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UNDERSTANDING WORK USING THE OCCUPATIONAL INFORMATION NETWORK (O*NET): IMPLICATIONS FOR PRACTICE AND RESEARCH

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The Occupational Information Network (O*NET) has recently been developed as a replacement for the Dictionary of Occupational Titles. As a comprehensive system designed to describe occupations, the O*NET incorporates the last 60 years of knowledge about the nature of jobs and work. This article summarizes its development and validation by first discussing how the O*NET used multiple descriptors to provide "multiple windows" on the world of work, utilized cross-job descriptors to provide a common language to describe different jobs, and used a

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hierarchical taxonomic approach to occupational descriptors. Second, we provide an overview of the O*NET's Content Model of descriptor domains (i.e., worker characteristics, worker requirements, occupational requirements, experience requirements, occupation characteristics, and occupation-specific requirements) and their potential uses. Third, we discuss some of the technical issues surrounding the O*NET. Finally, we discuss some of the implications for research and theory, as well as some limitations of the O*NET system.

The world of work is changing in many ways. For example, the types of jobs needed in the future are likely to be more service than manufacturing oriented (Drucker, 1994; Reich, 1992). Technological changes and global competition will also drive a need for new types of jobs (Cappelli, 1995; Howard, 1995). These fundamental changes in the nature of work create many problems and questions, such as what skills should be developed in our work force, how to prepare new entrants for the labor market, how to re-employ laid-off or disabled workers, and many more.

To answer these questions, we must be able to describe work accurately and efficiently. The purpose of this article is to present an overview of the Occupational Information Network (O*NET) and discuss how it addresses these issues. The O*NET is the result of a large-scale research project sponsored by the U.S. Department of Labor. It

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The various roles of the many authors require explanation. The research described in this article was a highly collaborative effort carried out by a consortium of several organizations: American Institute for Research, Personnel Decisions Research Institute, Jeanneret & Associates, Management Research Institute, and Westat, Inc. The first six authors (Peterson, Mumford, Borman, Jeanneret, Fleishman, and Levin) led the efforts of the research teams in their respective organizations to develop O*NET, Campion served as a technical advisor to the U.S. Department of Labor to oversee the project, Mayfield and Morgeson had the major role in the writing of the present article based on the technical reports and book on O*NET, Pearlman, Gowing, and Lancaster served on the Advisory Panel that conceived of the initial content model and delineated its design principles, and Silver and Dye administered and guided the O*NET project throughout its development for the Department of Labor. The opinions expressed in this article are solely those of the authors and not necessarily of their affiliating organizations. Nothing said in the article should be construed as representing the opinions or official positions of the Department of Labor or any other governmental agency.

A project of this magnitude was only made possible by the efforts of nearly an army of researchers and others from the various organizations. Special recognition must be extended to Lance E. Anderson, Wayne A. Baughman, Ruth A. Childs, Ashley E. Cooke, Christopher E. Sager, Paul A. Silver, Susan Wright, and George R. Wheaton from American Institutes for Research; Sharon Arad, Daren Buck, Marvin D. Dunnette, Mary Ann Hanson, Janis S. Houston, U. Christean Kubisiak, Robert J. Schneider, and Patricia Seelbach from Personnel Decisions Research Institutes; Barry R. Blakley, Tanya J. Collins, Erika L. D'Egidio, S. Morton McPhail, and Mark H. Strong from Jeanneret & Associates; David Constanza, Joanne Marshall-Mies, Leon Wetrogan, and Charles Whilman from Management Research Institute; Angie Becher, James Green, and Joseph Waksberg from Westat, Inc.; Dixie Sommers (Chair), Ken Baker, Sue Berryman, Manfred Emmrich,

was designed to provide a comprehensive system of occupational description to serve the needs for job information in the future. It is replacing the Dictionary of Occupational Titles (DOT), and incorporates the last 60 years of knowledge about the nature of jobs and work since the DOT was developed.

This article will focus on the conceptual underpinnings of the O*NET and applications to Human Resource Management and Industrial and Organizational Psychology. The content model to be discussed is a prototype that serves as the foundation for a comprehensive description of the world of work. It will describe the underlying philosophy and assumptions, as well as the job descriptor taxonomies that were developed. It is hoped that O*NET will be useful to practitioners by providing a variety of tools for understanding the nature of work and to scientists by providing a discussion of some of the theoretical issues involved in job analysis in the future. To provide a context for understanding the O*NET, a brief review of the DOT is provided, followed by an in-depth discussion of the O*NET and the implications that arise from this new system for describing the nature of work.

Dictionary of Occupational Titles (DOT)

The DOT was developed in the 1930s. It was intended to help deal with the economic crisis of the Great Depression by helping the new public employment system link skill supply and skill demand (U.S. Department of Labor, 1993b) and by providing a comprehensive system for describing all occupations. The most recent version of the DOT (U.S. Department of Labor, 1991) provides descriptive information on over 12,000 jobs. This includes occupational titles and codes, industries, and tasks, as well as a wide range of rated measures including training times, worker functions, physical demands, working conditions, General Aptitude Test Battery scales, temperaments, and interests. These data are available in the DOT itself, related published documents (U.S. Department of Labor, 1991), or from the U.S. Employment Service.

The DOT has used a variety of procedures over the last 60 years to describe jobs. Typically, one or two trained occupational analysts interview and observe workers, and then write job descriptions and make ratings on the characteristics of the occupation. To illustrate the magnitude of these efforts, over 75,000 on-site job analyses were conducted by analysts in U.S. Employment Service field centers throughout the country between the mid 1960s and mid 1970s alone (U.S. Department of La-

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Reese Hammond, Malcolm Morrison, Richard Santos, C. Gary Standridge, and Charles Tetro from APDOT; and Kristin Fiske from Aguirre International.

bor, 1977, p. xiv). Details on the data gathering process is contained in the job analysis handbooks published by the U.S. Department of Labor (1972, 1982).

The DOT has been utilized by a wide variety of users in a number of different capacities. For example, human resources specialists use the DOT to identify job requirements and write job descriptions for selection purposes, to establish training requirements, to develop performance appraisals, to identify benchmark jobs when establishing pay grades in job evaluation systems, to match jobs across organizations, and to plan career development. Vocational counselors use the DOT for career counseling in schools, as well as to advise the disabled or laid-off workers on potential new occupations. Curriculum developers in academic and industry settings use the DOT to match training objectives with job tasks and requirements. The armed forces use the DOT to link military and civilian occupations to help with out-placement of soldiers. The Social Security Administration uses the DOT to determine disability benefits. The U.S. Department of Labor uses the DOT in many of its training and placement programs (e.g., Employment Service, Job Training Partnership Act, Job Corps, Bureau of Apprenticeship and Training). The Bureau of Labor Statistics and other agencies use the DOT to categorize labor market information. Foreign Labor Certification programs use the DOT to demonstrate eligibility to work in the United States. Researchers from many disciplines use the DOT to study a wide range of workforce topics.

Although the DOT has proven to be useful for these purposes over the years, a number of limitations have become apparent. This led to the Secretary of Labor commissioning the Advisory Panel for the Dictionary of Occupational Titles (APDOT) in 1990 to review the DOT and make recommendations for its improvement. Three overall problems with the DOT were identified, relating primarily to its task-oriented focus. It should be noted that the DOT had ability estimates via ratings on data, people, and things, but these data were not fully used.

First, the information generated was very job specific. New tasks need to be generated for each new job, which was very costly and time consuming. Second, the information contained in the DOT was becoming dated, especially given the accelerated pace of change in work and jobs in the past 20 years. Third, focusing on the task level did not provide a cross-job organizing structure. This made it difficult to compare similarities and differences across jobs. Fourth, a task focus did not directly tell what characteristics workers must have to perform the job or the conditions under which the job was performed. For example, the DOT did not directly yield much information on the skills and knowledge required to perform the jobs. The extensive review of the DOT by

Cain and Treiman (1981) expressed many additional concerns, including the quality of some of the measures, the manufacturing orientation, the unclear focus on jobs versus occupations, the aggregation of data, the reliability, and the dimensionality.

