, the labor market situation for specific occupations is likely to be far more dynamic and require more frequent updating. Computerization of the new database will make such updating more feasible than would have been possible in the past, although the task will be complicated by variation in the reporting frequencies for the data series that will serve as sources for this component.

Methodology. In approaching this task, our starting point was the discussion of labor market context in the technical proposal for this project (AIR, 1994). Our first step was to formulate a list of potential labor market descriptors based on the list included in the proposal and supplemented by internal staff discussion. We also developed a matrix that would be used in inventorying and describing the key features of the available data sources for each of the descriptors. Both the list of descriptors and the matrix were circulated for review by members of the research team.

The second stage of our work involved library research to: (a) identify one or more possible data sources for each of the potential descriptors, (b) enter in the matrix descriptive information for each of the sources, (c) note any technical limitations in the sources and (d) identify other descriptors which might be added to our list. The research was conducted in the contractor, Department of Labor (DOL) and Department of Education libraries.

During the second stage, a meeting was held with the DOL project officer and her staff to discuss our analytic approach to the project and the remaining steps, particularly the arrangements for interviewing DOL personnel.

The third stage in our research involved interviews with representatives of the agencies responsible for the data sources identified in our library research and with other LMI experts.

The interviews were intended to achieve several objectives: to review and correct the entries in our matrix of descriptors/sources; to solicit suggestions for additional/alternative descriptors and sources; to discuss the accessibility of the sources and any potential technical problems in their use; and, more generally, to discuss the desirability of including a labor market context component in the new occupational database. (A list of the agencies that were contacted is presented in Figure 13-2.)

Employment and Training Administration

Bureau of Labor Statistics

National Occupational Coordinating Committee

National Center for Educational Statistics

Ohio Bureau of Employment Security

Interstate Conference of Employment Security Agencies

Iowa Crosswalk Service Center

Washington State Prevailing Wage Advisory Panel

Defense Manpower Data Center

Figure 13-2
List of Agencies Contacted

Based on these interviews and further library research, we refined and edited the entries in our matrix of potential descriptors and sources. We also utilized the results of the interviews in selecting the most appropriate data source for each descriptor where more than one source was available. We reviewed the revised matrix in order to select those descriptors that we would recommend be given priority for inclusion in the prototype.

Overview of Report. In the next part of this chapter, we present a menu of potential labor market context descriptors, note some potential uses of the descriptors and describe and comment on data sources for the descriptors. (The matrix of descriptors and sources is appears in Appendix 13-A.) We then discuss the possibility of linking state labor market information databases to the new occupational database. As we noted at the outset, one of our working assumptions is that many users of the new system will be primarily interested in the state and local labor market context of occupations. Thus, we discuss the possibility of linking the labor market context descriptors with state and local data for these descriptors available from the non-federal LMI systems that exist — in varying levels of detail and quality — in each of the 50 states. We conclude this chapter by recommending the descriptors and databases that we feel should be given priority for inclusion in the labor market context component.

Potential Labor Market Context Descriptors

In this section, we present a menu of descriptors that may be appropriate for inclusion in the labor market context component of the content model. To assist reviewers in selecting the descriptors that will eventually be included in the model, we comment on some of the potential uses of each descriptor and discuss the available databases that could be used as sources for the descriptors.

While we recognize that the various users of the new occupational database are likely to find virtually all labor market descriptors useful to some extent, we note those user groups that may make particular use of individual descriptors. The principal groups of users discussed in this chapter and specific examples of how the labor market context component will be used by these groups are listed in Table 13-1.

Table 13-1
Potential Uses of Labor Market Component of New Occupational Database

USER GROUP	EXAMPLES OF USE
Counseling and Job Placement	• Career, vocational counseling • Individual vocational exploration and career planning • Individual job search • ES, private agency placement activities
Education, Training, Economic Planning	• Planning JTPA, other job training • Planning vocational education • Developing curricula • Economic development
Human Resource Management	• Recruitment • Compensation • Labor/management negotiations • Training
Regulatory Determination/Compliance	• Alien labor certification • EEO/affirmative action

The databases discussed in this section are all data series collected by federal agencies. We focused on federal sources in our research because they are the most readily accessible, will provide national labor market indicators for occupations and are most likely to be used in the first generation of the new occupational database. While these databases provide information at the national level, only some of the series also provide data at the state level and substate information, where provided, is limited to only a few large metropolitan areas.

For most of the descriptors we will discuss, it will be desirable to present labor market trend data rather than a single-point-in-time measure. To present trends, however, consistency in the definition of a descriptive measure over time will be an important consideration.

The potential labor market context descriptors we will discuss provide information with respect to three different aspects of the labor market for individual occupations and will be discussed under these broad headings: labor demand descriptors; labor supply descriptors; and descriptors that provide other labor market information about the occupations. Under each of these headings, we list the descriptors, note some potential uses of the descriptor, and indicate the data sources for the descriptor.

We describe and comment on each of the sources, highlighting some of their strengths and limitations. The sources to be discussed and their principal features are presented in matrix form in Appendix 13-A. For each descriptor database, the matrix displays: the definition of the descriptor used, the occupational coding system and available occupational detail, occupational coverage, industry coverage, geographic coverage, availability (format and frequency), and additional comments on the database.

Labor Demand Descriptors. Labor demand descriptors will provide users with an indication of the current or projected demand for workers in an occupation. We have identified four labor demand descriptors that should be considered for inclusion in the content model. We note some of the possible uses of each descriptor and list the available data sources for each.

1. Current occupational employment. This descriptor would provide the total number of persons employed in an occupation, either as of a specific period of time (e.g. annual average) or as a trend covering a series of time periods.[1] The data would cover the most recently available time periods.

(a) *Use of descriptor*. It would enable users to gauge the relative magnitude of employment in an occupation and, if presented as a time series, to determine whether employment in the occupation has grown, contracted or remained stable in recent years. Individuals exploring careers or actively seeking employment would have a particular interest in information at the state and local levels which would serve as an indicator of those areas where employment opportunities are likely to be most prevalent. The descriptor would serve similar purposes for counselors and training

[1] Ideally, a complete measure of current demand in an occupation would consist of current occupational employment plus current unmet demand in the occupation, as measured by unfilled job vacancies. While DOL has experimented in the past with various approaches to collecting vacancy data, such data are not presently collected. Thus, we use current occupational employment as the best available proxy for the current demand for labor in an occupation.

program planners but its value would be greatly enhanced if used in conjunction with the descriptor on projected employment, discussed below.

(b) Sources: Current Population Survey

2. Current occupational employment, by industry. This descriptor would provide, for all individuals employed in a given occupation, the distribution of occupational employment by specific industry. As in the case of descriptor 1 on current employment, the data would cover the most recently available time periods and could be presented either as of a specific period of time (e.g., annual average) or as a trend covering a series of time periods.

(a) *Use of descriptor.* This descriptor would enable users who may be interested in a particular occupation — particularly job seekers, employment counselors and placement specialists — to identify those industries in which the occupation is heavily represented, thus enabling them to target and narrow their job search and placement activities. Presented as a time series, the descriptor can indicate whether employment in an occupation is expanding or contracting within a given industry.

(b) Sources: Occupational Employment Statistics Survey and Current Population Survey

3. Projected occupational employment. This descriptor would provide projected employment growth in an occupation over a designated time period. The currently available projections cover a thirteen-year period, 1992-2005.

(a) *Use of descriptor:* This descriptor would provide users with information concerning the magnitude of projected employment growth in an occupation over a long-term time period. This descriptor would be particularly useful for individuals exploring possible future careers and for career counselors. Employment projections will also be helpful for education and training program planners by identifying those occupations that are most likely to be expanding rapidly in the future. For all users, these national projections will provide general indicators; for program planning particularly, however, state and local occupational projections, utilizing databases discussed later, will be of greater operational value.

(b) *Source:* BLS Employment Projections

Factors Influencing Occupational Outlook. The descriptor on projected employment could be broadened to include a brief narrative discussion of the principal factors that are likely to influence the outlook for a given occupation. These factors, such as technological changes, changes in business practices and changes in the demand for goods and services, are all taken into account by BLS in developing their occupational employment projections. The factors are summarized for clusters of occupations in the BLS reports on employment projections and are discussed for selected occupations in the Bureau's Occupational Outlook Handbook which is published every two years. This additional information would enable users of the employment projections descriptor, particularly vocational counselors and education and training program planners, to recognize those emerging developments in the economy and in society that are likely to influence the projected demand for workers in a given occupation.

4. Projected job openings due to employment growth and total replacement needs. This descriptor would provide projected job openings that will occur in an occupation over a designated time period as a result of employment growth and replacement needs. This descriptor combines data on projected employment growth in an occupation (descriptor 3, above) with data on projected replacement needs in the occupation that will result from transfers or retirement. The currently available projections cover the period, 1992-2005.

(a) *Use of descriptor:* This descriptor would generally serve the same purposes as descriptor 3. For counselors and career planners, however, it would provide a more precise estimate of likely job openings that will occur in an occupation by adding the dimension of replacement needs. For analysts of employment trends in occupations, descriptor 3 would probably be more useful since it focuses on changes in the levels of employment in an occupation which would be obscured if combined with data on replacement needs.

(b) *Source:* BLS Occupational Projections and Training Data (Supplement to Occupational Outlook Handbook)

Data sources for labor demand descriptors. In this section we briefly describe each of the sources cited above and comment on the adequacy of the source as an indicator of labor demand. The principal features of each source are summarized in the matrix in Appendix 13-A.

The Current Population Survey (CPS) is a monthly sample survey of about 60,000 households conducted by the Bureau of the Census for BLS. Each month, BLS analyzes and publishes statistics derived from the CPS on the labor force, employment, unemployment, and persons not in the labor force, classified by a variety of demographic, social and economic characteristics. Quarterly and annual averages are also published.

Comments: The CPS provides the most frequent measure of occupational employment. Its principal limitations are the limited level of occupational detail and geographic coverage provided due to sample size. Occupational coverage is at the 3-digit level covering approximately 500 occupations. Subnational data only are available for 11 states and two metropolitan areas. As a source of occupational employment by industry data, the CPS provides a measure that differs from the measures provided by the OES (see below). In the CPS household survey, respondents identify only one occupation in which they are employed. In contrast, OES occupational employment data are collected from establishments rather than individuals, with the possibility of double counting multiple jobholders who work in more than one establishment.

Occupational Employment Statistics Survey (OES) is an annual mail survey of nonfarm establishments that collects occupational employment data on workers by industry. BLS provides the procedures and technical assistance for the survey and state employment security agencies collect the data. The OES data are used to estimate total employment by occupation for the nation, each state and, within each state, for selected areas.

These occupation/industry data may be utilized in two ways. One may focus on the occupational composition of individual industries in order to determine how industries utilize workers in different occupations. The data may also be aggregated to indicate how each occupation is distributed across industries. Since the new occupational database will be keyed to occupations, the latter aggregation of the OES data would be particularly useful. However, data on staffing patterns — industry employment by occupation — would also be of interest and could be made accessible through the new system.

The OES survey follows a three-year cycle. Three surveys are conducted alternately for manufacturing, nonmanufacturing, and the balance of nonmanufacturing industries. Employment information is currently being collected for approximately 750 occupations in 7 major industry divisions and 400 detailed industries. The OES occupational classification system is compatible, through "crosswalks," with the current DOT and most other occupational classification systems. The industrial classification system used in the OES is the Standard Industrial Classification (SIC) system.

> Comments: A major advantage of OES is that it is the only database that provides a detailed industrial distribution of occupational employment. A limitation of the OES is that the data for individual industries are collected only once every three years and, thus, even if the new occupational database is regularly updated, an OES-based descriptor will always be at least a few years out of date.

Technical problems will arise in using OES data as a time series. The sampling frame of the OES can change substantially as a result of industrial changes in the economy which are reflected in revisions in the definition of industries in the SIC. As a result, it will be difficult, if not impossible, to accurately compare OES data from periods prior to a revision of the SIC to periods after the revision.

BLS Employment Projections are developed through the Bureau's employment projections model system. Projections of occupational employment are the final product of a complex, multi-step process which also projects the size and composition of the labor force, the rate of economic growth and industrial production and employment by industry. Projections are developed on a two-year cycle. The most recent projections cover changes in the level of occupational employment over a 13-year period (most recently for 1992-2005). Because the long-term course of the economy is uncertain, the Bureau develops projections based on three scenarios of future economic growth with varying assumptions about the growth of the labor force, output, productivity, inflation and unemployment.

> Comments: Although the projections are updated every two years, reflecting revised assumptions about the economy and labor force, they still must be used with some caution due to unforeseen events and factors which may occur during the two-year periods between projections and which may have implications for the outlook in specific occupations. To provide the user of the new system with information on these factors, the descriptor on projected employment might include a brief narrative statement about the factors that may influence the employment outlook for a given occupation, as discussed earlier in this section.

BLS Occupational Projections and Training Data (Supplement to Occupational Outlook Handbook) provide average annual openings that will occur in an occupation as a result of the combined effect of employment growth and replacement needs that arise as a result of transfers or retirement. BLS does not collect data on replacement needs directly; replacement needs in occupations are estimated by the Bureau using a procedure that involves determining the mobility patterns in occupations based on data from CPS surveys.

> Comments: Due to differences in occupational classification systems, occupational data in the industry-occupation matrix that is used in projecting employment growth are not directly comparable with data in the CPS used in projecting replacement needs. Where comparable data were not available, proxies were used which may have affected the precision of the resulting estimates.

Labor Supply Descriptors. To obtain a complete picture of the labor market context for a given occupation, data on labor demand would need to be accompanied by information on the projected number of individuals who will be entering the occupation. Theoretically, comparison of labor demand and labor supply projections would then enable the user to determine whether there will be a future labor shortfall or surplus in a specific occupation. Unfortunately, several problems arise which make such precise supply/demand comparisons impossible in most occupations.

The available data on the emerging labor supply in occupations are limited to data on participants who are enrolled in or who have recently completed formal occupational education and training programs. However, with the exception of certain occupations, the data on participants in formal occupational education and training programs do not provide a complete measure of future labor supply. While the importance of formal occupational training is increasing, it is likely that, as in the past, most workers either need no specific skills training for their jobs or acquire their occupational skills informally, on the job.[2] In addition, experienced trained workers who were unemployed, out of the labor force or employed in other occupations may reenter the occupations in which they were originally trained.

The dynamics of the labor market also make it difficult to anticipate occupational labor supply. Individuals change career or occupational plans in response to indicators of shortages or surpluses in specific occupations, such as increased employer advertising and rising wage levels and fringe benefits. Even at the professional level, the level of college enrollments in specific fields may shift in response to information concerning prospective shortages or surpluses in those fields.

The foregoing is intended to suggest the limitations involved in including labor supply descriptors in the new occupational database. For most occupations, labor supply descriptors can only serve to suggest rough trends in the number of individuals preparing for occupations rather than to provide definitive measures that can be matched against labor demand descriptors. However, as we will note, for certain professional fields, labor supply measures will provide considerably more accurate measures of future labor supply.

It should also be noted that certain labor supply descriptors, such as enrollment in JTPA and apprenticeship training, can be useful for purposes other than anticipating the level of worker supply in individual occupations. For example, a high level of JTPA training in a particular occupation would suggest to non-JTPA vocational counselors and placement specialists that the occupation may be suitable for training and placing individuals who are economically disadvantaged or face other employment barriers. Similarly, data indicating that an increasing

[2] In a 1983 BLS survey, 73% of all employed workers reported that they either needed no specific training to qualify for their present jobs (45%) or received their training informally on-the-job (28%).

proportion of women are enrolled in apprenticeship training for "non-traditional" occupations may suggest to career counselors the possibility of counseling women to seek apprenticeship training in these occupations. Seven potential labor supply descriptors are discussed below.

