# The Feasibility of Using O*NET to Study Skill Changes

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## Introduction

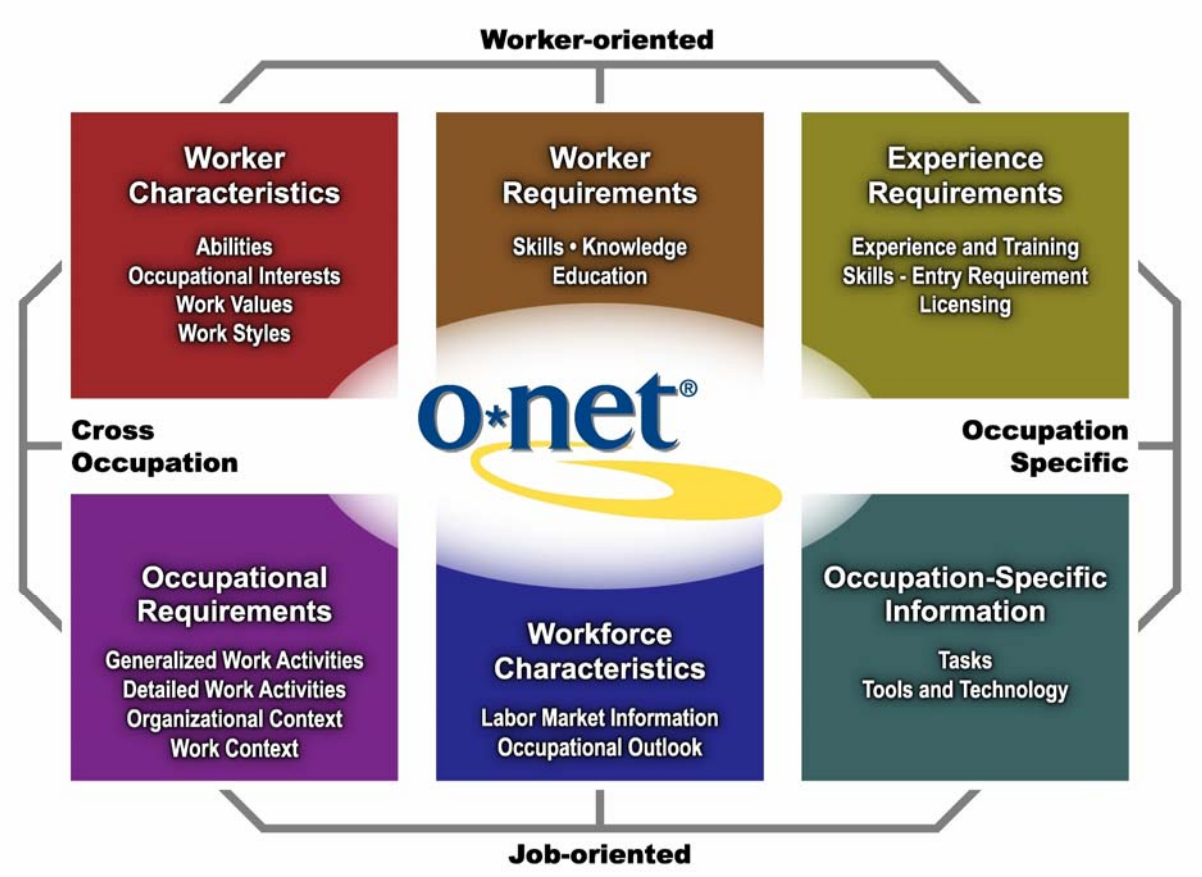
The Occupational Information Network (O*NET) is a comprehensive system developed by the U.S. Department of Labor that provides information for 812 occupations within the U.S. economy. This information is maintained in a comprehensive database which was developed to replace the Dictionary of Occupational Titles (DOT) (U.S. Department of Labor, 1991). The DOT, which was first published by the Department of Labor in 1939, provided information on 12,000 occupations. The information was collected by observing and interviewing job incumbents, much of which occurred during the 1970s. In the late 1980s, the Employment and Training Administration (ETA) of the U.S. Department of Labor embarked on a review of the DOT. This review was aimed at assessing the costs and problems associated with maintaining the information. As part of this review, in 1990 the Secretary of Labor appointed an Advisory Panel on the DOT (APDOT). This group recommended developing an electronic database to house occupational information, collecting information on additional types of job descriptors, and relying, primarily, on surveys to collect the requisite data. In addition, APDOT noted the importance of implementing timely updates and maintenance of the database. Based upon these recommendations, O*NET was created.