*Principles Underlying the Occupational Information Network (O*NET)*

Due to the shortcomings of the DOT, the APDOT recommended the development of a system that would:

> ... promote the effective education, training, counseling, and employment of the American workforce. It should accomplish its purpose by providing a database system that identifies, defines, classifies, and describes occupations in the economy in an accessible and flexible manner. (U.S. Department of Labor, 1993b, p. 6)

APDOT also recommended that the over 12,000 "different" occupations of the DOT be dramatically reduced (to what ultimately ended up at about 1,100 occupational categories). In addition, APDOT made a series of specific recommendations regarding design principles for an effective, flexible, and accessible national occupational information system that would provide a comprehensive description of worker and job attributes. These principles include: (a) the need for multiple descriptor domains that could provide "multiple windows" into the world of work; (b) the need for a "common language" of work and worker descriptors that would be applicable across the occupational spectrum; (c) the need for a hierarchical, taxonomic approach to occupational description; and (d) the need for a comprehensive integrated "content model" (which APDOT developed in prototype form) built upon the preceding three elements. These principles, elaborated below, served as the blueprint for subsequent O*NET development.

Multiple Windows

Because of the wide range of intended uses of the O*NET, no single type of descriptor could provide an adequate system. Multiple descriptor domains or categories were needed, such as tasks, work behaviors, abilities, skills, knowledge areas, and work context, in order to provide "multiple windows" on the world of work. Such an approach allows people to work with the kinds of descriptors most useful for the questions they are asking. It also allows the examination of relationships among descriptor domains, such as how skills are related to different types of work activities. This is needed because it has practical uses (e.g., for finding new occupations for laid-off workers), and it provides theoreti-

cal insight into the relationships among descriptor domains (Fleishman & Mumford, 1991).

Common Language

A key contribution of O*NET is the development of cross-job descriptors that provide a common language to describe different jobs. This makes the O*NET very efficient because a new descriptive system does not need to be invented for every job, and information can be gathered and updated more rapidly. In addition, job-specific information can change rapidly, whereas more general descriptors tend to be more stable. Most importantly, many of the intended applications of O*NET require comparisons between jobs, thus necessitating common language (Campbell, 1993).

The generality of a cross-job system is obtained at the price of specificity, however, and many applications of job analysis data require job-specific information (e.g., designing training programs). O*NET addresses this issue by allowing the accumulation of job-specific information, but doing so within the organizing structure of the broader descriptors. For example, job-specific task lists are generated, collected, and archived within the generalized work activities domain, and occupation-specific skills and knowledge areas are organized under cross-job skills and knowledge areas.

Taxonomies and Hierarchies of Occupational Descriptors

The O*NET utilizes a taxonomic approach to occupational classification. This approach allows information to be summarized and assigned to fewer categories (Fleishman & Quaintance, 1984). Taxonomies are not simply lists, but can instead be considered a fairly exhaustive delineation of the elements of a given domain, based on research or some other systematic process, with each element conceptually independent of the others. The development of a taxonomy requires three major steps: (a) the content domain of the objects to be described must be delineated; (b) descriptors allowing the assessment of objects' similarities and differences must be developed; and (c) rules for grouping objects must be created (Fleishman & Mumford, 1991).

Because O*NET is concerned with both positions and occupations, a broad range of descriptors were developed. For example, there are descriptors that focus on key skills needed to perform specific jobs, as well as descriptors which are concerned with broader organizational and contextual factors (e.g., organizational climate). Variables thought to be relevant for each content domain were identified through an in-depth ex-

amination of relevant theoretical and empirical research. Independent taxonomies were then developed for each of the descriptor domains.

Following taxonomic principles, the descriptors within each domain were hierarchically arranged in order to provide users with varying levels of description, from broad to specific. This hierarchical arrangement provides four advantages: (a) different levels of description result in a more comprehensive system; (b) the articulation of the relationships between variables at different specificity levels delineates the nomological network, allowing for stronger inferences regarding construct validity; (c) different levels of description allow users flexibility in selecting descriptors that fit their needs; and (d) the original taxonomies can be amended and expanded in order to address unanticipated future needs and questions.

Overview and Uses of the Content Model Domains

The above three design principles—multiple windows, common language, and hierarchical taxonomies—informed the development of what was termed the "O*NET Content Model," that fully operationalized APDOT's prototype content model. The model was designed to comprehensively include the major types of cross-job descriptors and to provide a general descriptive framework within which more specific position-related information could be organized. This section presents a description of the content model's six domains and the major categories within each domain (Figure 1). For each category, we define and provide an overview of the taxonomy and then discuss how each category might be used by practitioners. Tables are provided in order to highlight the structure of selected taxonomies.

Worker Characteristics

Worker characteristics are relatively enduring individual attributes that influence the capacities they can ultimately develop as well as their willingness to engage in certain kinds of activities.

Abilities

Overview. Abilities are relatively enduring basic capacities for performing a wide range of different tasks (Carroll, 1993; Fleishman, 1975, 1982). Although abilities are relatively stable, they can also develop over time and with experience in many different situations (Snow & Lohman, 1984). The O*NET ability taxonomy and measurement system is based on Fleishman's extensive body of research (Fleishman, 1975,

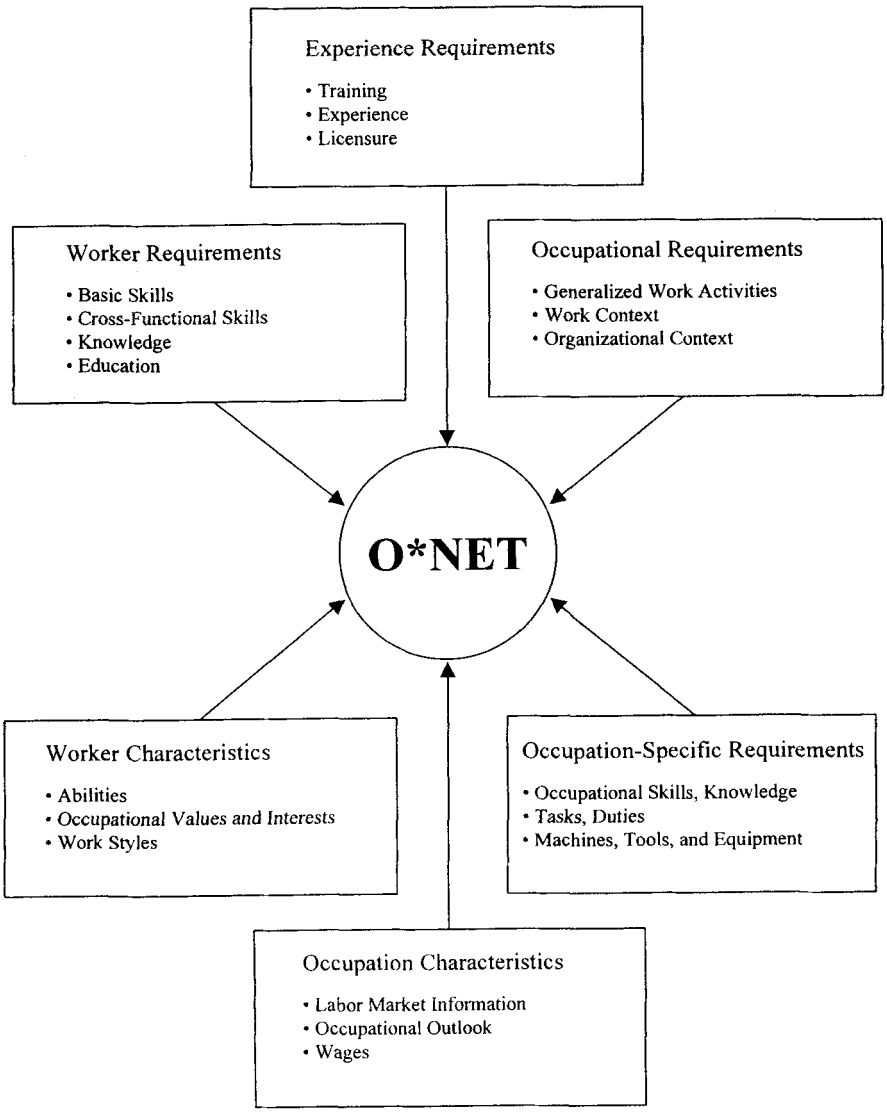

Figure 1: **O*NET Content Model**

TABLE 1

Abilities Taxonomy

- Cognitive abilities
  - Verbal abilities
    - Oral comprehension
    - Written comprehension
    - Oral expression
    - Written expression
  - Idea generation and reasoning abilities
    - Fluency of ideas
    - Originality
    - Problem sensitivity
    - Deductive reasoning
    - Inductive reasoning
    - Information ordering
    - Category flexibility
  - Quantitative abilities
    - Mathematical reasoning
    - Number facility
  - Memory
    - Memorization
  - Perceptual abilities
    - Speed of closure
    - Flexibility of closure
    - Perceptual speed
  - Spatial abilities
    - Spatial orientation
    - Visualization
  - Attentiveness
    - Selective attention
    - Time sharing
- Psychomotor abilities
  - Fine manipulative abilities
    - Arm-hand steadiness
    - Manual dexterity
    - Finger dexterity
  - Control movement abilities
    - Control precision
    - Multilimb coordination
    - Response orientation
    - Rate control