1. Completions in professional/technical occupational education programs. This descriptor would provide data on the number of persons who have completed specific fields of educational study at the post-secondary level — in accredited educational institutions — that are oriented to qualifying participants for entry into specific occupations at the professional and technical levels. Data on enrollments are not available.

(a) *Use of descriptor.* This descriptor would provide users with a good indicator of the emerging supply of individuals in those professional and technical occupations that require specific courses of postsecondary study (e.g., physicians, medical technologists). When used in conjunction with the employment projection descriptors for these occupations, it would be of particular value to vocational counselors in helping them assess the possible level of competition for future employment opportunities in these occupations. These data could also be used by education program planners, in conjunction with demand descriptors, to help determine the need for future program expansion or contraction.

This labor supply descriptor, as well as others discussed below, would be useful in the alien labor certification process by indicating the availability of trained personnel in occupations for which aliens are being considered for admission to the United States on the basis of lack of qualified American workers.

(b) *Sources:* Surveys conducted through the Integrated Postsecondary Education Data System

2. Enrollment/completions in occupational education programs below the professional/technical level.[3] This descriptor would provide data on the number of persons

[3] Both enrollment and completion data are available for this descriptor as well as for other supply indicators discussed below. While they are listed together for convenience of presentation, they should be viewed and considered separately. For most users, trends in completions would be the more meaningful descriptor since it

enrolled in or who have completed occupational education programs that provide training for occupations below the professional and technical levels in postsecondary institutions, both public and private.

(a) *Use of descriptor:* This descriptor would provide users with an indicator of the emerging supply of trained individuals in those occupations below the professional and technical levels (e.g., mechanics, precision production trades, practical nurses) that require specific courses of vocational study in such institutions as community colleges and private proprietary schools. It would also provide an indication of the types of institutions that currently train individuals for these occupations. This descriptor, used with state or local employment projection data, could also be used in planning local occupational education programs for specific occupations since the data are available at the state and local levels.

(b) *Sources:* Surveys conducted through the Integrated Postsecondary Education Data System

3. Enrollment/completions in apprenticeship programs. This descriptor would provide data on enrollment and completions in apprenticeship programs in specific apprenticeable trades. The descriptor would be limited to apprenticeship programs registered with the Bureau of Apprenticeship and Training (DOL) and recognized state apprenticeship agencies.

(a) *Use of descriptor:* The number of apprentices in training would provide users with a good indicator of the emerging supply of individuals in those occupations, such as the construction trades, for which apprenticeship is a major source of supply. Apprenticeship statistics would be useful for career counselors and individuals exploring career options by indicating those occupations in which apprenticeship is an important entry route and, if the data are presented by sex and race/ethnicity, could identify occupations that have offered women and minorities training for non-

would provide a closer approximation than will enrollments of the number of trained persons who will actually enter an occupation. However, current enrollment data might prove useful to an individual considering entry into an occupational education program since it would serve as a closer proxy for the number of students likely to be eventually completing a program of study.

traditional occupations. By identifying those occupations in which apprenticeship is prevalent, the descriptor would also provide a useful indicator for employers who may be considering the establishment of formal occupational training programs for their workers.

(b) *Source:* Apprenticeship Information Management System

4. Participants in JTPA training programs. This descriptor would provide data on individuals who participate in occupational skills training programs under Title II, Title III, and Title IV-Job Corps of the Job Training Partnership Act (JTPA). The data would cover the number of individuals who participate in these programs and, of this number, those who enter unsubsidized employment following termination.

(a) *Use of descriptor:* JTPA training is provided for economically disadvantaged persons and dislocated workers who are prepared for entry into occupations that require only short-term (usually less than six months) skills training. This descriptor, at the state and local levels, would indicate to employers, the geographic location of available JTPA-trained personnel for these occupations. The descriptor could also prove useful to program planners and counselors who work with the economically disadvantaged and welfare recipients and, in the case of Job Corps, severely disadvantaged youth, by identifying occupations for which JTPA participants have been trained and which are therefore suitable for persons with limited skills and educational backgrounds. Similarly, the descriptor would be helpful for firms or counselors in advising workers who are facing or have experienced displacement from their jobs about occupations for which other dislocated workers are being trained and placed in their communities or elsewhere in the nation.

(b) *Sources:* JTPA Standard Program Information Report system; Job Corps Student Pay Allotment Management Information system

5. Separating military service members. This descriptor would provide data on the number of persons separated from the military services who have been trained in specific military occupational specialties which have civilian counterparts.

(a) *Use of descriptor:* This descriptor would be useful to human resource professionals in private firms by indicating, for certain occupations, the availability of trained, experienced personnel by geographic locations. The information could be used for recruitment and plant relocation purposes. State and local economic development planners could use this information for attracting new employers to areas with large reductions in military personnel.

(b) *Source:* Unpublished DOD (Defense Manpower Data Center) data

6. Occupation, by academic degree and field. This descriptor would indicate the number and percentage of persons employed in an occupation who had received academic degrees, by academic major and level of degree (bachelor's and advanced).

(a) *Use of descriptor:* This descriptor would enable users to determine, for broad occupational categories, the extent to which persons employed in the occupation were college graduates or had advanced degrees and their academic field of specialization. This would be of particular interest to individuals and counselors exploring career alternatives and the various types of preparation that would be appropriate for these occupations. Since these data are available only for broad occupational categories, the descriptor would serve as an initial indicator of the academic background of individuals employed in the occupation. More detailed investigation of sources such as the BLS Occupational Outlook Handbook would be required to determine the educational prerequisites for specific occupations.

(b) Source: Census Survey of Income and Program Participation

7. Persons identifying with an occupation. This descriptor would provide a broad measure of current labor supply in an occupation. It would provide a count of all persons — employed, unemployed and not in the labor force — who currently identify themselves as having skills or experience in an occupation.

(a) *Use of descriptor:* This descriptor would provide users with an indication of the number of workers currently or recently identified with an occupation. Used in combination with other descriptors, such as current occupational employment (see Labor Demand, above) and worker displacement (see Other Labor Market Descriptors, below), it can provide an indication of the recent pattern of labor supply/demand in an occupation. For example, an occupation might have a current employment level of 500,000, but the number of persons identified with the occupation might be 650,000. If a third descriptor — worker displacement — shows that a substantial loss of jobs due to layoffs has occurred over a long-term period in the occupation, then the three descriptors may be viewed as signaling a possible labor surplus trend in the occupation. This information could be used by individuals considering careers in specific occupations and their counselors. If the Census is used as the source for this descriptor, it would provide detailed information about the geographic availability of workers that would be of interest to economic development and human resource professionals.

(b) Sources: Census of Population and Current Population Survey

Data sources for labor supply descriptors. In this section, we briefly describe each of the sources cited above and comment on the adequacy of the source as an indicator of labor supply. The principal features of each source are summarized in the matrix in Appendix 13-A.

The Integrated Postsecondary Education Data System (IPEDS) is a system of surveys of all institutions of postsecondary education that receive federal funding (virtually all accredited institutions of higher education), conducted annually by the National Center for Education Statistics of the U.S. Department of Education. IPEDS involves a series of interrelated surveys that collect a range of institution-level data including enrollments and completions. IPEDS data are also used to produce reports on trends in degrees conferred by institutions of higher education.

Comments: IPEDS enrollment and completion data generally will be best used as a general indicator of the trend in the number of individuals preparing for entry into certain occupations requiring a postsecondary degree or certificate. The IPEDS survey that provides the most accurate and complete measure of future labor supply is the Survey of First Professional Degrees since first professional degrees are likely to be the sole route for entry into such occupations as physician, registered nurse, and lawyer. There is a 12-15 month lag between IPEDS data collection and publication.

Apprenticeship Information Management System (AIMS) is an internal management information system maintained by the Bureau of Apprenticeship and Training of DOL. It tracks registered apprentices and programs over time. AIMS includes demographic characteristics of apprentices and the geographic location of programs. As a tracking system, it provides data on new entrants, individuals currently in training and those who cancel or complete the program.

<u>Comments</u>: AIMS is not nationally representative because several state apprenticeship agencies do not participate in this information system. However, AIMS does provide information on about 70 percent of all registered apprenticeships. Since AIMS is an internal management information system, data are not regularly reported or released to the public; special arrangements would have to be made in order to use these data in the new occupational database.

JTPA Standard Program Information Report (SPIR) system. SPIR is an internal management reporting system that provides detailed information on economically disadvantaged youth and adults trained under JTPA Title II and dislocated workers trained under Title III. Among the data collected are the number of individuals who participated in JTPA occupational training programs and, of that number, those who entered nonsubsidized employment after termination. The data are available by the specific occupation for which individuals were trained and can be aggregated at the national, state and local levels.

<u>Comments</u>: SPIR is an internal management reporting system. Special arrangements would have to be made to use SPIR data in the new occupational database.

Job Corps Student Pay Allotment Management Information System (SPAMIS). The Vocational Completers Reports and Participant Profiles provide data on individuals who complete the Job Corps program by occupation for which they were trained as well as their address and occupational placement after completing the program.

Comments: Like SPIR, SPAMIS is an internal management reporting system; special arrangements would be required to incorporate these data into the new system.

Unpublished DOD (Defense Manpower Data Center) data. These data on separating military service members are available from DOD's Defense Manpower Data Center (DMDC). Data are available by military occupational specialty which can be "cross-walked" into civilian counterpart occupations. Geographic data are available at the national, state and local levels, based on the servicemember's first post-service address.

Comments: This database has been shared by DMDC with other federal agencies, including DOL and the Veterans Administration. It is updated monthly by DMDC with data on persons who leave each of the military services, their reasons for leaving and first post-separation address.

Decennial Census of Population is a source of detailed information on the characteristics of the U.S. population and labor force. Every ten years, the Bureau of the Census conducts a census of the total population of the United States. The data collected from individuals include information concerning their occupations and other aspects of their labor force status. There are approximately 500 occupational categories to which responses are coded, with the coding scheme generally based on the Standard Occupational Classification (SOC) system.

Comments: The major shortcoming of the decennial census is that the survey is conducted only once every ten years. In addition, there is a time lag of a few years between the survey and actual release of the data. The primary advantages of the census are (a) its reliability because, as a census, it provides a complete count of the population rather than an estimate based on a statistical sample and (b) its level of geographic detail (data are available at the national, state, local and census tract levels).

Census Survey of Income and Program Participation (SIPP) is a nationwide longitudinal survey of approximately 12,000 households. Individuals are interviewed once every 4 months over a 2-1/2 year period. A new panel is produced each year. Among the core survey questions is a question on primary occupation by degree and field for persons 18 to 64 years old. In addition to core survey questions, SIPP also includes various topical modules.

> Comments: The survey data do not reflect length of time within an occupation. If many of the incumbents of an occupation are young, it is likely that they will have a higher level of education and/or degree compared to an occupation with many incumbents who are close to retirement age because an increasing proportion of the work force is attending college and more jobs require a college background or at least a high school diploma.

Other Labor Market Descriptors. In addition to descriptors that will provide information on labor demand and supply for specific occupations, there are additional potential descriptors that can provide information on other aspects of the labor market context for individual occupations. Five descriptors are discussed below that can provide users with the following information with respect to specific occupations: demographic characteristics, the extent of fatal occupational injuries, the level of unemployment, worker displacement and compensation and fringe benefits .

1. Demographic characteristics. This descriptor would provide the demographic characteristics — age, gender, race/ethnicity, education attainment — of persons identified with a given occupation, i.e., all persons — employed, unemployed and not in the labor force — who currently identify themselves as having skills or experience in an occupation. This descriptor is presented here separately, rather than subsumed under the labor supply descriptor "persons identifying with an occupation," because we may want to include the demographic profile of occupations as a separate descriptor.

> (a) *Use of descriptor*: The descriptor would be used primarily to determine the extent to which the demographic profile of individuals associated with a specific occupation varies significantly from the demographic profile of the work force as a whole. Such information might be useful for planning affirmative action/EEO initiatives and identifying non-traditional occupations for purposes of counseling and planning training and promotional programs. A high concentration of workers in their fifties in an occupation might suggest to career counselors and training program planners that

there will be a need for replacement personnel in several years as these workers retire from the labor force.

(b) Sources: Current Population Survey and Decennial Census of the Population

2. Fatal Occupational Injuries. This descriptor would indicate the number of workers fatally injured annually, by occupation and by type of injury.[4]

(a) *Use of descriptor:* The descriptor would enable users to determine the extent of occupational hazard associated with an occupation and the nature of that hazard. This information would be of value to individuals either exploring possible careers or actively seeking employment and to counselors and placement personnel in assisting these individuals. The information would also be of value to human resource personnel by identifying occupations within their firms that may require safety or health training for workers. The descriptor might alert occupational curriculum developers to include safety information in the curricula for certain occupations.

(b) *Source:* Census of Fatal Occupational Injuries

3. Unemployment rate. This descriptor would provide the rate of unemployment in individual occupational categories. An unemployed person's occupation is defined as the last job in which the individual was employed.

(a) *Use of descriptor:* This descriptor would provide an indication of the extent of unemployment within occupational categories. Consistently low unemployment rates in an occupation may indicate the possibility of shortages of workers whereas high unemployment rates may indicate a labor surplus and the possibility of limited job opportunities. Presentation of occupational unemployment time series would enable users to determine the extent to which the occupation was subject to significant seasonal and cyclical variation. Information concerning occupational unemployment rates would be useful for users engaged in planning occupational training or education

[4] In April 1995, BLS will publish data on non-fatal occupational injuries and illnesses, by occupation, as well as fatal occupational injuries.

programs as well as job seekers, counselors and placement personnel. The data could also be used, in conjunction with other information, in the alien labor certification process.

(b) *Source:* Current Population Survey

4. Worker displacement. This descriptor would indicate the number of workers displaced in individual occupational categories. "Displaced workers" are defined as individuals 20 years or older who lost or left a job because of plant or company closings or moves, insufficient work, or position or shift abolishment. A displaced worker's occupation is defined as the job the individual lost.

(a) Use of descriptor: This descriptor would enable users to determine if an occupational category has experienced large numbers of worker displacements in recent years. As in the case of upward trends in unemployment in an occupation, persistently high levels of worker displacement could signal to a range of user groups that current job opportunities in an occupation may be limited.

(b) *Source:* Displaced Worker Supplement to the Current Population Survey

5. Occupational compensation/earnings. This descriptor provides earnings, wages, or salary and fringe benefit information for specific occupations or job descriptions that can be related to specific occupational categories.

(a) *Use of descriptor*: This descriptor would provide individuals exploring or actively seeking employment in an occupation as well as their counselors with information concerning the current compensation levels and availability of fringe benefits in the occupation. Where subnational data are available, this would greatly enhance the usefulness of this descriptor since compensation levels for the same occupation may vary considerably, by locality. This descriptor could be utilized by a variety of business users of the new occupational database to assist in such areas as setting occupational wage and salary levels, estimating labor costs, labor-management negotiation and planning plant or office relocation. The descriptor might also be used, as a first reference, in determining the prevailing wage for alien labor certification purposes. Since wage levels in any given year may be affected by cyclical changes in the economy, presenting this information as a time series will be particularly informative.

(b) *Sources:* Current Population Survey and Occupational Compensation Survey Program

Data sources for other labor market descriptors. Below are possible data sources for other labor market descriptors.

Decennial Census of Population. We previously described this source under Labor Supply Descriptors. The principal source for a descriptor on the demographic characteristics of individuals in an occupation is the Equal Employment Opportunity File of the 1990 census.