## O*NET Content Model

The O*NET system is based upon the O*NET Content Model, which provides a framework for classifying, organizing, and structuring O*NET data. The components of the Content Model were developed based on a thorough review of an extensive body of literature from the job analysis arena within the field of industrial/organizational psychology (e.g., Fleishman, 1992; Lubinski & Dawes, 1992). The research team synthesized the available information and identified a taxonomy of variables to serve as the foundation of the Content Model (Peterson, et al., 1995, Peterson, 1997, & Peterson, 1999). Since its inception, the Model has been reviewed and

evaluated, as a result, slightly revised. In general, the Content Model contains four types of descriptors: job-oriented, worker-oriented, cross-occupational, and occupation-specific. In turn, these descriptors are organized into the six domains shown in Figure 1 and described below.

**Figure 1. O*NET Content Model**



The six Content Model domains are:

- **Worker Characteristics—**enduring characteristics that may influence both performance and the capacity to acquire knowledge and skills required for effective work performance. Included in this domain are:
  - Abilities: enduring attributes of the individual that influence performance.
  - Occupational Interests: Preferences for work environments and outcomes. Occupational Interest Profiles (OIPs) are compatible with Holland's (1997) model of personality types and work environments.
  - Work Values: Global aspects of work composed of specific needs that are important to a person's satisfaction. Occupational Reinforcer Patterns (ORPs) are based on the Theory of Work Adjustment (Dawis & Lofquist, 1984).
  - Work Styles: personal characteristics that can affect how well someone performs a job.
- **Worker Requirements—**work-related attributes that are acquired and/or developed through experience and education. Included in this domain are:
  - Basic Skills: developed capacities that facilitate learning and information acquisition.
  - Cross-functional Skills: developed capacities that facilitate performance of activities that occur across jobs.
  - Knowledges: Organized sets of principles and facts applying in general domains.
  - Education: Prior educational experience required to perform in a job.
- **Experience Requirements—**requirements that are explicitly linked to certain types of work activities. This domain includes:

- Experience and Training: The amount of work activity required in order to be hired to perform the target job.
- Basic Skills – Entry Requirement: The skills required to be hired for a job; these skills facilitate learning or the more rapid acquisition of knowledge.
- Cross-functional Skills – Entry Requirement: The skills required to be hired for a job; these skills facilitate performance of activities that occur across jobs.
- Licensing: Licenses, certificates, or registrations that are awarded to show that a job holder has gained certain skills. This includes requirements for obtaining these credentials, and the organization or agency requiring their possession.

➢ **Occupation Requirements—**variables or detailed elements that describe specific occupational requirements. Included in this domain are:

- Generalized Work Activities: general types of job behaviors occurring on multiple jobs.
- Work Context: physical and social factors that influence the nature of work.
- Detailed Work Activities: detailed types of job behaviors occurring on multiple jobs.
- Organizational Context: Characteristics of the organization that influence how people do their work.

➢ **Workforce Characteristics—**variables that define and describe the general characteristics of occupations that may influence occupational requirements (labor market information, occupational outlook).

➢ **Occupation-Specific Information—**variables or other elements (tasks, tools and technology) that apply to a single occupation or a narrowly defined job family.

Within each Content Model domain, information is organized by different levels of description. The hierarchical structure of the Content Model can be thought of as a staircase that leads O*NET users to the specific level of worker- or job-related information needed for their particular purpose. Information on 277 descriptors is gathered as part of the O*NET program and even more data is collected by other federal agencies (e.g., Bureau of Labor Statistics).