TABLE 1, continued

- Psychomotor abilities (continued)
  - Reaction time and speed ability
    - Reaction time
    - Wrist-finger speed
    - Speed of limb movement
- Physical abilities
  - Physical strength abilities
    - Static strength
    - Explosive strength
    - Dynamic strength
    - Trunk strength
  - Endurance
    - Stamina
  - Flexibility, balance, and coordination
    - Extent flexibility
    - Dynamic flexibility
    - Gross body coordination
    - Gross body equilibrium
- Sensory abilities
  - Visual abilities
    - Near vision
    - Far vision
    - Visual color discrimination
    - Night vision
    - Peripheral vision
    - Depth perception
    - Glare sensitivity
  - Auditory and speech abilities
    - Hearing sensitivity
    - Auditory attention
    - Sound localization
    - Speech recognition
    - Speech clarity

Note: Construct definitions are provided in Fleishman, Costanza, and Marshall-Mies (1999). More complete construct definitions are provided in Fleishman and Reilly (1992) including representative tasks and jobs defining each ability and a review of the tests measuring each ability. Fleishman (1992) contains the complete set of definitions and rating scales for each ability.

1992; Fleishman & Quaintance, 1984; Fleishman & Reilly, 1992). This research identified 4 higher-order constructs, 15 mid-level constructs, and 52 lower-level abilities (Table 1).

Uses. The abilities domain organizes information about jobs in a way that links job task characteristics with the abilities required for effective job performance. In this manner, it should provide useful information for several applications, including development of selection programs, vocational counseling, development of job families, setting performance standards, linking job requirements to disability and medical standards, and development of databases of jobs and job tasks classified according to common ability requirements.

Work Styles

Overview. The work styles represent a range of personality and dispositional factors. To develop this taxonomy, five prominent personality taxonomies were reviewed for job-relevant constructs: (a) the five factor model (Barrick & Mount, 1991; Goldberg, 1990); (b) the Hogan Personality Inventory (Hogan & Hogan, 1992); (c) the U.S. Army's Project A's Assessment of Background and Life Experiences taxonomy (Hough, in press); (d) the Occupational Personality Questionnaire (Saville & Holdsworth, 1990); and (e) Guion's (1992) job analysis questionnaire designed to measure jobs' personality requirements. Factor analytic and correlational research on personality structures (McCrae & Costa, 1987) was also reviewed. The resulting work styles taxonomy has 7 higher-order constructs and 17 lower-order constructs (Table 2).

Uses. At least three applications are foreseen for the work styles domain. First, information on the work style requirements of occupations should be useful in personnel selection in order to identify candidates with potential for high job performance. Second, work style information should be useful to vocational counselors in person–job matching. Finally, job seekers could use this information to identify occupations that might suit them.

Occupational Values and Interests

Overview. Occupational values are an evaluation of the importance of activities and other characteristics of work environments. Interests refer to likes and dislikes that are derived from affective evaluations of life experiences. Because the goal of the O*NET is to describe occupations, this taxonomy's purpose is to measure occupations in terms of their potential to satisfy individuals' occupational interests and values.

TABLE 2

Work Styles Taxonomy

Achievement orientation
Achievement/effort
Persistence
Initiative
Social influence
Energy
Leadership orientation
Interpersonal orientation
Cooperative
Concern for others
Social orientation
Adjustment
Self-control
Stress tolerance
Adaptability/flexibility
Conscientiousness
Dependability
Attention to detail
Integrity
Independence
Independence
Practical intelligence
Innovate
Analytical

Note: Construct definitions are provided in Borman, Kubisiak, and Schneider (1999).

Interests were assessed using Holland's 6-factor taxonomy (i.e., realistic, investigative, artistic, social, enterprising, and conventional; Gottfredson & Holland, 1989) for two reasons. First, this taxonomy provides information about interests that is different from that assessed by personality measures (Dawis, 1991; Hansen & Campbell, 1985; Tokar & Swanson, 1995). Second, this taxonomy is prominent in the career counseling and vocational literatures.

Dawis' (1991) 6-dimension taxonomy of work values (i.e., achievement, comfort, status, altruism, safety, and autonomy) was adopted for the occupational values and interests taxonomy. These represent the importance of a work environment that encourages accomplishment, is comfortable and not stressful, provides recognition, fosters harmony and service to others, is predictable and stable, and stimulates initia-

tive, respectively. Twenty-one lower-level descriptors are associated with these six values. Additional information on the interests and values taxonomies and rating scales are available in Sager (1999).

Uses. Although the most important application of the occupational interests and values domain is in person–job matching in counseling and job search contexts, it has other uses as well. For example, normative data on preferred types of occupations and reinforcers could provide employers with information on what people, in general, expect from their work. The type of environmental characteristics desired by members of an occupation could inform counselors and policymakers about the motives and values associated with movement into various occupations. A program being used in Texas has an online work values self-assessment that directly links to the work values taxonomy in O*NET so individuals with certain interests and values can get a list of occupations that fit their personal profile.

Worker Requirements

Worker requirements are general attributes that are developed through education and experience. As such, they are more amenable to change than worker characteristics. They include knowledge, skills, and education.

Knowledge

Overview. Knowledge refers to the possession of a body of information (both factual and procedural) that is related to the performance of a task. It is acquired through education, training, and specific experiences. Knowledge can be general and apply to many jobs, or specific and apply to only one job. The knowledge requirements taxonomy is based on the ability requirements approach developed by Fleishman and colleagues (Fleishman, 1975; Fleishman & Quaintance, 1984). In their earlier work, because there existed no comprehensive taxonomies of knowledge areas, Costanza and Fleishman (1992) examined job descriptions in the DOT for tasks and behaviors indicative of underlying knowledge. Additional knowledge areas were then added based on a literature review, yielding a total of 86 knowledge areas. For the present project, these areas were grouped together into categories based on previous research (Holland, 1976; Rounds & Dawis, 1979; Zytowski, 1976). After sorting the original list of 86 knowledge areas into 7 preliminary categories, seven psychologists reviewed the list for completeness. This resulted in a consolidated group of 52 cross-occupation knowledge areas. Additional pilot studies resulted in a reduced set of 33, deemed to

be sufficiently simple, homogeneous, and useful for both discriminating between jobs and classifying individuals according to knowledge level. These 33 knowledge areas were grouped into 10 high-order knowledge domains. Additional information on the knowledge area taxonomies and rating scales are available in Costanza, Fleishman, and Marshall-Mies (1999).

Uses. The information on occupational knowledge contained in the knowledge domain of the O*NET should prove valuable for personnel selection, person–job matching, job training and retraining, career counseling, identifying vocational interests, and creating job families or clusters. This information could also be used in job classification and the development of wage and salary systems where compensation is based on job knowledge rather than the position occupied. Finally, the state of Texas has used the knowledge taxonomy (as well as skills and abilities) as standardized terms to identify 65 emerging and evolving occupations across 13 industries that are impacting the state's economy, requiring revamped just-in-time training programs.

Skills

Overview. Skills represent a person's level of proficiency or competency to perform a task. Skills usually improve with training or experience on the task. Two distinct types of skills were identified in O*NET. *Basic skills* are capacities that facilitate learning or acquisition of new knowledge and can be further divided into content and process components. Content skills are used to acquire more specific skills in a variety of different domains. Examples of content skills include reading (Beck & Carpenter, 1986), writing (Hayes & Flower, 1986), and mathematics (Greeno & Simon, 1988). Process skills reflect the way in which individuals work with information to facilitate learning. As such, they can contribute to the more rapid acquisition of knowledge and skills. Examples of process skills include active learning (Chi, Bassock, Lewis, Reimann, & Glaser, 1989) and critical thinking (Halpern, 1994).

Drawing from open systems theory (Katz & Kahn, 1978), *cross-functional skills* are developed capabilities that facilitate performance across job contexts. That is, they are the core set of skills needed to solve problems that arise in the transformation process. They are comprised of five components: (a) problem solving skills (Runco, 1994; Sternberg, 1986), (b) social skills (Cantor & Kihlstrom, 1987), (c) technical skills (Mumford, Peterson, & Childs, 1999), (d) systems skills (Bass, 1994; House & Howell, 1992), and (e) resource management skills (Fleishman et al., 1991). The skills taxonomy has 2 higher-order constructs, 7 mid-level constructs, and 46 lower-level constructs (Table 3).