Comments: See the discussion under Labor Supply Descriptors.

Current Population Survey (CPS). See the basic description under Labor Demand Descriptors.

Comments: The general limitations of this source were discussed earlier. For example, it does not provide sufficient sample sizes for statistically significant measures of descriptors by detailed occupation.

An additional drawback in using a CPS-based occupational unemployment descriptor is that it relates to the respondent's last job before becoming unemployed which may or may not represent his or her regular occupation. For example, an unemployed auto worker who last worked for one month as a retail sales clerk would be classified as an unemployed sales worker rather than an unemployed auto worker.

As a source for occupational compensation, the CPS would provide data on median weekly earnings of full-time wage and salary workers before deductions. Weekly earnings include overtime pay, commissions, or tips received. As a measure of central tendency, median weekly earnings do not reflect tenure in an occupation. Thus, it does not provide a measure of entry wages for an occupation.

Occupational Compensation Survey Program (OCS). BLS conducts this program which consists of the Area Wage Survey and the White Collar Pay Survey. The two surveys are based on a common set of administrative forms, a single manual of procedures, and common concepts and definitions.

The surveys do not use an occupational classification system; they use job descriptions that are designed to take account of variations across establishments in the duties associated with the same jobs. However, BLS provides corresponding occupational codes and titles from the SOC manual.

The Area Wage Survey is conducted annually or every two years in a sample of metropolitan areas or labor markets, for selected professional, technical, office clerical, maintenance, toolroom, powerplant, material movement, and custodial occupations. In many cases, occupations have been divided into two or more work levels. The data available through Area Wage Surveys include: averages and distributions of workers, by straight-time earnings; wage trends for five occupational groups; and selected employee fringe benefits and employer compensation practices, such as shift pay provisions and minimum entrance salaries.

The White Collar Pay Survey is conducted annually in a sample of medium-sized and large firms in private industry. It provides averages and distributions of salary rates for selected professional, administrative, technical and clerical work levels. The data are used in the federal pay-setting process.

> Comments: The OCS provides data for a smaller number of occupations than does the CPS but OCS data are generally considered to be more accurate. The reason is that the OCS does not rely on self-reporting as does the CPS but, instead, collects compensation data from employers who furnish this information from their own payroll records. In 1993, OMB revised the statistical definitions of metropolitan areas, creating new areas and geographically redefining some existing areas. As a result of these changes, the possibility of providing trend data for the areas covered by the Area Wage Survey will be limited.

Displaced Worker Supplement to the CPS. Since 1984, BLS has included a Displaced Worker Supplement (DWS) in the January CPS that is used to estimate the number of workers displaced from employment at any time over the five-year period prior to the survey. The DWS survey is conducted every two years. Beginning in 1994, the survey is being conducted in February rather than January, and the period of dislocation is limited to the three years (rather than five years) prior to the survey. Among the data collected in the survey are the occupations of the jobs lost by displaced workers.

> Comments: A limitation of the DWS for purposes of the new database is the need to aggregate displaced worker data into broad occupational categories in order to obtain statistically significant sample sizes. Because of the changes made in the survey design in 1994, estimates based on the DWS for years prior to 1994 will not be directly comparable to estimates made in 1994 and subsequent years.

Census of Fatal Occupational Injuries (CFOI) is annually carried out by BLS in conjunction with participating state agencies to compile comprehensive and timely information on fatal work injuries occurring in each of the 50 states and the District of Columbia. In order to obtain a complete census of fatal occupational injuries, multiple data sources are used, such as death certificates, workers' compensation reports and claims, and other federal and state administrative records. Work relationship is verified for each fatality by using at least two independent source documents. Data are collected by state agencies and processed by BLS.

Among the data collected under CFOI are the occupations of the individuals at the time of their fatal injuries.

> Comments: Since CFOI is a census, sampling error is not a factor. Thus, a complete count of fatal occupational injuries as well as the fatal injury rate for individual occupations could be presented in the new occupational database. While CFOI provides the most complete count of fatal work injuries available, the survey does not cover certain occupational groups: the self-employed, unpaid family workers, laborers on small farms and state and local government employees without OSHA-approved safety programs

Linkage to State Occupational Labor Market Information Systems

The labor market context component differs from other components of the content model in several respects: it is based on existing data sources rather than on a new system of data collection and analysis and will require more frequent updating than the other three components of the model. Another important distinction is that, while for the other components, nationally-developed descriptors may be generally applicable throughout the country, national labor market trends in an occupation may vary considerably from the trends in individual states and localities. For example, projected rapid national growth in an occupation may, in fact, be concentrated in a small number of states and areas; the projections for other jurisdictions may call for slow growth or even employment decline in the same occupation. Furthermore, while the federal data sources that are available for each of the potential labor market context descriptors provide national-level occupation-specific data, they do not uniformly provide information at the substate level.

All SESAs, however, collect, analyze and disseminate information on the labor market in their states. Most importantly for our purposes, the large majority of the SESAs, with the assistance of the SOICCs in their states, have packaged these various labor market data sources into a series of computerized databases. Access to such subnational occupational labor market data will be particularly valuable for counselors, individuals actively seeking employment or exploring vocational options and state and local education and training program planners.

In this section, we discuss the possibility of linking these state labor market information databases to the new occupational database. We describe these state LMI and LMI-related systems, and discuss two new initiatives designed to expand and improve the systems.

State LMI Systems. All state employment security agencies (SESAs) collect, analyze and disseminate information on the labor market in their states. The type of information available varies from state to state and depends on the level of data collection, synthesis, analysis and dissemination efforts that prevail in the state. It may include occupational data for the labor demand, labor supply and other descriptors previously discussed. It may also include, for individual occupations, such additional information as educational requirements, licensing and working conditions.

These data are disseminated in a variety of hard copy and computerized formats. Increasingly, states have been moving in the direction of computerization. As will be discussed further below, DOL is actively encouraging states to increase the computerization of their labor market information systems. Fortunately, the large majority of SESAs have already packaged their labor market information into a series of computerized databases. Linking these occupationally-oriented, computerized state labor market databases to the new occupational database would provide users with the ability to access the available state and local data as well as labor market information for the descriptors identified above.

In this subsection, we focus on three computerized state LMI databases that are already in existence and that could be made accessible to individuals using the new occupational database.

Occupational Information Systems (OIS) are computerized databases primarily designed to help states meet the occupational information needs of vocational education, economic development and employment and training program planners and managers. A state OIS is a multi-source database that includes information on the current and projected demand in the state for workers by occupation as well as information on the supply of graduates of related training programs. Some systems also contain information on occupational working conditions, educational requirements and wages of specific occupations as well as information about training programs, educational institutions, industries and employers. As of 1993, OIS systems had been established in 40 states.

NOICC is currently undertaking major improvements in microcomputer hardware and software for state OIS systems that will make the systems more comprehensive and user friendly.

As part of this redesign, NOICC is developing an Occupational and Labor Market Information Database (OLMID) that is intended to achieve a more coordinated approach to the maintenance and delivery of occupational and labor market information. Eventually, it is envisioned that a comprehensive database will be maintained by an OLMID manager at the state level in each state. It will be linked, through various input and extraction utilities, to sources of data and to information delivery systems which could include the new occupational database. Indeed, it is intended that the new classification system will be used to standardize the language to be used in the state OLMIDs.

Career Information Delivery Systems (CIDs) are computer-based systems that provide information about occupations and educational programs within a state. In contrast to OIS, which is designed for program planners and managers, CIDs are geared for use in individual career and employment counseling, job placement, and educational planning.

Occupations are described in terms of duties, state and local employment outlook, earning levels, working conditions, and licensing and educational requirements. The systems also provide, for individual occupations, information concerning education and training programs related to the occupations that are available in the state. Educational information includes descriptions of postsecondary and job training programs available in specific institutions, as well as their admission policies, financial aid and other services. In addition to civilian occupations, CIDs provide information on military occupations and training opportunities.

In some states, CIDs include special features such as graduate school files, employer files, files about the world of work, resume and interview techniques, current job listings from the state's Job Service agency and detailed profiles of individual communities. The systems permit individuals to relate personal characteristics, such as interests, aptitudes and educational goals to compatible occupational and career possibilities.

Two-thirds of all CID sites are located in public elementary and secondary schools; the remainder are available at employment and training and other sites providing career counseling services for adults.

State Wage Data Systems offer computerized access to wage survey data collected by SESAs. Most states conduct surveys which provide wage and fringe benefit data for specific occupations, by industry, at the state level and for local or sub-state areas. The quality and availability of data differ markedly from state to state and comparability is hampered by a lack of common definitions or codes.

State LMI-Related Systems. Computerized databases are available at the state level that provide information, by occupation, on current job openings registered with the state Employment Service and the availability of training and education programs.

It could be argued that the information provided through these systems is not labor market information in the strictest sense. However, for many users, accessing this information would be the next logical step after reviewing the other information in the new occupational database concerning a specific occupation. For example, an individual actively seeking employment or his or her counselor might use the four components of the model to select an appropriate occupational objective for the individual. It is likely that they would then be interested in information concerning the availability of actual job openings or training programs in the occupation. The following databases could be linked to the new system, thus enabling an individual user to follow a process that begins with an initial inquiry concerning a range of possible occupational options, proceeds to selection of a specific vocational objective and culminates in a list of job openings and training opportunities in the occupation that currently are available in the state or local community.

State Job Banks are computerized databases, available in all 50 states, that list current job openings that employers have registered with the state Employment Service. The openings are listed by DOT code and provide information concerning salary level, required education and experience, and geographic location. Names of employers are generally not included; interested job seekers must be interviewed by local ES offices before being referred to individual openings. A related computerized database (America's Job Bank), which is available in all state ES offices, lists ES job openings in all 50 states that could not be filled within the state and were referred to this central job bank.

State Training Inventories are computerized inventories, maintained by state SOICCs, that provide information on all training and education programs and the institutions at which they are offered in the state, localities within the state and the region. Information can be accessed by program, institution, type of institution, and geographic area.

New Initiatives. DOL has embarked on two new initiatives that are designed to greatly improve the quality and accessibility of state labor market information systems: America's

Labor Market Information System (ALMIS) and Labor Market Information Adapted to Skills Based Employment Relations (LASER). Both initiatives are in their early stages and their future course cannot be predicted. However, as work proceeds on the labor market context component of the content model, it will be important to track these initiatives. If the initiatives eventually achieve their objectives, they will facilitate linkage between the new occupational database and state labor market information systems and upgrade the quality and comprehensiveness of the information available.

ALMIS. DOL's vision is to achieve, over the long term, an integrated and expanded national LMI system that will include substantial increases in locally available information, easier to use LMI products and services and improvements in the labor exchange services of the state ES agencies. The expanded information will be presented through a delivery system that will utilize the latest in communication technology, presentation shells to integrate multiple databases, and a series of print, video and interactive ways of displaying national, state and local labor information. A common language, including a common coding structure, will be used to bind all LMI data, products and delivery systems together.

The Department has developed a detailed blueprint for achieving the first steps in the development of ALMIS in FY 1994 and FY 1995, primarily through grants to the states. During these two years, the primary objectives will be to: (a) expand the size and scope of state ES electronic labor exchange systems, primarily by improving Job Banks; (b) develop new LMI products and services that will be available in all states; and (c) build upon the current OIS and CIDS systems described earlier in this chapter. The intent is to establish state of the art, customer-focused LMI delivery systems in selected states in conjunction with newly-established one-stop career centers that provide a common point of access to employment, training and education information and services.

LASER. LASER is a pilot program, being jointly conducted by BLS and ETA, that is designed to develop a new occupational classification system focusing on occupational skills rather than job titles. Under the system, occupations requiring comparable skills are grouped together into job families. The families are then cross-referenced with "preparation level" which defines the level of education, training or experience required for each occupation. The system was primarily designed to be used by staff at local one-stop career centers in assisting displaced workers. It would enable the staff to identify occupations with skills similar to those possessed by the displaced worker and, for these occupations, would provide information concerning wages, employment outlook and industries with a high proportion of workers in the occupation. LASER demonstration projects were funded in several states in FY 1994.

Recommendations

In this chapter, we have listed and discussed a series of descriptors and databases which merit consideration for inclusion in the content model. While there may be labor market descriptors and sources that were overlooked, we did attempt to err on the side of inclusion rather than exclusion. We also recognize that, in developing a prototype for the new system, it may be necessary to limit the scope of the labor market context component to a small number of descriptors because of cost or other considerations. We have identified those descriptors and databases which, in our judgement, should be given priority consideration for inclusion because of their value to a broad range of future users and the quality of the data available for the descriptors in terms of such factors as level of occupational detail and timeliness. The following are six recommended priority descriptors and sources.

Labor Demand Descriptors and Sources. Below are listed labor demand descriptors and sources.

1. Current occupational employment. This descriptor would provide basic information on the magnitude of employment in an occupation and, presented as trend data, would indicate whether employment in the occupation has grown, remained stable or declined in recent years.

The recommended source for this descriptor is the CPS, primarily because of its timeliness.

2. Current occupational employment, by industry. This descriptor also would provide very basic information, in this case indicating which industries are most likely to employ workers in an occupation and, if presented as a time series, would indicate whether this pattern has been changing.

The recommended source for this descriptor is the OES, principally because of the substantial level of occupational detail that it provides.

3. Projected occupational employment. This is probably the most valuable labor market context descriptor. Virtually all users of the labor market context component of the content model will be interested in the employment outlook for specific occupations. In view of the importance of this descriptor, we also recommend that serious consideration be given to including, with this descriptor, a narrative statement on factors influencing occupational outlook.

The recommended source is the BLS Employment Projections. The sources for the narrative statement would be the BLS Occupational Outlook Handbook and unpublished BLS data.

Labor Supply Descriptors and Sources. Below are listed labor supply descriptors and sources.

4. Completions in professional/technical occupational education programs. Among the potential labor supply descriptors, this descriptor provides the broadest coverage of the emerging supply of formally trained workers in professional and technical occupations. This descriptor will be particularly important if the new DOT focuses on high skills occupations which require some form of postsecondary training.

The recommended source is IPEDS.

5. Enrollments and completions in occupational education programs below the professional/technical level. This descriptor provides the broadest coverage of the emerging supply of formally trained workers in occupations below the professional and technical levels. As in the case of 4. above, this descriptor will be of particular value if the new DOT emphasizes those nonprofessional/technical occupations that are relatively high-skilled and require postsecondary training. Since both enrollment and completion data are available for this descriptor, we would suggest that both be included because of their value to different users of the DOT, as discussed in chapter II.

The recommended source is IPEDS.

Other Labor Market Descriptors and Sources. Below are other labor market descriptors and sources.

6. Occupational compensation/earnings. Among the potential labor market context descriptors, it is likely that this descriptor ranks second in importance, after employment outlook, as an area of interest for future users of the new system, particularly individuals who are exploring careers or considering employment in specific occupations and those who provide counseling for these individuals.

To maximize the occupational coverage of this descriptor, it is recommended that both the Occupational Compensation Survey Program and the CPS be used as sources.

References

American Institutes for Research (1994). *Development of Prototype New Occupational Information/Classification System to Replace the Current Dictionary of Occupational Titles.*

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington D.C.: Author.

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

Westat, Inc. (1993). *DOT User Survey: A Report and Analysis.* Rockville, MD: author.