## Occupational Structure

As noted above, the Content Model provides the informational framework for an occupation. The organizational schema for all occupations is provided by the O*NET-SOC taxonomy which is based on the Standard Occupational Classification (SOC, U.S. Department of Labor, Bureau of Labor Statistics (2004). The initial taxonomic system was based on an Occupational Employment Statistics classification (O*NET OU 1998). However, in 2000, the Office of Management and Budget (OMB) required all government agencies to collect occupational data based on the SOC. As such, O*NET underwent a major revision which resulted in the O*NET SOC 2000 (Levine, et. al., 2000). This change was followed by another update that resulted in the O*NET-SOC 2006 (National Center for O*NET Development, 2006b). Additional modifications to the taxonomy are planned when New and Emerging (N&E) occupations are added (National Center for O*NET Development, 2006a). Currently, research is being conducted on high growth industries to identify potential new and emerging occupations. When this research is complete, these additional occupations will be added to the taxonomy.

During the revision process, it was paramount to identify a taxonomy that would permit the collection of data at an appropriate level of specificity and would reflect the changing nature of work in light of new technologies and innovative business practices (National Center for O*NET Development, 2006b). In a large majority of the cases, the O*NET SOC is identical to an

occupation in the SOC. In other cases, the O*NET-SOC is more detailed than the original SOC occupation.

There were five types of modifications that occurred during the 2006 revisions to the taxonomy:

1. Detailed O*NET-SOC occupations were aggregated to the SOC-level occupation.
2. Two or more detailed O*NET-SOC occupations were aggregated into a new detailed O*NET-SOC occupation.
3. Detailed O*NET-SOC occupations were subsumed by an existing detailed O*NET-SOC occupation.
4. Detailed O*NET-SOC occupations were subsumed by a SOC-level occupation.
5. Detailed O*NET-SOC occupations were added to the taxonomy.

(National Center for O*NET Development, 2006b)

As a result, the new occupational taxonomy includes 949 titles, 812 of which represent data-level occupations. That is, the O*NET program is collecting updated data for these 812 occupations. The remaining occupations include military occupations, “all other” occupational titles, and SOCs which are broken down into more detail in O*NET. No data will be collected on these 137 occupations; they will remain in the system by title only.

For users of previous classification systems, including the DOT, Classification of Instructional Program (CIP), Military Occupational Classification (MOC), and Registered Apprenticeship Information System (RAIS), the National Crosswalk Service Center has created and maintains comprehensive crosswalks, which are available at the following link: http://www.onetcenter.org/supplemental.html#ncsc_xwalk. Crosswalks between the O*NET-SOC 2000 and O*NET-SOC 2006 can be found at http://www.onetcenter.org/taxonomy.html#listings. All crosswalks are straightforward, effective, and current.

## Data Collection and the O*NET Database

The O*NET data collection program is a continual process aimed at identifying and maintaining current information on the characteristics of workers and jobs. The carefully designed methodology has received clearance from the Office of Management and Budget (OMB), a testament to the rigor and quality of the work (for the recent OMB clearance packet, see http://www.onetcenter.org/dl_files/omb2005/Supporting_Statement2.pdf).

The information that populates the O*NET database is collected from four primary sources: legacy analysts, incumbents, occupational experts, and analysts. The data collection process can be divided into three broad phases: analyst, update, and in-demand. Initially, ratings were obtained from occupational analysts using DOT information on a set of descriptors. This yielded the first database – O*NET 98 - which contained 1,222 Occupational Units that were based on BLS OES codes. Then, as previously noted, the occupational taxonomy was modified to be more consistent with the SOC. O*NET 4.0 includes the ratings of the 900+ occupations in the O*NET-SOC 2000 and represents the final release of "analyst ratings only" data. This database is referred to as the Analyst database.

Moving into the Update Phase, subsequent databases have included additional descriptor information and have reflected input from incumbents as well as analysts. Beginning in June 2001 and continuing to-date, the full-scale data collection effort relies on incumbent participation and involves updating all occupational information. Prior to implementing the new procedures, the U.S. Department of Labor and the National O*NET Consortium conducted extensive research to identify the most effective methodology for surveying incumbents. Of particular interest was an investigation of the impact alternative approaches had on response rates. The resulting methodology included the following two key features:

1. identifying a statistically random sample of businesses likely to have employees in the target occupations, and
2. selecting a random sample of employees in those occupations within those businesses.

The targeted incumbents provide ratings on occupational tasks, skills, generalized work activities, knowledge, education and training, work styles, and work context areas. Clearly, asking each respondent to provide judgments on *all* of these elements would be quite burdensome. Therefore, with the exception of the task questionnaire and demographic questions which all raters receive, the questions are divided among four different questionnaires which are randomly assigned to the sampled incumbents.