TABLE 3

Skills Taxonomy

Basic skills	
Content skills	Process skills
Active listening	Active learning
Reading comprehension	Learning strategies
Writing	Monitoring
Speaking	Critical thinking
Mathematics	
Science	
Cross-functional skills	
Problem-solving skills	Social skills
Problem-identification	Social perceptiveness
Information gathering	Coordination
Information organization	Persuasion
Synthesis/reorganization	Negotiation
Idea generation	Instructing
Idea evaluation	Service orientation
Implementation planning	
Solution appraisal	
Technical skills	Systems skills
Operations analysis	Visioning
Technology design	Systems perception
Equipment selection	Identification of downstream consequences
Installation	Identification of key causes
Programming	Judgment and evaluation
Testing	Systems evaluation
Operation monitoring	
Operations and control	
Product inspection	
Equipment maintenance	
Troubleshooting	
Repairing	
Resource management skills	
Time management	
Management of financial resources	
Managing material resources	
Managing personnel resources	

Note: Construct definitions are provided in Mumford, Peterson, and Childs (1999).

Uses. Several uses are foreseen for this information on skill requirements. First, the information can be used in the development of human resources. Workers can use the information to determine if they are qualified for a job, as well as what kinds of experiences they should acquire to improve their qualifications. In this manner, the O*NET's information on job skill requirements can provide a framework for identifying training needs. Second, the skills data can be used to identify

related jobs using similar cross-functional and basic skills for workers recently downsized or otherwise seeking new opportunities. For example, at their Monrovia, California plant, Boeing and the California Employment Development Department used the skills taxonomy to identify dislocated workers' skills and match these skills with available jobs.

Third, skill requirements information could be used in job classification and the development of wage and salary systems where compensation is based on qualifications or skills rather than the position occupied. Fourth, information about skill requirements is commonly used to develop assessment systems for the selection and promotion of employees. Finally, the skills domain of the O*NET could provide information to government, industrial groups, and educators on the skills required for high-wage jobs, thereby assisting in the development of educational and licensure programs that will prepare the American workforce for the next century. The state of Minnesota will use the skills identified by O*NET, combine them with academic skills, test them with employers, and integrate them into the Minnesota School-to-Work electronic information system.

Education

Overview. Education refers to formal schooling, coursework, and training. The focus of this domain is not on the content of knowledge per se, but on how and when it is acquired. Because education has a large impact on the development of both knowledges and skills (Snow & Swanson, 1992; Ward, Byrnes, & Overton, 1990), educational background is an important worker attribute that can be used to describe cross-occupation differences in worker requirements.

In terms of educational requirements, the O*NET measures the amount of formal education needed (e.g., subject areas, setting) and the degrees or certificates required (e.g., the type of education needed), as determined by the degrees and certificates of those currently holding the jobs. Although there are several taxonomies for subject areas and educational settings (e.g., Bloom, 1956; Gagne, 1985; U.S. Department of Education, 1990), only the Classification of Instructional Programs (CIP; U.S. Department of Education, 1990) was useful for understanding the educational requirements of different occupations.

The CIP taxonomy includes such educational programs as high school programs, certificates, undergraduate and graduate education, and adult education programs. The Academic and Occupationally Specific Programs listing from within the CIP was used as the basis of the content model. This resulted in a list of 52 instructional programs. In addition to the CIP taxonomy, another taxonomy (National Center for Educa-

tion Statistics, 1993) was used to classify high school subject areas. This resulted in a list of 15 subject matter areas (e.g., physical science, humanities, social science, and technical/vocational) for inclusion in the education subject area taxonomy. Additional information on the education area taxonomies and rating scales are available in Anderson (1999).

Uses. Educational information is extremely important for many types of users, including career counselors, employers, students, training developers, and job seekers. Uses of educational information include career selection, career planning, curriculum development, personnel selection, and vocational rehabilitation counseling. For example, employers can use educational information to help set minimum hiring standards for experienced or entry-level applicants. As another example, once a potential occupation is identified by counselors or job seekers, they can consult O*NET to identify the level (e.g., high school degree, associates degree, bachelors degree) and specific type of education (i.e., what subject they should major in and the type of coursework) needed to enter the occupation. This information will be particularly useful for individuals who are in high school or early in their college careers and are attempting to decide on a career. It is also useful for individuals who are contemplating a job or career switch and want to understand the kind of education that is needed for different occupations.

Occupational Requirements

Occupational requirements represent descriptors of the work itself, as compared to descriptors of the worker (McCormick, 1979). As such, these occupational requirements describe the work activities and context within which work is performed.

Generalized Work Activities

Overview. A generalized work activity (GWA) is an aggregation of similar job activities or behaviors for the accomplishment of major work functions. This definition is based on the principles that underlie the Position Analysis Questionnaire (PAQ) and its worker-oriented perspective (McCormick, Jeanneret, & Mecham, 1972). The first literature that was used to develop the GWA taxonomy was the extensive body of job analysis research that has focused on describing the structure of work. For example, the PAQ (McCormick et al., 1972), the Job Element Inventory (Cornelius, Carron, & Collins, 1979), the Occupational Analysis Inventory (Cunningham, 1988), and the Generalized Work Inventory (Cunningham, Wimpee, & Ballentine, 1990) all include descriptions of various work activities. Factor analyses and comparisons of the resul-

tant factor structures revealed substantial similarities, suggesting a basic underlying structure of work.

Because much of this job analysis research has focused on hourly production jobs, managerial taxonomies (e.g., Borman & Brush, 1993; Flanagan, 1951; Tornow & Pinto, 1976) were also reviewed to avoid domain deficiency. Finally, a few other nonmanagerial taxonomies were reviewed for the sake of thoroughness (Campbell, McCloy, Oppler, & Sager, 1993; Dowell & Wexley, 1978). The GWAs selected for inclusion in the content model were based on this review of the literature, with emphasis placed on selecting descriptors that are unique (i.e., conceptually different), and descriptors that are comprehensive (i.e., capable of describing all jobs). Forty-two GWAs were selected, organized into the four higher order dimensions of information input, mental processes, work output, and interactions with others (Table 4).

Uses. Because GWA descriptors describe jobs at a work activity level (i.e., task and duty), they have a number of uses. First, researchers and practitioners will be able to observe similarities and differences across occupations in terms of critical work activities. This will facilitate the clustering and classification of jobs for a wide range of purposes, such as defining job families for selection or defining job hierarchies for compensation. Second, potential job seekers will be able to determine the kinds of work activities different occupations entail. Third, GWAs could serve as compensable factors in job evaluation efforts. Fourth, GWAs may provide a useful level of analysis for grounding the job-relatedness of selection procedures. Finally, GWAs might serve as dimensions for performance appraisal systems.

Work Context

Overview. Work context factors describe the social–psychological and physical conditions under which work is performed. A systems approach was used to identify the higher-order work context factors that influence workers and work performance. Both the psychosocial and workplace stress and health literatures were examined for work context factors that could be included in the work context taxonomy.

Several classification systems have been developed in the psychological and stress literatures that deal with work elements affecting performance and health. For example, McGrath (1976) distinguished six types of stressors: task-based stress, role-based stress, stress intrinsic to the behavioral setting, stress manifesting from the physical environment, stress from the social environment, and stress brought to the environment by the worker. Other researchers have examined how work context factors

TABLE 4

Generalized Work Activities Taxonomy

- Information input
  - Looking for and receiving job-related information
    - Getting information needed to do the job
    - Monitoring processes, materials, and surroundings
  - Identifying/evaluating job-relevant information
    - Identifying objects, actions, and events
    - Inspecting equipment, structures, or materials
    - Estimating the characteristics of materials, products, events, or information
- Mental processes
  - Information/data processing
    - Judging the qualities of objects, services, or persons
    - Processing information
    - Evaluating information for compliance to standards
    - Analyzing data or information
  - Reasoning/decision making
    - Making decisions and solving problems
    - Thinking creatively
    - Updating and using job-relevant knowledge
    - Developing objectives and strategies
    - Scheduling work and activities
    - Organizing, planning and prioritizing work
- Work output
  - Performing physical and manual work activities
    - Performing general physical activities
    - Handling and moving objects
    - Controlling machines and processes
    - Operating vehicles and mechanized devices or equipment
  - Performing complex/technical activities
    - Interacting with computers
    - Drafting, laying out, and specifying technical devices, parts, or equipment
    - Implementing ideas, programs, systems, or products
    - Repairing and maintaining mechanical equipment
    - Repairing and maintaining electronic equipment
    - Documenting and recording information
- Interacting with others
  - Communicating/interacting
    - Interpreting the meaning of information for others
    - Communicating with supervisors, peers, or subordinates
    - Communicating with persons outside the organization
    - Establishing and maintaining interpersonal relationships

TABLE 4, continued

Assisting and caring for others
Selling or influencing others
Resolving conflicts and negotiating with others
Performing for or working directly with the public
Coordinating/developing/managing/advising others
Coordinating the work and activities of others
Developing and building teams
Teaching others
Guiding/directing and motivating subordinates
Coaching and developing others
Providing advice and consultation to others
Administering
Accomplishing administrative activities
Staffing organizational units
Monitoring and controlling resources

Note. Construct definitions are provided in Jeanneret, Borman, Kubisiak, and Hanson (1999).

can differentiate between jobs. For example, McCormick (1979) identified physical working conditions, work schedule, organizational context, social context, and incentives as job context dimensions necessary for differentiating between jobs.