Appendix 13-A

Potential Labor Market Context Descriptors and Sources

Labor Demand

Descriptor	Source	Definition	Occupational Coding		Occupational Coverage[b]	Extent of Industry Coverage[c]	Geographic Coverage			
			System[a]	Detail			National	State	County	MSA
Current Occupational Employment	Current Population Survey (CPS)	Number of employed persons age 16 and older	Census OCS	3 digit	500 occupations	236 industries (Census ICS)	Yes	11 states (CA, FL, IL, MA, MI, NJ, NY, NC, OH, PA, TX)		2 major local areas
Current Occupational Employment, by Industry	CPS	Number of employed persons age 16 and older employed during the survey week	Census OCS	3 digit	501	237 (Census ICS)	Yes	11 states (listed above)		2 major local areas
Current Occupational Employment, by Industry	Occupational Employment Statistics (OES) Surveys	Number of workers in an occupation by industry	OES	5 digit	512	400 non-agri-cultural (3-digit SIC)	Yes	50 + 4 (DC, PR, GUAM, A. SAMOA)		

Descriptor	Source	Definition	Occupational Coding		Occupational Coverage[b]	Extent of Industry Coverage[c]	Geographic Coverage			
			System[a]	Detail			National	State	County	MSA
Projected Occupational Employment	BLS Employment Projections	Projected occupational employment (and projected occupational employment by industry)	OES	5 digit	512	400	Yes			
Projected Job Openings Due to Employment Growth and Total Replacement Needs	BLS Occupational Projections and Training Data	Job openings due to growth and replacement needs	OES	5 digit	512	400 3-digit SIC	Yes			

Descriptor	Source	Definition	Availability		Notes
			Formats	Frequency	
Current Occupational Employment (Continued)	Current Population Survey (CPS)	Number of employed persons age 16 and older	Published, tape, CD-ROM, and diskette	Monthly	This is the primary source for most national employment statistics. The Census classification system for industries and occupations can be cross-walked to the Standard Industrial Classification (SIC) and Standard Occupational Classification (SOC) systems.
Current Occupational Employment, by Industry (Continued)	CPS	Number of employed persons age 16 and older employed during the survey week	Published, tape, CD-ROM, and diskette	Monthly	This is the primary source for most national employment statistics. The Census classification system for industries and occupations can be cross-walked to the Standard Industrial Classification (SIC) and Standard Occupational Classification (SOC) systems.
Current Occupational Employment, by Industry (Continued)	Occupational Employment Statistics (OES) Surveys	Number of workers in an occupation by industry	Published, tape, CD-ROM, and diskette	Annual; however, 3 year rotation of industries	Data are published each year in the form of national occupational estimates at 2-digit SIC level. Data at 3-digit level are available upon request. Data for individual states may be obtained from each state's Employment Security Agency.
Projected Occupational Employment (Continued)	BLS Employment Projections	Projected occupational employment (and projected occupational employment by industry)	Published and diskette	3 year cycle	Although the OES classification system is used, non-OES occupations are added. For example, CPS data from agriculture, private households and government are used to supplement OES data.

Descriptor	Source	Definition	Availability		Notes
			Formats	Frequency	
Projected Job Openings Due to Employment Growth and Total Replacement Needs (Continued)	BLS Occupational Projections and Training Data	Job openings due to growth and replacement needs	Published and diskette	2 year cycle	BLS bases its projections on data from the National Industry-Occupation Matrix and the CPS.

Descriptor	Source	Definition	Occupational Coding		Occupational Coverage[b]	Extent of Industry Coverage[c]	Geographic Coverage			
			System[a]	Detail			National	State	County	MSA
Completions in Professional/Technical Occupational Education Programs	Integrated Postsecondary Education Data System (IPEDS) Completions Survey	Bachelor's, Master's, and Doctor's Degrees Conferred and First Professional Degrees Conferred	CIP (1990)	6 digit	1,066 individual programs and 10 professional fields (e.g., JD, MD)	--	Yes	Yes		
Enrollment/ Completions in Occupational Education Programs Below the Professional/Technical Level	Integrated Postsecondary Education Data System (IPEDS) Surveys	Number of postsecondary vocational education students and number of sub-baccalaureate certificates and degrees conferred	CIP (1990)	6 digit	420 occupationally specific programs	--	Yes	Yes		
Enrollment/ Completions in Apprenticeship Programs	Apprenticeship Information Management System	Number of registered apprentices in training, number of completers	DOT	9 digit	800+ occupations	60	Yes	Yes		

Descriptor	Source	Definition	Occupational Coding		Occupational Coverage[b]	Extent of Industry Coverage[a]	Geographic Coverage			
			System[a]	Detail			National	State	County	MSA
Participation in JTPA Training Programs	JTPA Standard Program Information Report (SPIR)	Number of JTPA IA, II and III participants (enrollers and terminees)	OES	5 digit	Around 24 occupations		Yes	Yes		
Participation in JTPA Training Programs	Job Corps Student Pay Allotment Management Information System (SPAMIS)	Profiles of Job Corps participants and completers	DOT		80 occupations (and 3 levels within each occupatin)		Yes	Yes	Yes	Yes
Separating Service Members	Defense Manpower Data Center, DOD	Separating military service members	Military Occupational Coding (MC)		Around 600 occupations		Yes	Yes		Yes
Occupation, by Academic Degree and Field	Census Survey of Income and Program Participation (SIPP)	Primary occupation, by degree and field for persons 18 to 64 years	Census OCS	1-2 digit	15 broad occupational categories					

Descriptor	Source	Definition	Availability		Notes
			Formats	Frequency	
Completions in Professional/Technical Occupational Education Programs (Continued)	Integrated Postsecondary Education Data System (IPEDS) Completions Survey	Bachelor's, Master's, and Doctor's Degrees Conferred and First Professional Degrees Conferred	Published and on diskette	Yearly	Regional coverage is also provided. The relation between field of study and a specific occupation varies across fields of study.
Enrollment/ Completions in Occupational Education Programs Below the Professional/ Technical Level (Continued)	Integrated Postsecondary Education Data System (IPEDS) Surveys	Number of post-secondary vocational education students and number of sub-baccalaureate certificates and degrees conferred	Published and on diskette	Yearly	Regional coverage is also provided. Proprietary schools are sampled, while data from nearly all accredited post-secondary institutions are included in this survey. Also, the relation between field of study and an occupation varies across fields of study.
Enrollment/ Completions in Apprenticeship Programs (Continued)	Apprenticeship Information Management System	Number of registered apprentices in training, number of completers			Files from this internal management database can be extracted for use in the O*NET.
Participation in JTPA Training Programs (Continued)	JTPA Standard Program Information Report (SPIR)	Number of JTPA IA, II and III participants (enrollers and terminees)	ORACLE SA format file	Yearly	Information is available at the Service Delivery Area (SA) level. Data can be aggregated, through special run, to the national and state level.

Descriptor	Source	Definition	Availability		Notes
			Formats	Frequency	
Participation in JTPA Training Programs (Continued)	Job Corps Student Pay Allotment Management Information System (SPAMIS)	Profiles of Job Corps participants and completers	Tape		Information is available at the Job Corps Center level, and while not routinely available at the national and substate level, it could be obtained through special runs.
Separating Service Members (Continued)	Defense Manpower Data Center, DOD	Separating military service members	Tape		
Occupation, by Academic Degree and Field (Continued)	Census Survey of Income and Program Participation (SIPP)	Primary occupation, by degree and field for persons 18 to 64 years	Published		

Other Labor Market Descriptors

Descriptor	Source	Definition	Occupational Coding: System[a]	Occupational Coding: Detail	Occupational Coverage[b]	Extent of Industry Coverage[c]	Geographic Coverage: National	Geographic Coverage: State	Geographic Coverage: County	Geographic Coverage: MSA
Demographic Characteristics	Current Population Survey	Demographic characteristics and geographic location of persons identifying themselves with an occupation, regardless of employment status	Census OCS	3 digit	500	236 Census ICS	Yes			
Demographic Characteristics	Decennial Census of Population and Subsequent Equal Employment Opportunity File	Demographic characteristics and geographic location of persons identifying themselves with an occupation, regardless of employment status	Census OCS	3 digit	500	236 Census ICS	Yes	Yes	Yes	
Fatal Occupational Injuries	BLS Census of Fatal Occupational Injuries (CFOI)	Number of workers fatally injured - by type of fatal injury	Census OCS	2-3 digit	500	236 Census ICS (civilian)	Yes	50 + DC		

Descriptor	Source	Definition	Occupational Coding		Occupa-tional Coverage[b]	Extent of Industry Coverage[d]	Geographic Coverage			
			System[a]	Detail			National	State	County	MSA
Unemployment	CPS	Number of persons, age 16 and older, without jobs, seeking work or expecting recall, and currently available to take a job	Census OCS	1-2 digit	15-20	236 ICS (civilian)	Yes			
Worker Displacement	CPS-Displaced Worker Supplement	Number of workers with 3 or more years of tenure who lost or left their job during past 3 (5) years due to plant closing, etc.	Census OCS	3 digit	500	236 ICS (civilian)	Yes			
Occupational Compensation-Earnings	CPS	Median weekly earnings of full-time wage and salary workers age 16 and older	Census OCS	3 digit	500	236 ICS (civilian)	Yes			

Descriptor	Source	Definition	Occupational Coding		Occupational Coverage[b]	Extent of Industry Coverage[c]	Geographic Coverage			
			System[a]	Detail			National	State	County	MSA
Occupational Compensation-Wages	BLS Occupational Compensation Survey Program/Area Wage Survey	All industry pay averages; weekly earnings based on regular straight time for standard workweeks; earnings for plant workers exclude late shift differentials and premium pay for overtime	Work levels			Mfg; trans, comm, pub utilities; wholesale /retail trade FIRE; select services	Yes			70 SMSAs
Occupational Compensation-Salary	BLS Occupational Compensation Survey Program/White Collar Pay Survey	White collar salary levels and distributions in medium and large firms of private industry as of March; straight time salary for normal work schedule	Work levels	Approx. 150 occupations		Mining; constr; mfg; tcpu; wh/retail trade; FIRE selected services	Yes		Yes	

Other Labor Market Descriptors

Descriptor	Source	Definition	Availability		Notes
			Formats	Frequency	
Demographic Characteristics (Continued)	Current Population Survey	Demographic characteristics and geographic location of persons identifying themselves with an occupation, regardless of employment status	Tape and published	Monthly	Major limitation is that small sample sizes which limit the occupational and geographic detail.
Demographic Characteristics (Continued)	Decennial Census of Population and Subsequent Equal Employment Opportunity File	Demographic characteristics and geographic location of persons identifying themselves with an occupation, regardless of employment status	Compact disk and published	Decennial	Comprehensive information because it is a census. Major limitations are: (1) the time lag in release of the data and (2) 10 years between revisions.
Fatal Occupational Injuries (Continued)	BLS Census of Fatal Occupational Injuries (CFOI)	Number of workers fatally injured - by type of fatal injury	Published	Annually	
Unemployment (Continued)	CPS	Number of persons, age 16 and older, without jobs, seeking work or expecting recall, and currently available to take a job	Tape and published	Monthly	Main disadvantage is small sample sizes, which limits the occupational detail.
Worker Displacement (Continued)	CPS-Displaced Worker Supplement	Number of workers with 3 or more years of tenure who lost or left their job during past 3 (5) years due to plant closing, etc.	Tape and published	2 year cycle	This is the only source for information on the number of displaced workers.
Occupational Compensation-Earnings (Continued)	CPS	Median weekly earnings of full-time wage and salary workers age 16 and older	Published	Quarterly and annually	Because the CPS is a household survey, earnings information is self-reported by workers and subject to error.

Descriptor	Source	Definition	Availability		Notes
			Formats	Frequency	
Occupational Compensation-Wages (Continued)	BLS Occupational Compensation Survey Program/Area Wage Survey	All industry pay averages; weekly earnings based on regular straight time for standard workweeks; earnings for plant workers exclude late shift differentials and premium pay for overtime	Published	Annual	
Occupational Compensation-Salary (Continued)	BLS Occupational Compensation Survey Program/White Collar Pay Survey	White collar salary levels and distributions in medium and large firms of private industry as of March; straight time salary for normal work schedule		Annual	Accounting, legal services, personnel management, engineering and chemistry, purchasing, photography, drafting, and computer science, and clerical. Definitions are designed to be translatable to specific pay grades of federal white collar employees.

a 'Occupational coding system' refers to the procedures for coding the occupations or educational fields of study included in a particular data source. For example, the Census Occupational Classification System (OCS) is the occupational classification system used in the CPS and the Occupational Employment Statistics (OES) classification is used to code occupations identified in the OES surveys. Other classification systems referenced in this table include: NCES' Classification of Instructional Programs (CIP); Military Occupational Classification system (MC); and the Standard Occupational Classification (SOC).

b For labor supply descriptors, entries in this column refer to the numbers of occupations for which training is offered in the program represented by these data or the number of distinct educational fields of study covered by the particular data source.

c Industry classification systems included here include the Census Industry Classification System (ICS) and Standard Industrial Classification System (SIC).

SECTION VI

OCCUPATION-SPECIFIC REQUIREMENTS

Section VI
Occupation-Specific Requirements

In the preceding chapters of this report, we have fleshed out a content model consisting of different kinds of cross-occupation descriptors that would be included in the O*NET. This concern with cross-occupation elements of the descriptive system is essential, if the resulting occupational descriptive information is to have the intended generality.

By the same token, however, to address many issues there may be a need for more specific information describing the characteristics of a particular position or set of positions. Trainers, for example, often need rather detailed information describing the specific tasks performed on a job and the occupation-specific skills that must be developed if people are to perform those tasks. Thus, this section of the report we examine how one might go about obtaining this occupation-specific information.

Unlike the preceding chapters, in which we presented general cross-occupation taxonomies of constructs, no taxonomies will appear in this section. Because tasks, tools, duties, occupation-specific skills, and occupation-specific knowledges are all tied to the requirements for performance in a particular position, or a limited subset of positions, taxonomies of occupation-specific descriptors cannot be readily formulated. Instead, what one must do is formulate a set of procedures for generating these more specific types of descriptive information.

In the chapter included in this section, Chapter 14, we propose a set of procedures for gathering more detailed information about occupations, using a set of occupation-specific descriptors. In the first part of the chapter we propose procedures for using existing task inventories (initially) and generalized work activities (eventually) to both generate and organize information about occupation-specific tasks, tools, and duties. In the second part of the chapter we consider how information about requisite job tasks can be used in conjunction with information about basic and cross-functional skill requirements to generate information about occupation-specific skills and knowledges.

Chapter 14
Procedures for Collecting Occupation-Specific Information
Table of Contents

Tables

Figures

Appendices

Chapter 14
Procedures for Collecting Occupation-Specific Information

Michael D. Mumford
American Institutes for Research

Virtually all of the foregoing chapters have focused on the development of taxonomies, and measures that might be used to describe occupations. This kind of cross-occupation descriptive system provides the foundation for a system intended to answer questions about a variety of occupations. These cross-occupation descriptions, however, do not and, in fact, cannot address all of the various types of descriptors considered in the APDOT report (U.S. Department of Labor, 1993). More specifically, these taxonomies of cross-occupation descriptors provide occupation-specific information, such as the tasks and occupation-specific skills that only apply to a single occupation or to a narrowly defined job family.

Many questions can be answered without referring to occupation-specific information (Pearlman, 1993). But as McCage (1994) points out, occupation-specific information may be required to answer other important questions. For example, occupation-specific descriptive information may well be necessary to specify training, develop position descriptions, and undertake redesign of jobs.

The various applications of occupation-specific information clearly argue for inclusion of certain types of occupation-specific descriptives in a comprehensive occupational information system such as O*NET. The inclusion of occupation-specific information, however, raises a host of issues. As illustrated in the history of the DOT (U.S. Department of Labor, 1991) and the concerns voiced by the APDOT panel, occupation-specific information often is collected in a patchwork fashion. Further, by its very nature, this kind of descriptive information is difficult to embed within a broader organizing structure. Finally, collection of occupation-specific descriptive information is resource intensive.