Importance and level information regarding the abilities associated with these occupations is being collected from trained analysts who rely on updated occupational information provided by job incumbents. It should be noted that there are theoretical or philosophical reasons for preferring one rater group to the other for collecting different types of data. For example, incumbents are generally more familiar with the day-to-day duties of their job; therefore, they are the best source of information regarding tasks and GWAs. In contrast, it is likely that trained analysts understand the ability constructs better than incumbents and therefore should provide the ability data. Although not published yet, data for the new and emerging (N&E) occupations are being collected from occupational experts.

The results of the data collection efforts during the Update Phase have yielded high quality data from a national sample of job incumbents. There is strong participation from both businesses and employees, with over 70% and 66% response rates, respectively. In addition, more than 400 national associations have endorsed O*NET. All ratings are carefully analyzed (e.g., reliability, inter-rater agreement, standard errors of the mean) in order to evaluate the quality of the data.

These data checks provide invaluable information regarding the O*NET methodology and constructs and facilitate the continual review and improvement of the system as a whole.

At the completion of the Update Phase, the focus will shift to collecting data from "in-demand" occupations. These include industries that are economically critical, are projected to add substantial numbers of new jobs, or are being impacted by technology and innovation.

The O*NET database contains the information associated with the Content Model. It should be noted that there also are supplemental data files available. These include:

- **Detailed Work Activities**: statements that relate to work content within a Generalized Work Activity.
- **New Emerging Tasks**: tasks that were listed by incumbents during the survey process as being omitted from the existing task list were identified as emerging tasks.
- **Lay Titles**: a list of alternate occupational titles for O*NET occupations derived from job incumbents, transactional analyses, and other governmental agencies (e.g., BLS, Census).
- **Related Occupations**: identified based on a complex, comprehensive algorithmic formula, based on relatedness among selected O*NET characteristics.
- **Tools and Technology (T2)**: provides information on machines, equipment, tools, and software that workers may use for optimal functioning in a high performance workplace. The information is not exhaustive.

Currently, O*NET releases updated databases twice a year. The first update based on the new data collection procedures (Update Phase) was O*NET 5.0, which was released in April 2003. This database included updated and new information for 54 occupations, based on the O*NET-SOC 2000. Specifically, the new data includes ratings of task statements and information on work context, work styles, training and work experience, and education. In addition, the abilities, work activities, knowledge, skills, job zone, and work context data were updated.

Supplemental modifications included an update of the emerging occupational tasks and the addition of detailed work activities and tools and technology.

Subsequent database releases, which occur regularly at six month intervals, include a comprehensive update of approximately 100 occupations for each release. O*NET 10.0 was the first database to contain the O*NET-SOC 2006 taxonomy. The most recent version, O*NET 11.0, is the seventh update of the database from the Data Collection Program and it contains updated data on 680 occupations.

The O*NET database is a very flexible tool. For example, one can start with a skill or ability profile and identify occupations with similar profiles. As another option, one may start with an occupation and search to find other occupations with similar characteristics. If the user enters a previous occupation code or title, O*NET OnLine automatically redirects the user to its current equivalent. The database is structured according to the Content Model and can be downloaded as a flat file from the O*NET Center (www.onetcenter.org) or in Microsoft Access, Visual FoxPro, or SAS/PC versions. Examples of specific data in O*NET include mean importance and level-based ratings for various items (or descriptors), and text information on occupational definitions, descriptor definitions, scale anchors, and task descriptors. All information is available in a series of files or tables. The following Access tables contain data for the various currently available O*NET descriptors:

- Abilities
- Interests
- Work Values
- Work Styles
- Skills
- Knowledge
- Education, Training, and Experience
- Work Activities
- Work Context
- Tasks

- Occupation Data (definitions)
- Job Zones

(National Crosswalk Service Center, 2006)

## Uses of O*NET Data

Information contained within O*NET is used by a wide audience that includes businesses, job-seekers, educators, students, counselors, and researchers. The O*NET database serves as the foundation for O*NET OnLine, Career Exploration Tools, and Code Connector. O*NET OnLine is an interactive application for exploring and searching occupations. It helps people get a sense of the type of worker and job information that is available through O*NET, and provides a basic tool for accessing the information directly. From that point, one can request customized information about a particular occupation or search an entire O*NET-SOC. Alternatively, one can search across occupations. Job seekers may find the Skills Search particularly useful. As noted previously, it is also possible to convert other classifications to the O*NET-SOC taxonomy by using the Crosswalk. O*NET OnLine is updated whenever information from job incumbents and analysts becomes available.