Based on this literature and review of job analysis questionnaires, work context was divided into three components. The first is interpersonal relationships, which describes the social interaction processes of a job (e.g., communication, responsibility for others). The second is physical work conditions, which represent the interaction between worker and physical job environment (e.g., work setting, environmental conditions). The third is structural job characteristics, which concern the nature of the job itself (e.g., criticality of position, pace, and scheduling). Additional information on the work context taxonomies and rating scales are available in Strong, Jeanneret, McPhail, Blakley, and D'Egidio (1999).

Uses. Work context is a salient feature of an occupation for job seekers and those developing realistic job previews for job applicants. The evaluation of such information is also essential to the identification and correction of job hazards and stressors and the development of appropriate guidelines for worker safety, health, and stress reduction programs. Information on the structure of work and required interpersonal relationships could also be useful in designing selection systems, whereas information on physical work conditions is important when designing compensation systems. Work context information could also be used when

designing jobs to facilitate communication among workers and minimize work interruptions.

Organizational Context

Overview. Although work context is specific to a job or set of jobs, organizational context refers to characteristics of the organization that affect all jobs within the organization. The DOT included very little information about organizations. However, organizational context may have a very large impact on the nature of the jobs, and it is likely that jobs vary as a function of the organizations within which they reside. In addition, there is interest in "high-performance" business practices and how the characteristics of high performance organizations affect jobs.

Many types of organizational context factors were included in O*NET. First, type of industry has long been thought of as an important element in understanding organizations (Hall, 1982) and Standard Industrial Classification codes were used to classify them. Second, structural characteristics were assessed, including organizational structure (e.g., organizational size, differentiation, decision making system; Mintzberg, 1979) and human resource systems and practices (e.g., selection, training, and reward systems; Cascio, 1987). Third, social processes were measured, including organizational culture (Schein, 1992), goals (Locke & Latham, 1990), roles (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964), and leadership (Yukl, 1989). These factors were thought to be important because they can affect how work is structured and conducted on a day-to-day basis. Additional information on the organizational context taxonomies and rating scales are available in Arad, Hanson, and Schneider (1999).

Uses. This taxonomy of organizational context descriptors should provide information for several purposes. First, it will provide information on organizational-level variables that can impact the nature of jobs within organizations, thereby contributing to the O*NET's objective of describing occupations. Second, it will assist in amassing information on the practices and structures used by organizations, which may help future researchers identify practices of high performing organizations. Finally, the descriptive information should be useful to job seekers and vocational counselors in assessing person–job fit. Organizational context data provides information to job seekers that has not previously been included in occupational profiles.

Experience Requirements

Experience requirements are the types and quantities of experience that are required in a specific occupation, including incumbent experience in other jobs, job-related training, on-the-job training, and licen-

sure or certification requirements. This information is subsumed under a single taxonomy in the O*NET.

Overview. Individuals prepare themselves for occupations via experience, job-relevant training, and licensure/certification. This allows them to acquire the job knowledge and skills they are expected to have as they enter or progress in an occupation. Training and experience were combined into a category called "related work experience," which assessed whether the experience was gained on the job, through on-site or on-the-job training, or through apprenticeships. Licensure/certification requirements were assessed in terms of the specific license required, the requirements needed to obtain a license, and who requires the individual to obtain the license (e.g., the law, employer, union). Additional information on the experience taxonomies and rating scales are available in Anderson (1999).

Uses. Information about work experience will be extremely important for matching people with occupations, both from the point of view of the employee and the employer. Thus, experience information will be useful for career and vocational counseling, selection, and promotion. In addition, experience information is often helpful in the interpretation of job evaluation and classification results.

Occupation Characteristics

To describe individual occupations, three different aspects of the labor market were identified: labor demand, labor supply, and other labor market information. Unlike the other content model domains, which involve the collection of new data, these occupational characteristics were obtained by linking to existing databases maintained by other federal agencies.

Labor demand descriptors. Descriptors of the demand for labor provide information on current and projected demand for labor within an occupation. Three descriptors were recommended for inclusion in the content domain: (a) current occupational employment; (b) current occupational employment by industry; and (c) projected occupational employment. Current occupational employment provides basic information on both the magnitude of employment in an occupation and trends over recent years. Current occupational employment by industry provides information on which industries are most likely to employ workers within an occupation. Projected occupational employment, the most valuable labor market descriptor, indicates the employment outlook for specific occupations.

Labor supply descriptors. Describing the projected supply of labor is more problematic than describing its demand. Labor supply projec-

tions are based on enrollments and completions of formal occupational and training programs. However, this is a highly deficient measure for most occupations. These descriptors only provide rough estimates of labor supply projections, and cannot easily be matched with labor demand data. Two descriptors were recommended for the content domain. Enrollments and completions in professional/technical occupational education programs provide information on the emerging supply of formally trained workers in professional and technical occupations, and enrollments and completions in occupational education programs below the professional/technical level provide information on the supply for other occupations.

Other labor market descriptors. The O*NET database will not only be linked to national-level labor market databases, but also linked to local-level (e.g., state or metropolitan) occupational characteristics databases. This will give much more relevance to local labor markets without losing the national connection and coverage. Finally, information on occupational compensation/earnings will be provided. Additional information on the occupation characteristics and rating scales are available in Feldman, Bennici, and Yudd (1995).

Uses. Labor market information should be useful for many different functions. Counselors and job seekers can use it for career counseling, career exploration and planning, job search, and private agency placement activities. Educators and those interested in economic development can use the data for planning vocational education, training, and curricula, as well as targeting economic development initiatives. Human resource managers can use the information for projecting labor supplies and recruitment strategies, and for selecting locations for new facilities. Finally, government agencies can use the information for various activities, such as foreign-worker labor certification, equal employment opportunity/affirmative action monitoring, and goal-setting.

Occupation-Specific Requirements

The previous five content domains in the O*NET involve information that allows comparisons across occupations. However, some users may need in-depth information on single jobs. For example, when developing training programs it is necessary to identify the occupationally specific tasks, skills, and knowledge. As a result, the O*NET will include these types of occupation specific information, and information on duties, tools, and equipment. Because this information is tied to specific jobs, however, a general taxonomy cannot be developed. Instead, a technique is proposed in O*NET for users to follow to collect this information.

The technique involves having a panel of subject matter experts review a list of generalized work activities (GWA) and reach consensus regarding the GWAs for their occupation. Then, for each of the retained GWAs, the panel develops a list of specific tasks performed. Occupation-specific skills and knowledge would be delineated in a similar manner. First, an occupation's essential tasks are identified. Then, tasks with similar skill requirements are grouped together and then the skills are delineated. Finally, the knowledge underlying these skills is identified. Additional information on this technique is available in Sager, Mumford, Baughman, and Childs (1999). Initially, O*NET will collect occupation-specific information on tasks only, and additional information will be collected as the system is more fully developed.

Technical Issues

Measures

A variety of measures were used to operationalize these content model domains and corresponding descriptors. The predominant method used, however, was rating scales. Different types of rating scales were used depending on the descriptor and the attribute to be estimated. Notwithstanding this, two general characteristics were shared by virtually all of the rating scales developed for the O*NET. First, multiple types of ratings were obtained, such as level and importance. Second, where possible, behaviorally anchored rating scales were used. Figures 2 and 3 present illustrative rating scales developed for one skill and one generalized work activity. These rating scales exemplify the basic instruments used to assess occupations in O*NET.