These and other considerations suggest that it may be difficult and perhaps not especially useful to include occupation-specific information in the O*NET. At least over the short run there seems to be some truth to this proposition. Certainly, there is little point in collecting volumes of occupation-specific information until the various cross-occupation descriptors have been used to identify a coherent and reasonably parsimonious set of occupations and job families. Once that has been done, however, and once a viable framework for collecting occupation-specific descriptors has been constructed, then this more specific type of descriptive data should be included in the O*NET.

Describing Specific Work Activity

As Fleishman and Quaintance (1984) point out, a variety of techniques might be used to generate descriptive information about the activities being performed on an occupation. One might, for example, describe occupations in terms of performance errors. Alternatively, the work people do in their jobs can be described through qualitative ethnographic procedures. Still another approach to the description of occupational activities flows from recent work on the role of cognition in performance. In this instance activities are described in terms of requisite knowledge structures (Camarra, 1992).

These and other techniques used in job analysis all clearly have their own unique strengths and weaknesses. Further, it should be apparent that these techniques are all intended to provide somewhat different information about the nature of job performance. By the same token, however, these techniques all share a common starting point in that they begin with an attempt to define the nature of the activities people are performing on their jobs.

As a result, the definition and description of work activities provide a basis for virtually all job analysis efforts. The procedure most commonly used to define and describe these activities is task analysis. At a general level, task analysis represents a way of framing or organizing job activities. As McCormick (1979a) points out, fundamentally a task is an action applied to some object under certain conditions. The starting point for attempts to describe a specific occupation is, therefore, definition of the tasks to be performed in the occupation.

A variety of procedures have been used to identify the tasks performed in an occupation and to obtain descriptive information about the nature of those tasks. Tasks are sometimes identified by having job analysts watch people perform the work. At other times, panel meetings with incumbents or supervisors are used to define tasks. A third approach is to use existing task inventories (McCormick, Jeanneret, & Mecham, 1972). Generally, these task lists are used to identify the more important or frequently performed tasks (Friedman, 1990; Harvey, & Lozada-Larson, 1988). Often, however, these task lists, inventories, and questionnaires request other types of information about the nature of task performance, such as learning difficulty, criticality, degree of discretion, etc. (Mumford, Weeks, Harding, & Fleishman, 1987).

Although a variety of procedures may be used to identify requisite tasks in an occupation, the most common procedure is to convene a meeting of subject matter experts (SMEs). In SME meetings, a group of five to seven incumbents, or their supervisors, are called together. These SMEs are then asked to describe the activities they perform in their occupations. This unstructured recall approach will elicit usable task statements. However, to attain comprehensive coverage of the tasks performed in an occupation, it often is necessary to conduct a number of meetings. As a result, this technique often becomes unduly time consuming and expensive. Alternatives such as critical incident analysis or observation of job performance also unfortunately suffer from much the same problem.

This task identification problem is important with respect to the development of the occupational classification and information system. Even with a well developed classification system, there still are likely to be a relatively large number of job families and occupations within these families where detailed information will be needed concerning the underlying work activities. In the following section we review four potential techniques for collecting occupation-specific information about the tasks that are performed.

Approaches

General task inventories. One approach to collecting task data is the general, cross-occupation task inventory. Two advantages of this approach are that it is relatively fast and inexpensive. Perhaps the most frequently used general job analysis inventory of this sort is the Position Analysis Questionnaire (PAQ; McCormick, Jeanneret, & Mecham, 1972).

Cunningham (1988) and Harvey (1991) have also contributed general inventories. More recently, the American College Testing Program has developed a general task survey under the auspices of the Department of Labor (American College Testing, 1994).

There is evidence that these kinds of general cross-occupation task surveys can provide meaningful descriptions of activities performed in a number of occupations (McCormick, Jeanneret, & Mecham, 1972). On the other hand, this approach has some problems. First, general surveys have sometimes proven difficult to administer due to problems in communication or readability. More fundamentally, by virtue of their focus (i.e., tasks appearing in multiple occupations), necessarily give less attention to the specific activities occurring in a given occupation (Levine, 1983). As a result, it is questionable whether this approach will provide a truly comprehensive description of tasks and those activities that make a given occupation unique. This potential shortcoming of generic surveys in turn limits their value in defining occupation-specific tasks as well as occupation-specific skills and knowledges.

Available task inventories. A second technique that could be used to obtain information about tasks relies on the use of existing job analysis inventories.. Prior efforts have provided task analysis data for a number of occupations. Conceivably, an effort might be initiated in which a library is built up over time that describes the tasks identified in earlier occupation analysis efforts. When attempting to describe a particular occupation, relevant task inventories would be withdrawn from this library. Such occupation-specific lists of tasks would be reviewed and used as the basis for task inventory questionnaires.

This approach clearly would reduce the amount of effort needed to generate an initial set of task statements. On the other hand, however, a substantial amount of work would be required to develop the kind of library needed to make this approach feasible. Available task analysis inventories would have to be rewritten so that tasks statements were written at a common level of analysis. Further, arrangements would have to be made to obtain what in many areas will be proprietary data. Finally, available task inventories are likely to be available only for a relatively select sample of occupations, typically occupations in which performance is of sufficient importance to the organization to warrant an expensive and time consuming job analysis effort. As a result, other techniques would still be required for identifying the tasks occurring on other occupations not covered by the available task inventories.

Even if these difficulties could be overcome, one problem remains. The lists of tasks would probably be deficient. There are at least three reasons for this potential deficiency: (1) some of the inventories would be based on relatively old job analyses and important changes in the occupations may have occurred in the meantime; (2) some of the inventories would be based on job analyses that were performed for specific purposes, resulting in inventories that focus only on some parts of the examined occupations; (3) the inventories would be based on job analyses that vary greatly in quality and comprehensiveness.

Activity analysis. A third approach for generating occupation-specific tasks in rapid, cost effective fashion has been suggested by Prien (1994). This approach is based on the notion that all occupations involve a limited set of common activities such as installing, repairing, writing, tracking, or supervising. These common activities, or action verbs, might be used as a basis for generating tasks by applying the following procedures. First, a general taxonomy of action verbs would be identified, such as those proposed by Prien (1994) or Edwards (1989). Second, a group of SMEs would be asked to review this activity list and check the activities they perform in their occupation. Third, a second group of SMEs would be presented with each of these activities and for each activity they would be asked to list all objects of the activity providing modifications as necessary. Thus, in the case of electricians, incumbents might list install switches, install wiring, and install control boxes.

The procedures described above would, at least in theory, result in a set of task statements consistent with McCormick's (1979b) definition of a task as an activity occurring in relation to some object. Further, it is possible that this procedure, if coupled with an expert system might be used to generate tasks "on-line" or through telephone interviews. Thus, an activity-based approach to task generation would seem to warrant further consideration.

We use the word "consideration"quite intentionally. Although this activity-based approach to task generation has some attractive features, it has not been widely applied. Moreover, it may prove difficult to obtain a comprehensive list of activity statements and create procedures for identifying synonyms within a list of activity statements. Additionally, any activity-based approach may implicitly downplay the specific objects and the unique behavioral demands associated with a given set of tasks. Implementation of this approach would be relatively time-consuming and expensive.

Generalized work activities. A fourth approach that might be used to generate task statements has been suggested by Mumford and his colleagues (Clifton, Connelly, Reiter-Palmon, & Mumford, 1991; Connelly, Reiter-Palmon, Clifton, & Mumford, 1991; Gilbert, Connelly, Clifton, Reiter-Palmon, & Mumford, 1992; Mumford, Threlfall, Costanza, Baughman, & Smart, 1992; Reiter-Palmon, Uhlman, Clifton, Connelly, Deflippo, & Mumford, 1990). In this approach, a panel of SMEs is presented with a list of generalized work activities (GWAs) stated in general terms. Initially, panel members are asked to reach a consensus regarding the GWAs for their occupations. Finally, within each of the retained GWAs, panel members are asked to list the specific tasks occurring under each dimension.

This approach differs from more traditional approaches in the process used to elicit tasks. Rather than asking a global question, "What do you do on your job?," panel members are asked a series of more specific questions referring to the tasks performed under a given dimension or GWA. By using recall in relation to GWAs, tasks can be generated far more rapidly. Typically, a one-day panel meeting with five or six SMEs is sufficient to obtain 90 to 95 percent coverage of the occupation's relevant tasks.

Perhaps the most important characteristic of this approach is that it allows tasks to be generated quickly with good coverage of the relevant domain. Two other characteristics of the approach also make it attractive. First, it can be easily extended to capture contextual influences on performance as well as duties and tools. Second, it allows tasks to be generated and organized around broader dimensions of GWAs thereby providing a system for identifying tasks that explicitly integrates these tasks into a broader taxonomic structure. In terms of resources required, this approach would be more expensive and time-consuming than the general task inventory and available task inventory approaches, but would likely be faster and less expensive than the activity analysis approach.

Procedures

Our discussion of job analysis procedures suggests a two-step approach to the development of a task database for inclusion in O*NET. Initially, for the purposes of the prototype, a variant of the Available Task Inventories approach describe above will be used. Subsequently, we would implement the GWA approach. Both approaches are described below.

A Modified Available Task Inventories Approach. A variation on this library-based task generation procedure is now being employed for use in the prototype O*NET. The current *Dictionary of Occupational Titles* provides a short list of major tasks to be performed in each occupation included in the *Dictionary*. Thus, one might identify a set of tasks by abstracting core tasks included in those occupations subsumed under a given OES occupation.

This work has been initiated by the North Carolina Occupational Analysis Field Center. It began by identifying those DOT occupations associated with each of 80 OES occupations.. This initial clustering served to convert DOT occupations into the broader OES occupational structure. Next, a text analysis program was used to abstract tasks from the relevant DOT occupational descriptions.

Once the tasks occurring within a cluster of DOT occupations had been identified, they were presented to analysts at the OAFC field centers. These experienced job analysts then edited the identified tasks for clarity, brevity, and accuracy. Additionally, a second panel of job analysts reviewed the resulting list of task statements for comprehensiveness, adding to or correcting the initial task list to ensure that the task list was reasonably comprehensive and that the tasks were written to a common level of specificity.

This procedure resulted in the identification of 10 to 20 relatively broad task statements for each of the 80 OES occupations. The task lists were then used to create occupation-specific task rating questionnaires. One of these questionnaires is presented in Appendix 14-A. As shown in Appendix 14-A, respondents are asked to read each task statement and identify those tasks that are relevant to the performance of their job. If incumbents indicate that a task is relevant, they are asked to (a) rate the frequency with which they perform this task and (b) rate the importance of this task with respect to performance of the job. Importance and frequency ratings are used in part because they have been shown to provide unique descriptive information and in part because the simultaneous collection of multiple ratings contributes to reliability (McCormick, 1979a).

The tasks shown in Appendix 14-A represent a modified version of the Available Task Inventories notion described earlier in this chapter. In a more elaborate version the initial task lists would come from multiple sources (i.e., not from just the DOT task lists). They.

would stem from a review of prior job analysis programs including the job analysis work conducted by (a) the Department of Defense, (b) the Office of Personnel Management, and (3) those research institutes and consulting firms willing to share proprietary data. The process would include a careful review of the quality of each job analysis and its resulting task list. The tasks list that are judged of sufficient quality would be (1) edited for clarity and common level of specificity, (2) reviewed, (3) and edited again as necessary. It is important to note that this procedure would likely result in occupation-specific task rating questionnaires with a greater number of tasks per occupation (e.g., 100 - 200), and at a more specific level than is provided by the modified approach represented in Appendix 14-A.

The modified approach will provide an excellent vehicle for initial development. These broad task statements can be responded to relatively rapidly, thereby providing a low cost mechanism for collecting occupation-specific information with about the 80 occupations in the O*NET prototype. Further, they provide an explicit linkage between the new O*NET and the old DOT, expediting other conversion efforts, such as expert judgments about each occupation's skill requirements and GWA's. A drawback, however, is that the modified approach contains task statements that only provide a rather broad description of an occupation's activities. For many applications, including selection and training, these task statements may be too broad.

The GWA approach. The procedures sketched out above are most appropriate when existing task inventories are available. However, a different approach will need to be applied when available up-to-date task lists are not available. As noted above the most attractive approach for generating these new task lists is to use a cued recall approach where the GWAs provide a basis for task generation.

Broadly speaking, this approach is based on the earlier work of Mumford and his colleagues (Mumford, Threlfall, Costanza, Baughman, and Smart, 1992; Reiter-Palmon, Uhlman, Clifton, Connelly, Deflippo, and Mumford, 1990). This task generation procedure requires a group of five to six SMEs. Typically these SMEs are incumbents or supervisors who have at least six months experience. It generally is useful when forming SME panels to select panel members who have different backgrounds and somewhat different career histories (Campion, 1992; Landy and Vasey, 1991). Additionally, panel members should be good performers who hold

SUBCATEGORIES AND TASKS

Now that you have identified broad behavioral categories related to your job, the next step is to break the categories into subcategories, or more specific groups of activities. After breaking categories into subcategories, each subcategory will be further broken down into specific components, or tasks.

Let's say that you identified "self development" as a behavioral category related to your job. The next step would be to describe smaller parts of this category. For example, "participate in training," "keep up with new information," and "self assessment" are all subcategories important to self development. In this way, we may create several subcategories for any given category.

As you identify each subcategory, please list all of the specific tasks performed on your job that fall under that subcategory. A good description of a "task" includes two parts:

1) a specific action (what you do), and
2) the purpose of that action (why you do it)

EXAMPLE:

The subcategory "Keeping up with new information" might include tasks such as:

1. Subscribe to job related publications to obtain new articles.
2. Read newspapers to look for job related information.
3. Attend conferences related to the job.

It is important to list all the tasks that you do, no matter how unimportant you think they are. The purpose of this "category → subcategory → task process" is to generate more detailed information about what you do on the job. After you have listed all possible tasks under a subcategory, move on to identifying the next subcategory.

Figure 14-1
Prototype: Instructions for Task Generation

roughly similar positions in the organization (Landy and Vasey, 1991.) It may also be desirable to select panel members to represent different organizations, if this is possible, when there is need to obtain task data which extend across organizations. Alternatively, multiple panel meetings could be conducted. The panel meetings should be scheduled to occur over a day and a half. However, all requisite exercises typically can be completed in a single day.

Two job analysts would typically be required to conduct a panel meeting. One analyst would be responsible for guiding the meeting while the other would take notes. However, only one experienced job analyst may prove adequate in some settings. At the outset of the meeting, the first job analyst should provide a general introduction describing the objectives of the meeting.

Next, each incumbent would be asked to review the GWAs and make a yes-no decision about whether each GWA describes activities that are part of the job. Each GWA would be accompanied by an easy to understand operational definition. After panel members have made their individual decisions, the job analyst directing the meeting would ask panel members how many indicated yes to a given dimension. If all panel members indicate yes or no the analyst would proceed to the next dimension. If however, there were disagreement, panel members would be asked to indicate why they marked a dimension yes or no and then to reach a consensus as to whether the dimension should be retained because it describes a unique set of job activities. Alternatively, the job analyst could retain only those dimensions that 50 percent to 75 percent of the panel members felt covered important job activities.

Once a set of GWAs has been selected, panel members would be asked to proceed to the next exercise. They would be asked to generate a set of task statements for each GWA they retained. Figure 14-1 presents a set of prototype instructions for this task generation exercise. Essentially, panel members are asked to list the major type of tasks they perform under each GWA and then to list the more specific tasks performed.