The O*NET Career Exploration Tools include several computerized assessments that introduce users to a range of career options. These tools include the: Ability Profiler, Interest Profiler, Computerized Interest Profiler, Work Importance Locator, and Work Importance Profiler. A third O*NET application is the Code Connector, which greatly facilitates the process of interactive job coding.

In addition to the O*NET applications available through O*NET OnLine, many organizations use O*NET data to facilitate the design, implementation, and support of a variety of programs and systems. The U.S. Department of Labor's website contains a number of examples of how O*NET has been put "into action." A few examples of these applications include:

- West Virginia Rehabilitation Center is using O*NET to help transitioning students translate career dreams and “can-do” outlook into real jobs.
- A new book on unfocused kids discusses how O*NET can help these children
- Wisconsin Department of Workshop Development trains job center staff across the state on O*NET and O*NET OnLine so they can use the available tools on their job.
- Faculty and staff at Temple University Center for Professional Development in Career and Technical Education Center incorporate O*NET OnLine in their courses on program planning and evaluation, curriculum development, and cooperative education.

O*NET has also proven to be an invaluable source of data when trying to identify new and emerging skill needs. In response to the need for skilled 3-D computer artists and traditional animators in the multimedia and entertainment industries, California’s Employment Development Department conducted an industry study using O*NET’s survey data collection instruments along with other material. The results highlighted the gap between industry needs and the local labor market. In response, the local training and education initiatives were modified, in an effort to close that gap.

O*NET data are also relevant for various human capital management programs. For example, ability, skill, and experience information could be useful for employee selection purposes, whereas GWA and knowledge data are likely to be informative for training purposes. Furthermore, job evaluation systems could benefit from both GWA and work context information.

Economists and educational professional may also find relevant uses for O*NET. For example, O*NET data has been used to investigate the vulnerability of U.S. jobs to offshoring and

to analyze the relationship between educational attainment and occupational competencies (e.g., knowledge, skills, abilities) (Uhalde, Strohl, & Simkins, 2006).

## O*NET and Skills Demands

Given the characteristics of its occupational taxonomy and Content Model, O*NET is an ideal source to inform questions regarding future skills demands. In fact, a number of organizations and states already take advantage of O*NET data to project current skill supply and potential skill changes. Of particular relevance is the work done by the Projects Managing Partnership (PMP) which is a collaboration between (1) the U.S. Department of Labor, Employment and Training Administration (ETA); (2) the U.S. Department of Labor, Bureau of Labor Statistics (BLS); (3) the National Association of State Workforce Agencies (NASWA); and (4) the State Projections Workgroup (http://dev.projectionscentral.com/index.html). One component of this effort involves the implementation of the Skill Based Projections (SBP) tool. Using O*NET data (skills, abilities, and GWAs) and the target state/territory's short- and/or long-term occupational projections, SBP tool identifies the:

- current skill supply,
- projected demand, and
- potential skills gaps and replacement needs.

An example application of this is presented in *Illinois' Future Workforce: Will There be Enough Workers with the Right Skills?* (Ginsburg & Robinson, 2006). In this case, they found the following 15 job skills to have the largest projected shortages for all growing occupations in Illinois in 2012:

1. Reading comprehension
2. Active listening
3. Speaking
4. Writing
5. Critical thinking
6. Active learning
7. Instructing

8. Monitoring
9. Coordination
10. Learning strategies
11. Social perceptiveness
12. Time management
13. Judgment and decision-making
14. Complex problem identification
15. Mathematics

The Geo-Skills Profile (www.geoskillanalyzer.com, 2006) offers a slightly different example of using O*NET to project future skills. In this case the O*NET skills are coupled with data from BLS and the U.S. Census Bureau to analyze workforces, occupations, wage data, and skills in labor markets. Among the information it can generate is a report that depicts the skills that drive the economy in the targeted geographic area, including each skill's density when compared to the United States.