Data Sources

Data on the content model's descriptors were collected from four sources. The primary source of information is questionnaires collected from job incumbents. Incumbents were selected for several reasons. First, the incumbent-based data collection approach was explicitly designed to avoid the high cost of the analyst-based approach previously used for the DOT. Second, incumbents are best able to provide information across all descriptor domains, and large samples of knowledgeable incumbents are typically available. Third, the O*NET measures were developed with incumbents in mind. The use of rating scale definitions, behavioral anchors, and clear construct definitions allows incumbents to provide reliable and accurate estimates. This is in contrast to other job analysis measures (e.g., the PAQ) that require much higher reading

levels (Ash & Edgell, 1975). Fourth, over the past 30 years industrial-organizational psychologists have gained a great deal of experience using organizational surveys to assess a wide range of job, occupational, and organizational characteristics. Likewise, job incumbents have become much more accustomed to filling out survey questionnaires of all types (e.g., opinion and attitude surveys) than in the past. Finally, job incumbents are no doubt more familiar with job analysis surveys than they were when the DOT was originally developed (and the decision to use analyst ratings was made). This experience and familiarity is again suggestive that incumbents are an appropriate data source. But notwithstanding these reasons for using incumbents as a primary source of data, there is still the potential for systematic differences between job analysts and incumbents (see Morgeson & Campion, 1997). If such differences are found, the quality of the data could be adversely affected. This is an issue that should be closely monitored as additional data are collected.

Information regarding organizational context was collected from an organizational representative (typically from the organization's personnel department) through a Computer Assisted Telephone Interview (CATI). Economic descriptors for the occupation characteristics domain come from existing databases maintained by the Department of Commerce, the Department of Education, and the Bureau of Labor Statistics. Finally, as an interim source of data until incumbent questionnaires can be collected, occupational analysts used DOT task information to rate occupations on O*NET descriptor scales. This allowed descriptor information to be collected quickly for most occupations. The currently available database (O*NET 98) is composed primarily of analyst data. Research is currently underway to examine the comparability of different data sources (i.e., incumbents, analysts, and subject matter expert panels). Although final decisions have yet to be made, it is likely that at least some of the future data collection will include analysts and subject matter expert panels, even though the primary source will be incumbents.

*O*NET Database*

The O*NET system consists of (a) a comprehensive framework and relational database for describing the attributes of occupations in the U.S. economy; and (b) interface software that allows users to access the database. The O*NET Data Dictionary is the primary source of system documentation for the relational database underlying the O*NET, and contains the definition, description, and location of each data element within the O*NET database. The O*NET (like the DOT before it) will be used by every government agency as the primary source of

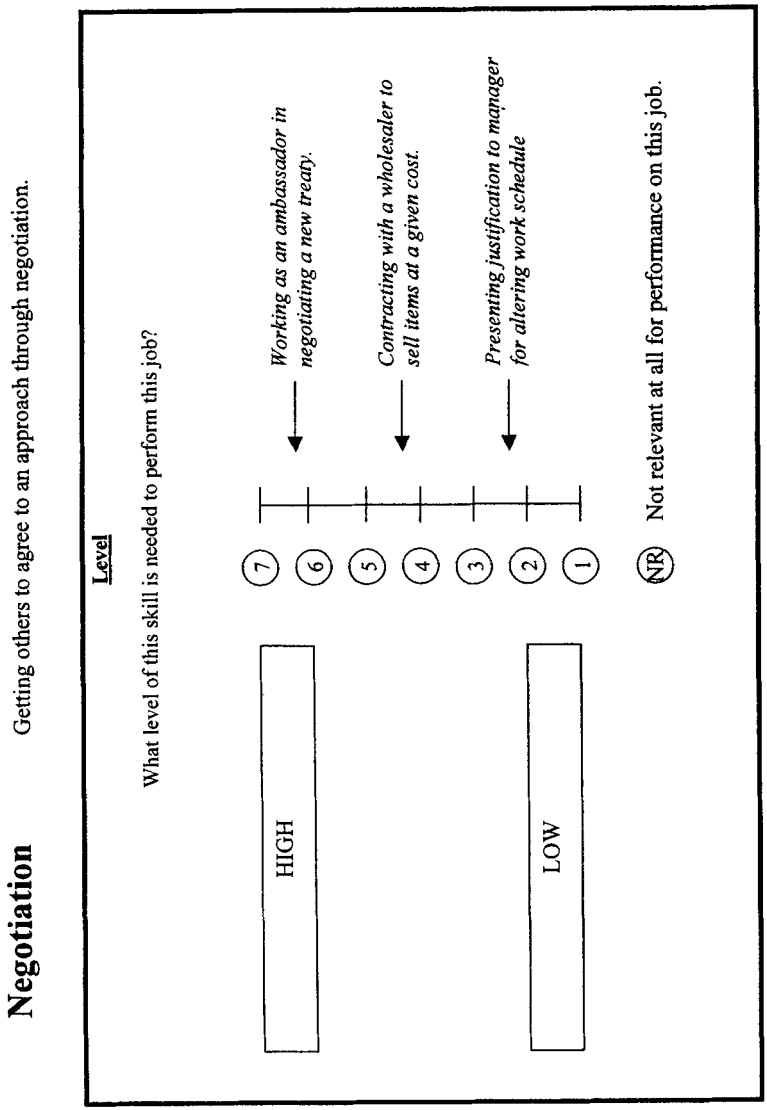

Figure 2: **Example Skill Survey Form**

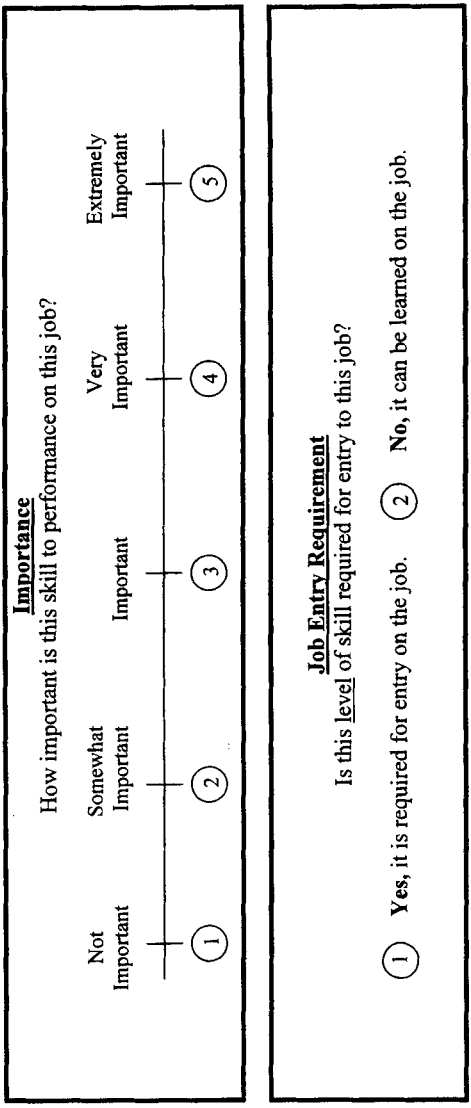

Figure 2, continued

Making Decisions and Solving Problems

Combining, evaluating, and reasoning with information and data to make decisions and solve problems. These processes involve making decisions about the relative importance of information and choosing the best solution.

Level

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

Reaching conclusions after considering a large number of choices that are often ambiguous or abstract, where there are competing viewpoints and alternatives that must be considered before reaching final decisions and the solutions decided upon will have very significant impact.

Reaching conclusions after considering a few choices that are usually well defined, where there are a limited number of possible actions, and the decisions or solutions will have minor impact.

7 — *Making the final decisions about a company's five-year strategic plan.*

Determining the best way to perform brain surgery

6

5

4 — *Deciding how to settle a moderate sized insurance claim.*

Selecting the location for a major department store.

3

2 — *Routing truck deliveries.*

Determining the meal selection for a cafeteria.

1

NR Not relevant at all for performance on this job.