After panel members have generated their lists of task types and specific tasks under each GWA, a panel member would be asked to read aloud one task type and the associated tasks that he/she generated. Other panel members would be asked to review these task statements for relevance, comprehensiveness, and clarity recommending any necessary changes. All panel members would repeat this procedure until tasks had been generated for all of the

1. Give distributors updated pricing information

2. Train new distributor sales representatives about applications of Firm X products, promotional activities, and new products

3. Inform distributor of the pricing terms for a particular job

4. Fill out SPA reports

5. Discuss pricing issues with distributors

6. Apply knowledge learned in the past to solve similar or related problems

7. Negotiate with pricing department about annual contracts and SPAs

8. Go on joint calls with distributor representative in order to assess user's lighting needs and recommend appropriate product for environment

9. Respond to requests from immediate management that require immediate attention

10. Implement local incentive plan and meet with distributors to explain the plan

11. Check report for expiring SPAs to determine which ones to renew

12. Receive performance appraisal from manager

13. Contact distributor management in order to convince them to allocate time and resources for training or promotional activities

14. Contact manager to notify him/her of a problem that cannot be immediately resolved or that cannot be solved by the sales representative alone

15. Talk to distributors to find out about solicitation by competitors and prices

16. Go over annual reviews with distributor and set mutual goals for the next year

17. Train experienced distributor sales representatives about applications of Firm X products, promotional activities, and new products

---

Figure 14-2
Illustrative Tasks for Commercial Sales in the Electrical Products Industry

In this final exercise, we will ask you to answer one other set of questions about your job. We would like you to list your major job duties.

A job duty is not a generalized work activity or simply one task. A duty is a set of tasks done to accomplish a major responsibility or produce an important product. Typically, many tasks are involved in a duty and a number of different generalized work activities.

For example, one duty of police officers is to arrest suspects. In arresting suspects, police officers must determine whether a crime has been committed, they must judge likely guilt, they must restrain the suspect, and read the suspect his/her rights. Thus the duty *arresting suspects* involves a number of tasks and at least the generalized work activities 1) obtaining information, 2) making decisions, and 3) communicating information.

In this exercise we would like you to think about your job and the major things that must be done. We would like you to briefly list each of these duties or products. After you have listed a duty we would then like you to look back at your list of generalized work activities and write down the number of the three or four most important generalized work activities involved in performing this duty.

Figure 14-3
Instructions for Identifying Job Duties

retained GWAs. Throughout this process job analysts would take notes writing down the final task statements arrived at by panel members. This review procedure only is intended to ensure that the proposed tasks are appropriate and that all relevant tasks under the dimension have been covered.

The job analysts' notes provide the basis for generating the final task list. Construction of the task list typically occurs two days after the panel meeting. Tasks would be typed up and initial redundances eliminated. Next, the tasks would be reviewed by two other job analysts to identify remaining redundancies and clarify the language. The resulting task list, as illustrated in Figure 14-2, could then be administered in survey form to a larger sample of incumbents using task rating scales like those presented in Appendix 14-A. It would be desirable, however, to have a second panel review the task list, adding any additional tasks needed to ensure a comprehensive description of the occupation. Not only will this procedure provide a comprehensiveness check, but also it should help ensure identification of any tasks not clearly linked to one of the retained GWAs.

For purposes of O*NET, the basic set of procedures described above should be extended to obtain two other necessary pieces of descriptive information. Information on duties and tools and equipment used would be obtained at the end of the panel meeting. In the case of tools and equipment, panel members would simply be asked to list the ten tools and ten pieces of equipment used most frequently on their jobs.

In the case of duties, a somewhat different approach would be followed. Panel members would be asked to read through the instructions presented in Figure 14-3. These instructions describe job duties as a distinct kind of entity with respect to GWAs. Subsequently, panel members would be asked to list the ten major duties performed on their job. Next, panel members would be asked to list the GWAs which contribute to the production of each duty or product produced listed. This information would then be used by job analysts to form a description of the relevant duties with reference to associate GWAs and tasks.

The procedures described above result in very rapid generation of requisite descriptive material. As a consequence, job analysts will need training on how to conduct SME meetings and how to collate the material obtained in those meetings. Prior experience indicates that this training can be accomplished relatively rapidly. Given the feasibility of training analysts to use this approach and the fact that this approach generates tasks related to O*NET's broader taxonomy, it would seem to provide a good strategy for developing occupation-specific information.

Even though the structured approach described above represents a cost-effective procedure for collecting occupation-specific information about relevant tasks, tools, and duties, it will typically take some time, roughly two weeks, to conduct the meetings and prepare the descriptive materials for questionnaire administration. Thus, these procedures are most likely to be applied when updating existing information due to changes in occupational requirements or when emerging, high-skill occupations are being examined where more detailed information is required about requisite occupation-specific skills and knowledges.

Procedures for Defining Occupation-Specific Skills and knowledges

As noted elsewhere both in this report and in the broader literature, a variety of procedures has been used to define occupation-specific skills. In some cases, an occupational skill is defined as practiced task performance. In other cases, occupation-specific skills are defined in terms of broad basic capacities.

In the case of occupation-specific knowledges the situation is somewhat less ambiguous. Most would agree that knowledge represents an organized set of facts and principles pertaining to the characteristics of objects lying in some domain (Fleishman & Mumford, 1989). Further, a variety of techniques, involving expert-novice comparisons (Chi, Glaser, and Farr, 1988) and think aloud protocols (Barsalou, 1991) are available for identifying relevant knowledge structures. Although the evidence indicates that these techniques can be effectively used to identify requisite knowledges, they also are relatively time consuming. In fact, the time involved in applying these techniques is such that it would effectively prohibit use of this approach in defining occupational-specific knowledges across a range of occupations.

Given the importance of occupation-specific skills and knowledges in assessment, selection, training design, and re-skilling, techniques are needed that will permit cost effective collection of this information. Thus, in this section we sketch out a set of general procedures that might be used to identify occupation-specific skills and knowledges.

Skills and Knowledges. Before proceeding to the procedures that will be used to identify occupation-specific skills and knowledges, it would be prudent to consider exactly what is meant by the terms skills and knowledges. As noted above, skills have been defined in a variety of different ways. One way is to define skills is as a general set of activities or procedures required for performance in some domain (Campbell, McCloy, Oppler, & Sager, 1992). Depending on the breadth of the domain, skills can be defined at a number of different levels. Further, there may be a number of different types of skills. For example, basic skills might reflect activities needed to learn various tasks. Cross-functional skills might represent general activities or procedures called for in domains that extend across occupations.

Occupation-specific skills represent still another kind of skill. In this case, the domain is some subset of the occupation's tasks that call for a common set of activities. In the case of electricians, installation, a common job activity, might be applied in three distinct types of task domains; (1) outside wiring installation; (2) inside wiring installation; and (3) installation of lighting fixtures. Accordingly, occupation-specific skills may be defined as a general activity (e.g., installation, repair, etc.) as applied to a similar set of tasks calling for related procedures.

Occupation-specific knowledges are less difficult to define. Knowledge, generally speaking, is held to reflect an organized set of facts and principles pertaining to the characteristics of objects lying in some domain. In this sense knowledge, particularly expert knowledge, can be viewed as a principle based organization of relevant material within a given task domain. Thus the principles needed to work with or apply a given skill in performing a set of related tasks may be said to reflect an occupation-specific knowledge.

Procedures for defining occupation-specific skills and knowledges. Given the foregoing definition of occupation-specific skills and knowledges it becomes possible to envision a four-step process for identifying them. First, the core tasks for an occupation must be identified. As discussed earlier in this chapter, the GWA and general Available Task Inventories are used to identify tasks. Second, tasks reflecting a common set of basic/cross-functional skill requirements would be specified. Third, within a given task set, where tasks are drawn from a common skill, tasks involving similar or related procedures would be identified. Fourth, the knowledges needed to perform a given set of procedurally related tasks would be identified. Figure 14-4 illustrates these four basic steps.

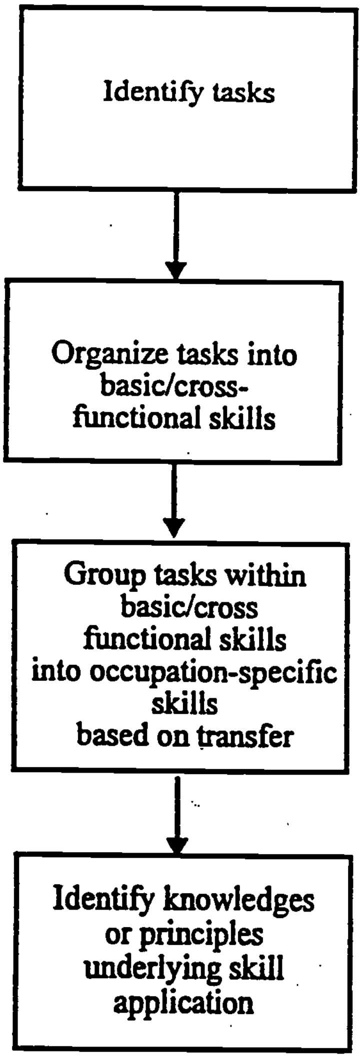


Figure 14-4
General Procedures for Identifying Occupation-Specific Skills and Knowledges

The general procedures sketched out in Figure 14-4 are intended, in part, to address a crucial problem identified by Stevens and Campion (1994). They found that SMEs typically group tasks together based on content similarity rather than underlying skill and knowledge requirements. Accordingly, we would not ask SMEs to identify occupation-specific skills directly. Instead, a job analyst reviews the task statements and assigns tasks to the most relevant basic and cross-functional skills. SMEs are asked to define occupation-specific skills within a broader basic and cross-functional skill. Thus, SMEs define occupation-specific skills by only looking at those tasks held to represent instances of one basic or cross-functional skill at a time.

This set of procedures displays three desirable characteristics. First, SMEs are presented with task sets already defined in terms of basic and cross-functional skills, making it possible for them to identify occupation-specific skills. Second, occupation-specific skills are identified in terms of basic and cross-functional skills, making it possible to link occupation-specific skills to a broader cross-job structure. Third, because occupation-specific skills are viewed as task instances of broader skills, the tasks assigned to an occupation-specific skill can be used in conjunction with task survey data to obtain scale scores reflecting the importance, time spent, learning difficulty, and performance of each skill.

These procedures, however, are based of three key assumptions. The first major assumption is that tasks can be organized into subsets based on the kind of activities called for. Thus one might group all installation tasks together . Within this subset of tasks, however, there will be a set of lower order groupings or task groups which represent unique occupation-specific procedures. It also is assumed that these lower order task groupings will not only share certain procedures but they will also share common knowledge requirements.

In the following sections, we describe the procedures introduced in Figure 14-4 in some detail. We begin with the second step inasmuch as the procedure for identifying tasks have already been described.

<u>Organize Tasks</u>. To generate task sets organized by a common basic or cross-functional skill requirement, a job analyst would be asked to sort the tasks into basic cross-functional categories. For example, the task of installing heavy outdoor wiring would be assigned to the

installation cross-functional skill. This sorting of tasks into basic and cross-functional skill categories need not be solely based on judgment. It is quite possible that computer based expert systems could be designed to guide this sorting in a hierarchical fashion.

The output of this sorting operation would be several sets of tasks. Each set would contain 10 to 30 tasks, all of which shared a cross-functional or basic skill requirement. Based upon our experience, roughly five to 15 task sets will be required to adequately cover the tasks involved in a given job.

<u>Identify occupation-specific skills and knowledges.</u> Once the task sets needed for a given occupation have been identified, they will provide the stimulus material used in defining occupation-specific skills and knowledges. The procedure includes steps 3 and 4 shown in Figure 14-4.

Because people who have not worked with these tasks would generally be unfamiliar with the procedures involved in task performance, it would be difficult, if not impossible, for job analysts to identify requisite occupation-specific skills and knowledges. Incumbents and supervisors, on the other hand, being familiar with tasks,should be able to define these specific skills and knowledges given adequate guidelines. Supervisors, however, by virtue of their breadth of perspective, provide a more appropriate source of information. Thus a group of four to five supervisors would be assembled. Panel members should, of course, be selected based on their expertise, prior performance, and diversity of perspective. Panel members would then be asked to help define occupation-specific skills and knowledges using the procedures described below.

At the outset of the panel meeting, panel members would be provided with a brief description of the task at hand. This introduction would begin with an overview of why skills and knowledges are important and why it is necessary to identify the particular skills and knowledges involved in their jobs. The introduction would conclude with a description of the steps involved in defining the occupational skills and knowledges.

Following the general introduction, panel members would be provided with a concrete example of the kind of products that need to be obtained from the meeting. Panel members would be presented with a set of stimulus tasks, for example, electrical worker installation tasks, and then shown the skills and knowledges emerging from those tasks. The material used in this example should be based on a set of clearly stated, unambiguous tasks obviously calling for a set of similar basic or cross-functional skills. Further, the need to define skills and knowledges based on related job tasks should be emphasized. Appendix 14-B provides one example of the instructions that might be given.

Having worked through the instructions and the associated examples, the process of identifying occupation-specific skills and knowledges would begin. During the first phase of this exercise panel members would be presented with a worksheet. Panel members would first be asked to read through the tasks presented on this worksheet. These tasks would, of course, represent the set of tasks requiring a common cross-functional or basic skill. After reading through this material, they would be asked to identify three groups of related tasks. In defining these task groups panel members would be asked to assign tasks to the same group only if prior knowledges or experiences with one task would help them learn to perform the other tasks included in the group. This grouping criterion, of course, assumes that skills can be defined based on potential analogical or procedural transfer (Reeves & Weisburg, 1994).

After each panel member has generated his or her task groups, they would be asked to answer three other questions on their worksheets. First, they would be asked to provide a label and a brief definition for each task group. Second, after writing down this label, they would be asked to list, by numeric code, the tasks falling into each group. Third, they would be asked to rate each task on a scale of 1 to 15 with respect to how long it took them to learn to perform it.

Panel members will be asked to generate one other set of products following initial definition of their task groups. After the task groups have been defined, they will be asked to look back over each group label and the associated tasks. As they reread this material they will be asked to think about the principles or general kinds of knowledges needed to perform the tasks they assigned to a given group. They would then be asked to list the three most important knowledges associated with a given task group. They then would rate, on a 1 to 15 scale, how long it took them to acquire each knowledge.

Once panel members have completed their worksheets, they would be asked to discuss their answers. This discussion would begin by asking one individual to propose a transfer group, to read the label, the tasks assigned to the group, and the three knowledges back to other panel members. Panel members would be asked to indicate whether they had a similar task group and to decide whether this task group represented a legitimate skill in the sense that learning one task in the group would help you learn the other tasks. If other panel members had proposed similar groups, and the panel agreed that this grouping reflected useful knowledges and skills, then it would be retained. This procedure would be repeated by asking another panel member to propose a new task group and would continue until all unique task groups identified by panel members had been presented and reviewed.

Once the initial generation of occupational skills and knowledges was complete for a given set of stimulus tasks, the task set calling for a common cross-functional or basic skill, these skills and knowledges would be read back to panel members. As each skill and knowledge was read back they would be asked to rate, on a 15-point scale, the difficulty or time needed to acquire this skill or knowledge. After this final review was completed, the meeting would proceed to the next stimulus set. The same steps would be repeated until occupation-specific skills and knowledges had been generated for all of the relevant task sets.

Field test. In a recent study, Mumford and Supinski (1995) attempted to apply these procedures to identify the occupation-specific skills and knowledges involved in two telecommunication job families: repair technicians and systems control analysts. Initially, a set of tasks was identified for each occupation and then ratings were obtained describing the importance, time spent, learning difficulty, and perceived performance of each task. Once these basic descriptive data had been collected attention turned to definition of requisite occupation-specific skills and knowledges.