Given the question about whether O*NET can provide information that would be useful in evaluating changes in skill demands, the short answer is yes. In fact, as noted above, organizations are taking advantage of the data associated with several of the descriptors (e.g., GWAs, abilities and skills) in the Content Model to evaluate the current and projected demands. In addition, it seems feasible to analyze the O*NET data in several other ways to adequately address this issue. For example, one could compare the occupational data from the Analyst Phase with data from the same occupations in the Update Phase. Recall that O*NET was initially populated with data provided by occupational analysts using DOT information rather than by incumbents. In addition, a few descriptors were added to the Content Model since the initial data collection phase. However, data on the most relevant elements (i.e., skills, abilities, and GWAs) is available at both points in time. The appeal of this type of analysis is that it allows for a comparison of skills for the same occupation from two different time periods. One potential issue is that the occupation taxonomies differed during the two data collection efforts, although the crosswalk between the two

occupational structures would help overcome this issue. Nevertheless, a perfect one-to-one comparison for all occupations is impossible. Another consideration when conducting this type of analysis is that the sources of data are quite different. Although analysts provide the information for abilities in both cases, incumbents provide skill and GWA data in the updated database. Despite these limitations, the resulting data could prove quite informative.

Another set of analyses that could be considered involves evaluating the emerging trends across occupations in the current database regarding important skills/abilities/GWAs. O*NET 11.0 contains 680 occupations and within a few months O*NET 12.0 will be released with another 100 occupations. The occupations that are added with each new release of an O*NET database tend to be from a variety of occupational categories. Given this, these analyses could be cut several different ways. The skills/abilities/GWAs can be rank-ordered based on importance across all the occupations with updated data. Alternatively, similar analyses can be done by major occupational category to see if there are different cross-category trends. Since the data collection effort spans a number of years, one could look at annual trends. Each year, data is collected on approximately 200 occupations. Therefore, this run would be comparing the 200 occupations collected in 2003, with those collected in 2004, and then 2005, and so on. Obviously, one limitation of this type of analysis is that the nature of the occupations within a given year may be quite different than those in another year. In addition, 200 occupations may not be deemed sufficient. Even if the analyses focusing across years is abandoned, it would be telling to conduct a close evaluation of the cross occupational trends.

It seems as though it would also be informative to take advantage of the Occupational Employment Survey (OES) data collected by BLS. Since both the O*NET and OES databases adopted the same occupational structure, one could match information from the two sources to examine whether occupations requiring particular transferable skills have grown. Also, as the

O*NET database continues to be updated, there will be opportunities to conduct more relevant analyses (e.g., time series), the most obvious being a comparison of the skills within the same occupation across time. Another analysis could involve using the OES and O*NET data to examine changes in occupational demands as well as changes in the number of individuals employed in those occupations.

## Summary

O*NET is a rich source of occupational information that is based on a comprehensive Content Model containing a broad set of descriptors. The O*NET database is continually updated with information provided by a range of workers from each occupation. Given the wealth of O*NET data, the potential applications are endless. It appears as though one of the most prevalent uses for the information is career exploration and planning. As noted, O*NET can also inform many human capital management programs, such as selection, promotion, training and succession planning. In addition, O*NET data and reports are informative for educators, economists, sociologists, as well as other prominent fields in the workforce community.

It is clear that there is a wealth of information currently available in O*NET that can be used in a variety of ways to inform the current and future skill demands. As noted above, O*NET provides skills data. However, one should also be aware that as Pearlman (1997) points out, the term *skills* seems to connote a variety of different definitions. Given that, it may be advisable to consider other elements (e.g., abilities, GWAs) of the Content Model when evaluating the change in skills demands. The relevance of the element can be determined by the user based on their O*NET definition.

Obviously, most informative analyses to address this issue would revolve around comparing occupational data for the same set of occupations across time. It is unfortunate that, at this point, the only data available across two time periods are not entirely comparable. Yet, as

described above, there are reasonable analyses that could be conducted to inform the potential changes in skill demands. In fact, a number of organizations are using O*NET data to answer this question. Then as the data collection effort continues, new occupational data will be available and analyses more directly related to the question can be conducted.

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