Figure 3: **Example Generalized Work Activity Survey Form**

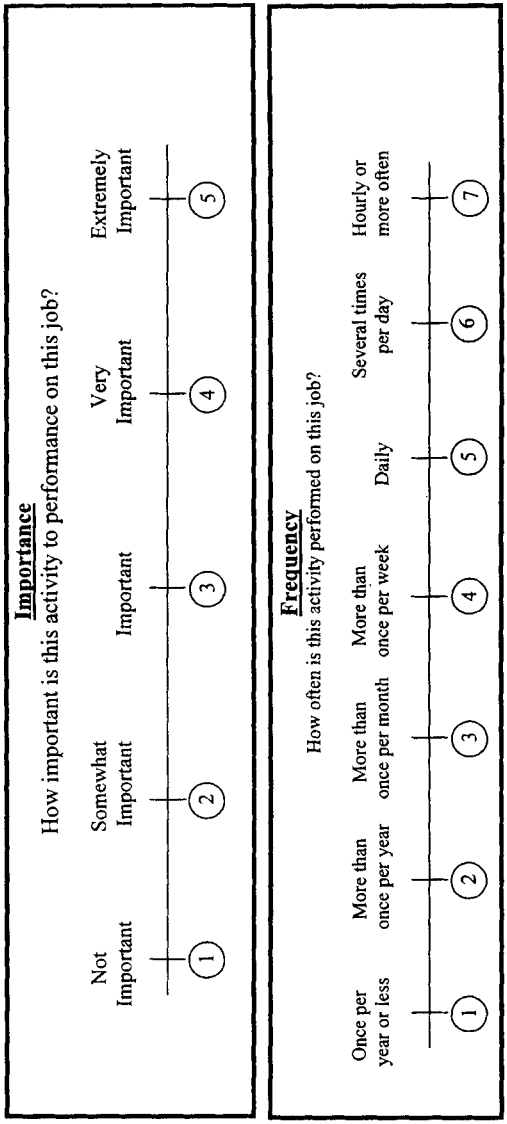

Figure 3, continued

occupational information and classification. As the result of its government funding and sponsorship, the O*NET instruments and data are available for use by the general public. The first public release of the O*NET is being produced and distributed by the Government Printing Office and is available on compact disk or in downloadable form on the Internet. Additional information is available from the Department of Labor's Web site (http://www.doleta.gov/programs/onet/). Information about contributing to the database and a future Web-based interactive version of the O*NET can be accessed from the National O*NET Consortium Web site (http://www.onetcenter.org/).

Initial Results

The results of preliminary data collection generally provided support for the O*NET system. It should be emphasized, however, that this data collection effort is simply the first effort at collecting information on occupational descriptors. Although initial data collection has suffered from low response rates (e.g., 181 of 661 organizations returned at least one completed survey) and has gathered complete information on a relatively small number of occupations (e.g., 29 of 80 that were initially sampled), initial results are encouraging. Across most domains of the model, interrater reliability estimates are at least .70 (with an average of 10 raters). This has led to the suggestion that approximately 15 raters per occupation would ensure sufficient interrater reliability.

There was variance across the content model domains and the descriptors were able to distinguish among different occupations in a sensible and expected manner. For example, one would expect that there would be strong correlations between GWAs that emphasize manual and physical activities (such as walking, twisting) and abilities that reflect bodily movement (strength, psychomotor capabilities) that would be important when performing those physical GWAs. Initial results indicated that the pattern of correlations was in accord with these expectations, and together with factor analysis findings provide evidence both for construct validity for comparable content domain dimensions and for the relationships between work and worker characteristics.

A further test of the value of the combined influence of multiple content domain descriptors was conducted by applying various cluster analytic techniques to the GWAs and the Basic and Cross Functional Skills for several data sets. Findings indicated that the resulting occupational clusters were coherent and easily interpreted from both statistical and rational perspectives, thus demonstrating the utility of O*NET for forming occupational families. Additional information concerning the initial research methods and results is provided in Peterson, Mumford,

Levin, Green, and Waksberg (1999) and Peterson, Borman, Hanson, and Kubisiak (1999). Data collection is currently underway in order to fully populate the database with incumbent data. It is currently estimated that complete information on all occupations will be gathered by the end of 2003. Annual updates are planned for the database (once complete), with growing occupations and those in rapidly changing industries being updated more frequently.

*Implications and Limitations of O*NET*

The O*NET represents a significant advance in describing work. Extending our understanding beyond that traditionally found in the job analysis literature, the O*NET draws on knowledge from a variety of fields to create a comprehensive framework for describing occupations and workers. Moreover, its hierarchical taxonomies ground each descriptor within a nomological network of constructs based on the past 60 years of cumulative wisdom in the field. As such, O*NET has a number of implications for research and theory. It is also the case, however, that there are some limitations of this system.

Implications for Research and Theory

Job analysis theory. Job analysis is not generally considered a highly theoretical area of research. In fact, it has often been considered atheoretical, consisting primarily of a set of techniques and terminology. As such, the content model and its descriptors represent a significant theoretical contribution to the field of job analysis in at least two ways. First, it provides a comprehensive listing of the possible descriptors of occupations and workers. Second, these descriptors are not merely lists, but taxonomies of conceptually independent and theoretically grounded constructs that fully delineate each descriptor domain. This taxonomic approach depicts the hierarchical relationships among the descriptors by showing how lower level (and more specific) constructs relate to higher level (and more general) constructs. This is likely to facilitate future theoretical development in job analysis.

Common language. Given that the content model draws on many diverse disciplines to describe occupations, it can help to promote a common language in describing work. Common language promotes the communication of ideas between researchers in different disciplines, as well as between practitioners, laypersons, governmental agencies, and academics. Thus, a common language is vital for scientific advancement (Kuhn, 1970). There are a number of factors that determine readiness for a common language.

First, an adequate amount of research must have been conducted so that enough terms have been defined to lay the groundwork for a common language. Second, the common language must be useful, divergent scholars must agree on the language, and institutions must require the use of a common language before it becomes widely accepted. Finally, the advantages of a common language (e.g., clarity of communication) must outweigh the disadvantages (e.g., stifling of creativity). The DOT provided some amount of common language (e.g., providing job titles, standardizing the description of tasks). The O*NET will go much further to promote a common language through the many descriptor domains, thus enhancing standardization and communication.

Identification of high performance practices. One goal in developing the organizational context descriptors was the collection of information on high performance practices. There has been a growing interest in how innovative human resource (HR) practices can be a source of sustained competitive advantage (Reich, 1990; U.S. Department of Labor, 1993a). Recent research suggests that high performance HR practices are related to such organizational outcomes as organizational effectiveness and profit (Huselid, 1995; Terpstra & Rozell, 1993). When combined with organizational performance information, the O*NET could be used to examine the range of HR practices that organizations use to gain and maintain a competitive advantage (cf. Vedder, 1992). In addition, O*NET could assist in identifying the knowledge, skill, ability, and other characteristics prevalent in high performance organizations.

Limitations

Response rate and sample size. The response rates in the initial data collection were lower than ideal. The plural term "rates" is used because there are many ways to calculate the response rate. For example, there is a rate at which organizations agree to participate and another rate at which incumbents complete the surveys. Nevertheless, one must conclude that a compound (total) response rate of 16% is problematic. A number of steps can be taken to increase the response rate. For example, the length of the questionnaires could be reduced, the "gatekeeper problem" might be avoided, meaningful incentives could be provided, and a mixed strategy might be developed whereby a variety of different data collection approaches might be used based on the occupation, the setting, and the opportunities available. Regardless of the approach, this is a major impediment to realizing the full potential of O*NET. Pretesting is currently underway to identify ways to increase the participation of both organizations and incumbent respondents and the strategies iden-

tified as most effective will be incorporated into future data collection efforts.

In addition, the current incumbent-based sample contains only a small number of occupations. Many of the key initial analyses are based on only 29 occupations. Although these 29 occupation-level data points are based on the aggregation of a sample of over 2,000 respondents (and are much more stable than individual-level data), the results must be viewed with caution until much more data are collected. With data collected on only 29 of over 1,100 occupations, there is still a long way to go before the O*NET database is adequate for widespread use. Although the analyst-based data can be used to fill in for some short-term purposes, they do not provide a long-term solution to the need for incumbent-based data. Fortunately, both the response rate and sample size problems are being addressed in the additional data collection that is currently underway.

Sources of inaccuracy. Although O*NET is an impressive job analysis system, one must always be concerned about the accuracy of job analysis information. By critically evaluating the O*NET, it may be possible to get a sense for some of the potential social and cognitive processes that may have influenced accuracy. Although not a direct test of the presence or absence of inaccuracy, it is possible to speculate as to which data or methodologies in the O*NET are consistent with the sources of inaccuracy outlined by Morgeson and Campion (1997). What follows are some illustrations of possible inaccuracy.

One potential source of inaccuracy in job analysis is impression management, where incumbents try to present themselves in a favorable light (Schlenker, 1980). There are a number of conditions under which impression management is more likely, and many of these are present in the O*NET data collection. For example, a common finding across O*NET descriptor categories is that incumbents rated their jobs more highly than analysts. These differences were often quite large, averaging about one scale point. This is consistent with impression management because incumbents are more likely to inflate their responses compared to analysts.