This effort began by having an analyst assign each task statement to one or more of the basic and cross-functional skills. These task-skill groupings were then presented to two panels of supervisors for each occupation. Panel members were asked to review the tasks assigned to a given basic or cross-functional skill. They were asked to describe the occupation-specific skills and knowledges using the kinds of procedures described above.

Table 14-1
Illustrative Occupation-Specific Skills and Agreement Coefficients – Analysts (Total number of skills = 84)

Reading Comprehension		**Monitoring**	
General status reading	75%	Team performance monitoring	38%
Reading for planning	50%	Individual performance monitoring	50%
Professional reading	75%		
Writing		**Social Perceptiveness**	
Office writing	75%	Organizational awareness	63%
Technical writing	75%	Customer awareness	63%
Status/Activity report writing	75%		
Speaking		**Coordination**	
Executive briefing	63%	Task-oriented coordination	63%
Technical briefing	88%	Peer coordination	38%
Task communication	75%	Management coordination	25%
		Technical coordination	25%
Critical Thinking		**Persuasion and Negotiation**	
Technical evaluation	75%	Cost negotiations	63%
Environmental monitoring	75%	Operational negotiations	50%
Evaluating resource requirements	50%	Presenting technical recommendations	75%
Learning Strategies		**Coaching**	
Self-directed informal training	100%	Technical teaching	50%
Self-directed formal training	88%	Coaching and monitoring	63%

Because multiple supervisory panels were used, it was possible to determine the degree of agreement across panels within an occupation. Table 14-1 presents the percent agreement coefficients for the occupation-specific skills identified by members of each panel. Good agreement, roughly 66 percent, was observed in the occupation-specific skills identified by the two panels assembled for each job.

Conclusions

In this chapter we propose two methods for collecting O*NET occupation-specific information. The first is a modified version of the Available Task Inventories approach. This approach consists of using task lists from the DOT to generate occupation-specific task rating questionnaires for the 80 occupations in the O*NET prototype. This is considered to be a good solution for including occupation-specific information in the prototype. These broad task statements provide a relatively fast, low cost, mechanism for collecting occupation-specific information. Further, they provide an explicit linkage between the new O*NET and the old DOT.

However, there are a number of reasons why this solution is less attractive for the collection of O*NET occupation-specific information once development moves beyond the prototype stage. First, our modified version of the approach creates a list of only 10 to 20 tasks per occupation. A per occupation task list of this size does not generate a sufficient number of tasks at a sufficient level of detail to support the proposed procedures for identifying occupation-specific skills and knowledges. Additionally, this modified version suffers from all of the disadvantages inherent is the fully elaborated Available Task Inventories approach. For example, the approach is completely dependent on the availability and quality of existing job analyses. Some of the task lists from these analyses already are out-of-date, some were developed for specific purposes resulting in task lists that only focus on some parts of the occupation, and the lists are likely to vary greatly in quality and comprehensiveness.

Because of these disadvantages, we recommend that after the prototype data collection the GWA approach be used to collect O*NET occupation-specific information. This approach certainly does not represent the only set of procedures that might be used to generate occupation-specific skills and knowledges as well as information about requisite tasks, tools, and duties. However, the GWA approach does have some attractive features visa a vis the O*NET.

By explicitly linking the generation of this occupation-specific information to broader cross-occupation taxonomies, as reflected in the cross-functional skills and GWAs, the proposed procedures should serve to facilitate organization of relevant occupation-specific information in terms of a broader more comprehensive taxonomic structure. Further, there is some reason to suspect that the kind of hierarchically structured job analysis procedures described here will serve to ensure more rapid and cost-effective collection of occupation-specific descriptive information.

The methods sketched out above also appear capable of addressing a number of practical problems. For example, it is expected that skills boards will seek to identify the occupation-specific skills and knowledges required in various occupations. Not only do the procedures sketched out above provide a systematic framework for defining these skills and knowledges, but they also explicitly link skill requirements to the tasks to be performed in the occupation. This should facilitate the work of the skills boards, while providing a relatively economical method for the identification of occupation-specific skills that possess some reliability and validity.

The skills boards, however, do not represent the only area where occupation-specific information is needed. In training, for example, there often is a need for the kind of job-specific information provided by those procedures. Trainers need to know what occupation-specific skills and knowledges must be developed. Further, these skills and knowledges must be developed within the context of requisite tasks. The procedures described above would, of course, provide trainers with this background information, thereby contributing to the design, delivery, and evaluation of training courses.

In addition to these applications of occupation-specific information, the type of information provided by these procedures might be used to address a number of other issues. First, this kind of occupation-specific information might be used to provide guidelines for person assessment. Second, it might be used in job redesign efforts. Third, it might prove useful in designing wage and compensation systems based on skill requirements.

Although this kind of occupation-specific information might prove useful in addressing a number of practical concerns, it will prove rather time-consuming and costly to collect. This statement holds true despite the fact that these procedures provide a reasonably cost-effective strategy for collecting occupation-specific information. As a result, these procedures will typically be applied when occupations are known to be changing or when growth in pay and openings dictates a more detailed description of occupation requirements. Under other conditions, the Available Task Inventories approach, based on the use of available task data, should be followed

References

American College Testing (1994). *The national job analysis study: Work activities survey.* Iowa City, IA: Author.

Barsalou, L.W. (1991). Pursuing categories to achieve goals. In G.H. Bowen (Ed.), *The psychology of learning and motivation: Advances in research and theory* (pp. 126-141). New York: Academic Press.

Camarra, W.J. (1992). *Implications of cognitive psychology and cognitive task analysis for the revision of the Dictionary of Occupational Titles.* Washington, DC: American Psychological Association.

Campbell, J.P., McCloy, R.A., Oppler, S.H., & Sager, C.E. (1992). A theory of performance. In N. Schmitt & W. Borman (Eds.), *Personnel selection in organizations* (pp. 35-70). San Francisco, CA: Josey-Bass.

Campion, M.A. (1992). *Job analysis for the proposed revision of the Dictionary of Occupational Titles.* East Lafayette, IN: Author.

Chi, M.T.H., Glaser, N.M., & Farr, M.T. (1988). *The nature of expertise.* Hillsdale, NJ: Erlbaum.

Clifton, T.C., Connelly, M.S., Reiter-Palmon, R., & Mumford, M.D. (1991). *Exploring the C Division regional sales manager position: Summary of subject matter expert meetings.* Fairfax, VA: George Mason University, Center for Behavioral and Cognitive Studies.

Connelly, M.S., Reiter-Palmon, R., Clifton, T.C., & Mumford, M.D. (1991). *Exploring the C&I Division regional manager position: Summary of subject matter expert meetings.* Fairfax, VA: George Mason University, Center for Behavioral and Cognitive Studies.

Cunningham, J.W. (1988). Occupational Analysis Inventory. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government* (pp. 975-990). New York: Wiley.

Edwards, D.L. (1989). *Action verb taxonomies.* Washington, DC: American Institutes for Research.

Fleishman, E.A., & Mumford, M.D. (1989). Individual attributes and training performance: Applications of ability taxonomies in instructional systems design. In I.L. Goldstein (Ed.), *Frontiers of industrial and organizational psychology. Volume III: Training and career development* (pp. 183-255). San Francisco, CA: Josey-Bass.

Fleishman, E.A., & Quaintance, M.K. (1984). *Taxonomies of human performance: The description of human tasks.* New York, NY: Academic Press.

Friedman, L.J. (1990). Degree of redundancy between time, importance, and frequency task ratings. *Journal of Applied Psychology, 75*, 748-752.

Gilbert, J., Connelly, M.S., Clifton, T.C., Reiter-Palmon, R., & Mumford, M.D. (1992). *Describing requirements for the position of regional manager for ED&C Division: Summary of subject matter expert meetings.* Fairfax, VA: George Mason University, Center for Behavioral and Cognitive Studies.

Harvey, R.J. (1990). Job Analysis. In M.D. Dunnette & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology: Volume II* (pp. 71-164). Palo Alto, CA: Consulting Psychologists Press.

Harvey, R.J. (1991). *The Common Metric Questionnaire (CMQ): A job analysis system.* San Antonio, TX: The Psychological Corporation.

Landy, F.J., & Vasey, J. (1991). Job analysis: The composition of SME samples. *Personnel Psychology, 44*, 27-50.

Levine, E.L. (1983). *Everything you always wanted to know about job analysis.* Tampa, FL: Author.

McCage, R.D. (1994). *Observations regarding the development of occupational/skills clusters.* Paper prepared for the U.S. Department of Labor.

McCormick, E.S., Jeanneret, P.R., & Mecham, R.C. (1972). A study of job characteristics and job dimensions as based on the position analysis questionnaire. *Journal of Applied Psychology, 56,* 347-367.

McCormick, E.S. (1979a). *Job analysis: Methods and applications.* New York, NY: Amacom.

McCormick, E.S. (1979b). Job analysis. In M.D. Dunnette (Ed.), *Handbook of industrial and organizational psychology.* Chicago, IL: Rand McNally.

Mumford, M.D., & Supinski, E. (1995). *Application of a model to develop occupation-specific skills.* Washington, DC: American Institutes for Research.

Mumford, M.D., Weeks, J.L., Harding, F.H., & Fleishman, E.A. (1987). Measuring occupational difficulty: A construct validation against training criteria. *Journal of Applied Psychology, 71,* 578-587.

Mumford, M.D., Threlfall, K.V., Costanza, D.P., Baughman, W.A., & Smart, B. (1992). *Analysis of Kidder, Peabody account executive jobs.* Fairfax, VA: Authors.

Pearlman, K. (1993). *The skills standards project and the redesign of the nation's occupational classification system.* Washington, DC: U.S. Department of Labor.

Prien, E. (1994). *Job activities taxonomy.* Memphis, TN: Unpublished report.

Reeves, L.M., and Weisburg, R.W. (1994). The role of content and information in analogical transfer. *Psychological Bulletin, 115,* 381-400.

Reiter-Palmon, R., Uhlman, C.E., Clifton, T.C., Connelly, M.S., Deflippo, B., & Mumford, M.D. (1990). *Describing sales position requirements: GE Lighting Division, SME meeting report.* Fairfax, VA: George Mason University, Center for Behavioral and Cognitive Studies.

Stevens, S.J., & Campion, M.A. (1994). Cross-group agreement in assessment of occupational requirements. *Journal of Business and Psychology, 14*, 321-342.

U.S. Department of Labor (1991). *Dictionary of Occupational Titles* (4th ed.). Washington, DC: Author.

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

Appendix 14-A

Example Task Rating Questionnaire for the Occupation Electrical and Electronic Assemblers

Instructions for Making Task Ratings

In this questionnaire you will be presented with a list of tasks. A task is an action or set of actions performed together to accomplish an objective. This list of tasks will be specific to the job you are describing.

For each task, please make the following three ratings: RELEVANCE, FREQUENCY, and IMPORTANCE.

(1) RELEVANCE. If the task is NOT RELEVANT at all to performance on the job, mark through the "0" in the NOT RELEVANT column. Carefully read the task before deciding whether it is RELEVANT or NOT RELEVANT to this job. If you select the "0" in the NOT RELEVANT column, however, there is no need to complete the IMPORTANCE and FREQUENCY ratings described below. If the task is part of this job, rate IMPORTANCE and FREQUENCY.

(2) FREQUENCY. (Do not complete if NOT RELEVANT was selected.) Ask yourself, "How often is this task performed on this job?" For example, "Interact with potential customers" is a task that an employee in one job might perform only "once per week or less," but an employee in another job might perform "hourly or more often."

Rate the FREQUENCY with which a task is performed by marking through the appropriate number, from 1 (indicating that the task is performed once per year or less often) to 7 (indicating that the task is performed hourly or more often) on the FREQUENCY scale.

(3) IMPORTANCE. (Do not complete if NOT RELEVANT was selected.) Ask yourself, "How important is this task to performance on this job?" For example, "Develop objectives and strategies to guide the organization" might be very important for an employee in one job, but less important for another job. For the second job, however, "Provide performance feedback to subordinates" might be very important.

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

The first two tasks show how "Frequency" and Importance" differ. An employee in a particular job indicates that "Land a plane under emergency conditions" occurs only "once per year or less," but, the task is an "extremely important" part of the employee's job. In contrast, the employee indicates that task 2 is performed, "several times per day," but is less important than task 1. Finally, task 3 is not part of this job, so the employee indicates this by selecting the "Not Relevant" circle.

Task	Not Relevant	Frequency: Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often	Importance: Not Important	Somewhat Important	Important	Very Important	Extremely Important
1. Land a plane under emergency conditions.	0	1	2	3	4	5	6	7	1	2	3	4	5
2. Verify that all luggage is loaded before taking off.	0	1	2	3	4	5	6	7	1	2	3	4	5
3. Load luggage onto the plane.	0	1	2	3	4	5	6	7	1	2	3	4	5

Turn the page to begin the Tasks Questionnaire.

Tasks	Not Relevant	Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often	Not Important	Somewhat Important	Important	Very Important	Extremely Important
1. Reads work orders, follows schematic diagrams, or receives verbal instructions to determine work to be performed.	0	1	2	3	4	5	6	7	1	2	3	4	5
2. Crimps, twists, cuts, strips, and wraps electrical and electronic components to attach or fit electrical and electronic assemblies.	0	1	2	3	4	5	6	7	1	2	3	4	5
3. Routes, wires, assembles, and installs electrical and electronic components, including junction and terminal boxes, control switch panels, and instrument panels.	0	1	2	3	4	5	6	7	1	2	3	4	5
4. Bolts, screws, or fastens subassemblies and parts to electrical assembly block, using metal strips, nuts, bolts, and other fastening devices.	0	1	2	3	4	5	6	7	1	2	3	4	5
5. Inserts screws, bolts, rivets, wires, and other components into electronic and electrical units, such as transformers, appliances, or voltmeters.	0	1	2	3	4	5	6	7	1	2	3	4	5
6. Connects wiring and terminals to accessories, including printed circuits, terminals, relays, circuit breakers, plugs, switches, and condensers.	0	1	2	3	4	5	6	7	1	2	3	4	5
7. Solders or welds wire and terminal connections at specified locations to attach components to each other and components to fixture.	0	1	2	3	4	5	6	7	1	2	3	4	5

Frequency: columns "Once per year or less" through "Hourly or more often". Importance: columns "Not Important" through "Extremely Important".