Another potential source of inaccuracy is socially desirable responding, which reflects a need for social approval that is attained through accepted and appropriate behaviors (Marlowe & Crowne, 1961). This source of inaccuracy is particularly likely when rating such desirable-sounding attributes as knowledge, skills, and abilities. This offers another explanation for the observation that incumbents showed higher mean levels for these descriptor domains than analysts.

Another potential source of inaccuracy likely to occur in job analysis is information overload. There is evidence to suggest that when faced with large amounts of information or complex judgment tasks, job anal-

ysis respondents simplify the rating process (Friedman, 1990; Sanchez & Fraser, 1992). One common finding in the O*NET data that is consistent with this simplification process is that response scales were highly correlated (often in the low .90s). Theoretically, these scales should be more independent.

Another potential source of inaccuracy is categorization. Similar to the simplification process described above, categorization refers to reliance on summary judgments about a job. Analysts are more likely to succumb to this problem because they are less familiar with the jobs, and may base their judgments on general impressions of the job (e.g., overall complexity or status). One common effect of categorization is reduced dimensionality of factor structures. In fact, analysts consistently produced less dimensionally complex factor structures than incumbents across descriptor domains in the O*NET data. Although this does not necessarily imply that the incumbent ratings are superior, it is suggestive that analyst ratings might have been subject to some form of cognitive simplification.

One final illustrative source of inaccuracy is method effects. This refers to the spurious covariation among responses that occurs when data are collected with the same instrument (Spector, 1992). Method effects can artificially inflate internal consistency estimates, reduce the dimensionality of factor structures, and exaggerate relationships between various job dimensions (Roberts & Glick, 1981). Given the consistent findings of very large correlations among some descriptors, it is likely that method effects occurred in the O*NET data to some degree.

It is important to emphasize, however, that these are simply potential sources of inaccuracy. This brief review does not prove that these processes occurred. It is also the case that these potential sources of inaccuracy are not unique to O*NET. Nonetheless, it is important that future data collection efforts attempt to minimize these potential problems. For example, it is important to carefully attend to the motivations of respondents through instructions and other means. It may be necessary to shorten the questionnaires and, although each respondent was not asked to complete all questionnaires in the initial data collection, further reductions in this respect might be warranted. Finally, it may be necessary to collect job information from multiple sources (e.g., incumbents, supervisors, and analysts) and through multiple methods (e.g., questionnaire, group interview, observation; see Morgeson & Campion, 1997).

Levels of analysis. One of the advances made by O*NET has been to expand our conception about the relevant levels of analysis in job analysis. Thus, not only are the traditional individual (e.g., skills and abilities) and occupational (e.g., education and licensure) levels included,

but the organizational (e.g., formalization and centralization), industry (e.g., type of industry), and economic (e.g., labor market information) levels are included as well (Figure 4). It may be the case, however, that expanding the levels of analysis has introduced unneeded ambiguity into the descriptive system.

Data are commonly gathered at lower levels (e.g., individual), and aggregated to higher levels (e.g., job or occupational levels). In other instances, data are simply collected with reference to the higher level. Differences among respondents are generally viewed as random error and eliminated through aggregation (Harvey, 1991). But as many have emphasized, there must be both a conceptual and an empirical justification for aggregation (Glick, 1985; James, 1982; Morgeson & Hofmann, 1999). This is the case for most of the domains in the content model. Some of the domains, however, contain constructs that should be conceptualized at levels of analysis other than the occupational level.

For example, work styles have been typically conceptualized and measured at the individual level. In addition, culture (from the organizational context domain) is commonly recognized as an organizational-level variable (Schein, 1992). There is, as yet, little theoretical reason these variables should be able to differentiate among occupations within an organization, or show correspondence within an occupation across organizations. Consequently, it is not surprising that these descriptors demonstrated relatively lower levels of interrater reliability and differentiation among occupations when compared to the other descriptors. The content model should be further developed to incorporate levels of analysis issues.

True score model. Most areas of psychological measurement are based on classical test theory and a true score model (Nunnally & Bernstein, 1994). This model assumes: (a) that a true score exists, (b) the goal of measurement is to approximate the true score, and (c) measurement variation or error can be eliminated through aggregation. Applied to describing occupations, this would imply that there is a true score for any particular occupation on any given descriptor. If this is the case, accuracy is predicated upon obtaining a reasonably large sample of respondents. O*NET is based upon these assumptions. For example, it recognizes multiple sources of error, it uses averaged responses to calculate point estimates, it uses large numbers of raters to get accurate measures, and it estimates the reliability of its measures.

Although appropriate in many measurement contexts, perhaps the true score model is not ideal for occupational analysis. As every job analyst has observed, there is often wide variation within job titles (Harvey, 1991). Furthermore, some have suggested that the fundamental nature of work is changing (Howard, 1995), and viewing jobs as static

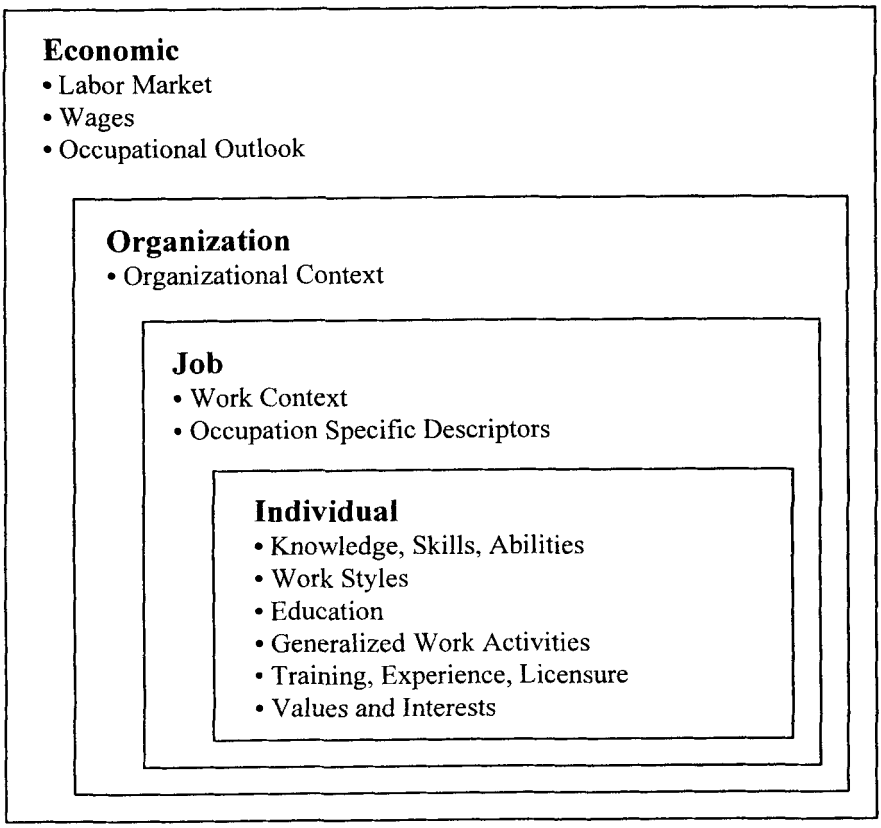

Figure 4: **Levels of Analysis in O*NET**

entities is no longer tenable (Carson & Stewart, 1996). Human resource innovations, such as organizing work around teams with only loosely defined tasks and responsibilities, would appear to dilute the notion of true scores for occupational descriptors. In addition, there is evidence that job duties may change with experience on the job (Borman, Dorsey, & Ackerman, 1992), leading to questions about how much variability can exist within an occupation before it is no longer viewed as the same job. Perhaps generalizability theory (Cronbach, Gleser, Nanda, & Rajaratnam, 1972) is a viable alternative to the true score model because of its ability to partition sources of variance into effects due to a range of factors (e.g., descriptors, respondents, occupations, organizations, etc.) relevant to the job analysis context. O*NET, as well as any other job analysis system, will have to address these issues as we attempt to describe the changing nature of jobs as we move into the next century.

Conclusion

The O*NET provides a highly usable and inexpensive methodology for analyzing jobs. The structured self-report questionnaire format of the O*NET's rating scales is much easier to use than the analyst-based and largely narrative format of the DOT. In addition, it will be readily available for public and private sector use through information technology (e.g., Internet). This suggests that the O*NET will have a great impact on research and practice. It is certain to provide many years of good service to the public, just as the DOT did.

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