Tasks	Not Relevant	Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often	Not important	Somewhat Important	Important	Very Important	Extremely Important
8. Positions and aligns components in holding devices for welding, soldering and assembly and for positioning in housing for completed assembly.	0	1	2	3	4	5	6	7	1	2	3	4	5
9. Fits covers, parts, and subassemblies into or onto main electrical assembly block or appliance and attaches subassemblies, using hand tools.	0	1	2	3	4	5	6	7	1	2	3	4	5
10. Applies adhesive and seals unprotected assembly into housing to complete component or subassembly package.	0	1	2	3	4	5	6	7	1	2	3	4	5
11. Tends machines that press, shape, and wind component parts, and trims materials from components to achieve specified dimensional characteristics.	0	1	2	3	4	5	6	7	1	2	3	4	5
12. Installs finished assemblies, subassemblies, or printed board assemblies, and attaches hardware, such as knobs, sockets, face plates, other hardware.	0	1	2	3	4	5	6	7	1	2	3	4	5
13. Adjusts and sets controls of processing equipment, including scribing machines, furnaces, power supplies, and timers.	0	1	2	3	4	5	6	7	1	2	3	4	5

Tasks	Not Relevant	Frequency: Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often	Importance: Not Important	Somewhat Important	Important	Very Important	Extremely Important
14. Mounts assembled parts and components, such as transformers, resistors, transistors, capacitors, integrated circuits, and sockets, on chassis panel.	0	1	2	3	4	5	6	7	1	2	3	4	5
15. Tests function and continuity of electrical and electronic assemblies, wiring, and other components, using electrical and electronic testing devices.	0	1	2	3	4	5	6	7	1	2	3	4	5
16. Inspects wiring and functioning of components of electrical and electronic assemblies, using electrical and electronic testing equipment and through observation.	0	1	2	3	4	5	6	7	1	2	3	4	5
17. Repairs and reworks defective assemblies routed to rework by removing, adding, or replacing parts or re-soldering or re-bonding defective connections.	0	1	2	3	4	5	6	7	1	2	3	4	5
18. Cleans parts and assemblies at various stages of production, using cleaning solutions and hand tools.	0	1	2	3	4	5	6	7	1	2	3	4	5
19. Lubricates gears and other moving parts and turns shaft to ensure free movement of assembled parts, using grease gun.	0	1	2	3	4	5	6	7	1	2	3	4	5
20. Explains and demonstrates work procedures to other workers in electrical and electronic fabricating, processing, and assembly functions.	0	1	2	3	4	5	6	7	1	2	3	4	5

Tasks	Not Relevant	Frequency: Once per year or less	More than once per year	More than once per month	More than once per week	Daily	Several times per day	Hourly or more often	Importance: Not Important	Somewhat Important	Important	Very Important	Extremely Important
Additional Relevant Tasks Please write in additional relevant tasks and provide a rating.													
21. ______	0	1	2	3	4	5	6	7	1	2	3	4	5
22. ______	0	1	2	3	4	5	6	7	1	2	3	4	5
23. ______	0	1	2	3	4	5	6	7	1	2	3	4	5
24. ______	0	1	2	3	4	5	6	7	1	2	3	4	5

Appendix 14-B

Prototype Instructions for Generation of Occupation-Specific Skills and Knowledges

Today you will be participating in an exercise intended to identify the kind of knowledge and skills you need to perform your job. In the first part of this effort we will try to identify the kind of skills you need to perform your job. In the second part off this exercise we will try to identify the knowledge you need to apply these skills.

To identify the kind of knowledges and skills involved on your job we will follow a five step procedure.

- You will review a set of tasks which call for similar types of activities
- You will group together those tasks based on whether learning one task in the group would help you learn the others
- You will note the knowledges needed to perform the tasks in a skill group
- You will review each others skills and the tasks that go with them to determine if you agree that this skill or knowledge is important
- You will rate how difficult it is to learn each skill and knowledge and the tasks included in a skill group

This system may seem like a lot to do today, we have provided a set of exercises and some examples to help move things along.

Before we go to our first example, we need to say exactly what we mean by the term skill. Skills have been defined in many ways. For our purpose today we will use one definition of a skill. A skill is a kind of learned activity that helps you perform many tasks.

Appendix 14-B

Prototype Instructions for Generation of Occupation-Specific Skills and Knowledges

To define these skills we will present you with a list of tasks performed on your job. We would like you to read through this list of tasks. As you read through this list, you should think about how these tasks can be grouped together. A good skill based grouping of tasks is one where the tasks in a group have common learning requirements. In other words if you learned one task in a group it should be easier to learn the others.

Once you have identified a task group, we will ask you to do four more things. First, we would like you to provide a label for your task group. Second, we would like you to list, by number, the tasks that belong to this group. Third, we would like you to rate, on a fifteen point scale, how long it took you to learn this task. A one means that it took no time at all to learn and a fifteen indicates that it took more than ten years. Finally, after looking back atthe tasks you assigned to a group we would like you to think about the principles or basic kinds of knowledges you need to perform these tasks and list the three that are most important.

After you have generated your skill groups and knowledges we will discuss them as a group. We will then rate the overall difficulty of the knowledges and skills you thought were important to determine which skills and knowledges take a particularly long time to learn. Again a rating of one indicates virtually no time to learn, while a rating of fifteen indicates ten years or more of learning is required.

You may think your job involves more than three skills and just a handful of needed principles or concepts - it probably does. But remember we will be looking at many task sets today and each task set only reflects a portion of your job. As a result, you only want to list the major task groups and knowledges. Other kinds of task or skill groups, and other knowledges, will come up later when we get to other task sets.

Before we start work, it might help clarify things if we look at the example on the next page.

SECTION VII

CONCLUSIONS

Section VII
Conclusions

In the preceding sections we have presented a set of taxonomies for identifying cross-occupation descriptors. The 14 chapters in the earlier sections all provide a basis for describing jobs and developing a new occupational information system, as envisaged for the O*NET. In this section, we consider some general issues related to the form and substance of the content model and indicate the next steps needed to develop a working prototype of O*NET.

Chapter 15
Conclusions
Table of Contents

Chapter 15
Conclusions

Michael D. Mumford
American Institutes for Research

The preceding chapters have, for the most part, focused on describing the major components of the O*NET content model. With regard to cross-job descriptors skills, generalized work activities, and work context for example we have provided a justification and measure for each of the variables included in the model. We have also showed how the general structural framework provided by this content model might be used to collect job-specific descriptive information, such as tasks and occupation-specific skills. And in the prior chapter we examined how all of these descriptors might be used to describe a set of positions, proposing a sampling plan for development of the prototype information system.

Having described the content model and presented the literature underlying its development, we now need to address a broader set of issues. These issues all revolve around a single question. Is there reason to believe that the content model will yield the kinds of occupational information that will allow us to address the various concerns raised in the APDOT report (U.S. Department of Labor, 1993)? In this final chapter we try to provide an initial, tentative answer to this question.

We begin by considering the nature of the O*NET content model and the procedures used in its development. We then consider the results obtained in an initial try-out study. Finally, we examine how the collection of data will contribute to further development of the model and examine some of the steps necessary to extend this initial effort.

Model Development

Content considerations. In the preceding chapters we have described the content of the taxonomies used to specify the variables that collectively define each major area of the content model. The painstaking literature reviews conducted within each area were not merely an academic exercise. Instead, they were intended to address what is perhaps the paramount concern in developing a viable occupational information system.

As we noted in Chapter 1 an adequate descriptive system must meet three criteria (Fleishman and Mumford, 1991; Messick, 1989). First, it must provide a comprehensive description of people's work activities. Second, it must capture the key variables needed to summarize and describe the similarities and differences among positions. Third, it must permit substantively meaningful inferences about the relationships among these variables.

The procedures used in explicating each of the major areas specified by the content model were explicitly chosen to ensure that the resulting descriptive system would indeed meet these criteria. These taxonomies of constructs related to the world of work were selected or developed with the express intent of capturing key variables within a broader framework that would permit an assessment of the adequacy of coverage. Throughout this exercise, scrutiny of prior substantive work provided a sound basis for development of both theoretical and operational definitions of the relevant variables.

The taxonomies used to buttress each component of the content model were predicated on the literature addressing each domain of the model. Thus, independent taxonomies were formulated for skills, knowledges, education, and generalized work activities, work context, organizational content, training, licensure, abilities, interests, work styles, and occupation characteristics. This procedure permitted a closer linkage to the literature in each major area, thereby providing a stronger basis for inferences about the resulting descriptive system's content and construct validity. This multi-pronged approach also provided potential users with multiple windows from which to view various aspects of the world of work. Thus, users interested in skill requirements need not refer to abilities or generalized work activities, while other users concerned with interests need not look at knowledges, etc..

One consequence of having developed a number of self-contained taxonomies, each with its set of descriptive variables, is that we cannot assess, a priori, it cannot cross-domain redundancies. Thus, some loss in parsimony of description may have occurred. Reduced parsimony, at least in the prototype of O*NET, is not troublesome, in part because it allows users with different concerns to select that part of the system of interest to them, and in part because it avoids the confusion likely to arise from the selective omission of certain variables. For example, a user interested in speaking skills would be surprised to be referred to abilities.

These practical points aside, the strategy of developing multiple taxonomies helped ensure both construct validity and comprehensiveness of description. Moreover, basing the prototype content model on a number of independent taxonomies does not, of course, preclude development of a more parsimonious descriptive system in the future. Given the collection of adequate amounts of descriptive data, the redundancies within and between domains of the content model can be empirically determined.

Hypothesis generation. The literature reviews on which much of the development work was predicated also provided a basis for assessing the existence of hypothesized relationships, both within and across major areas of the context model.. For example, one would expect to see relatively strong relationships between certain technological skills (e.g., troubleshooting) and certain problem solving skills (e.g., information gathering), but weaker relationships between the technological skills and other skills such as negotiation. At a higher level, the structure of the content model would lead one to expect strong relationships between certain cross-functional skills and certain generalized work activities, but the relationship between generalized work activities and interests should be somewhat more tenuous.

The capacity to generate such hypotheses, of course, provides further support for the meaningfulness, or validity of the content model and, importantly, provides a basis for addressing two other issues bearing on the validity of the content model. First, the ability to hypothesize linkages among variables provides a basis for the kinds of empirical, external validity tests needed for a fully adequate assessment of the content model. For example, a synthetic validation judgment task within and across domains might provide some useful external validity evidence. The empirical relationships observed among these variables using data from the upcoming initial data collection will serve to test such hypotheses.

Second, empirical confirmatory evidence for these relationships may provide an important basis for addressing the validity of the practical applications of an occupational information system like the one described in the APDOT report. For example, the linkage of generalized work activities (GWAs) to skills might enable users to describe a job in terms of GWAs,, and then use the O*NET to identify requisite skill requirements. Similarly, the relationship among generalized work activities, work context, knowledges, and skills, might help trainers develop particularly effective instructional programs.

Structural Considerations

We have just discussed the procedure by which the content of O*NET was specified to ensure valid and comprehensive description of occupations.A second issue is the extent to which the structure of the content model will enable users to address the many different kinds of applications that might arise.

Model extensions. It should be recognized that no single model, no matter how well conceived and developed, is likely to provide the highly detailed information needed for all conceivable applications. Even if one identified all of the major areas that might be examined and sought to specify the more important variables lying within each area (i.e., as we have attempted to do in building the prototype O*NET) it still would be impossible to cover every type of variable that might conceivably be of interest to so many different constituencies. We have attempted to deal with this problem by structuring O*NET in terms of hierarchical taxonomies of the sort presented in the preceding chapters. This kind of hierarchical structure allows different users to apply different levels of description as dictated by the type of questions they are trying to answer. Moreover, for users who require more detailed information to answer certain specific questions, variables can be added at the lower levels of the model.

The hierarchical arrangement of the taxonomies developed for the cross-job descriptors also is related to the way in which the content model can be used to capture job-specific information. In Chapter 14 on occupation-specific descriptors, we showed how this hierarchical structure could be used to facilitate identification of job-specific descriptors.

Implications

One attractive characteristic of the design framework and sampling plan is that it will provide a set of baseline data where a diverse group of positions is assessed on all of the cross-job descriptors. The availability of such a comprehensive database serves to provide a stronger basis for practical inferences bearing on the reliability and validity of the resulting descriptive information. It also provides the kinds of descriptive data necessary for development of a prototype occupational information system.

To begin, this database will provide a description of a wide variety of jobs on a reasonably comprehensive set of cross-job descriptors. Thus, it becomes possible to examine how different types of job descriptors are related to the variables included in other types of data sets. For example, requisite skills in different areas can be associated with available information pertaining to the pay rates for different jobs. This linkage, in turn, should help answer two questions, First, what kinds of skills must be developed in the work force to ensure access to high skill, high wage jobs? Second, what types of skills really make a difference in terms of occupational pay?

The database resulting from the proposed model should also prove useful in addressing a number of employer concerns. One important feature of the content model is that it explicitly seeks to link the requirements of the job to the requirements implied for people working on the job. Thus, by linking various job requirements to the person requirements included in this model, it should prove possible to use this initial prototype to begin to address a variety of concerns of employers. For example, by establishing the linkage between generalized work activities and skills, this model would allow employers to describe new positions, or existing positions, in terms of a limited number of functional requirements. The linkage between work activities and skills might then allow employers to draw inferences about the kinds of skills they should look for in new workers. Along similar lines, the organizational and work context variables might be used to draw inferences about how job redesign efforts can influence requisite work activities and skill requirements.

The kinds of relationships between descriptors resulting from the proposed content model and prototype development study will also serve to address the needs of workers. In a rapidly changing economy where workers are insecure about their future, they need current information about employment opportunities, the kinds of skills they need to develop to be suitable for these jobs and the kinds of training likely to promote the development of these skills. The envisioned occupational information system, once an adequate number of jobs has been described in terms of this content model, would clearly provide an adequate basis for systematic person-job matching efforts. Even over the short run, however, when only prototype data are available, the content model and the initial occupational information system should help workers address a number of questions along these lines. For example, by linking skills to education, training, and licensure, even the prototype system might be used to provide recommendations about useful developmental experiences. The linkage between interests and generalized work activities might be used to draw inferences about the kinds of occupations a person might be well suited to, if indeed, they can develop the requisite skills.

These potential applications of the prototype occupational information system, developed on the basis of the proposed content model, serve to demonstrate how the resulting descriptive data might be used in the short run. They also indicate that the content model will, when extended to a broader range of jobs, provide the kind of occupational information system needed to serve the needs of many constituencies as we move into the twenty-first century.

Does the model outlined in this report describe the content of an occupational information system that will serve the nation in an increasingly dynamic word of work? This new, more fluid and competitive situation increases the salience of a number of questions. Chapter 1 mentions a few of these:

> Workers wonder how they can find jobs that will capitalize on their prior training and experience. Employers wonder what skills they should seek to develop in their work force to maintain a competitive edge. Policymakers wonder what kinds of capacities must be developed in our children to promote access to high wage, high skill, and self-fulfilling jobs.

The O*NET content model describes and structures the occupational information necessary to address these and many other needs. A number of the model's features make this possible. Unlike most traditional job analysis efforts (e.g., the Dictionary of Occupational Titles), O*NET does not base its descriptions of occupations on occupation-specific characteristics. Rather, occupations are first described on a broad range of cross-occupation variables allowing for important comparisons among occupations. For example, students need to evaluate alternative careers, and dislocated workers need to be able to identify new occupations where the qualifications they developed in their old occupation are relevant.

Another feature of the model is that it explicitly includes information about the requirements of the occupation and the requirements implied for people working in that occupation. This will greatly facilitate person-job matching. For example, organizations will be able to describe position openings in terms of the work to be done and the qualifications that potential employees need to have.

A third attractive feature of the model is that it organizes the occupation-specific information within a cross-occupation framework. Organizing occupation-specific tasks, skills, and knowledges under cross-occupation descriptors further up in the hierarchy will greatly facilitate communication about the educational and training requirements of occupations.

Thus far, we have developed a content model which in form and substance will provide a great deal of useful information about current and emerging occupations, and will serve the diverse needs of many users. At this juncture we are now ready to move from the drawing board to actual development of the O*NET prototype. Taking that step will require implementation of the sampling plan described in Chapter 15 to collect descriptive information about a range of traditional and high-performance occupations. It will also require analysis of the obtained data to refine the content model, determine most cost-effective data collection procedures, and support initial applications. The data collection activity, which is to begin momentarily, will enable us to bring the O*NET concept to life.

References

Fleishman, E. A., & Mumford, M. D. (1991). Evaluating classifications of job behavior: A construct validation of the ability requirements scales. *Personnel Psychology, 44*, 523-575.

Messick, S. (1989). Validity. In R. L. Linn (Ed.), *Educational Measurement* (3rd ed., pp. 13-105). New York: Macmillan.

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