Stratifying Occupational Units by Specific Vocational Preparation (SVP)

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Addendum

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This technical development report contains information based on O*NET™ 98, whose occupational classification system contains 1,122 occupational units (OUs) based on the Occupational Employment Statistics classification system.

Since the writing of this report, the O*NET 3.0 database has been developed. The major difference between this database and the O*NET 98 database is its compatibility with the 1998 Standard Occupational Classification (SOC) System.[1] By making O*NET 3.0 compatible with the SOC system, the O*NET 3.0 database contains 974 occupations. Please note that the U.S. Office of Management and Budget has mandated that all federal agencies' occupational classification systems be compatible with the 1998 SOC system.

All O*NET 98 data have been converted to O*NET 3.0 data and verified.

O*NET 3.0 and O*NET OnLine, a Web-based application that allows users to view and use the O*NET 3.0 database, can be accessed via the National Center for O*NET Development's Web site, www.onetcenter.org .

[1] United States Department of Labor, Bureau of Labor Statistics. (1999). *Revising the Standard Occupational Classification System*. Washington, DC: Author.

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Executive Summary

The O*NET™ Career Exploration Tools are assessment instruments that can guide users to lists of potentially suitable occupations based on user-responses. These tools assess users in terms of their work values, interests, and abilities. To add to the usefulness of the tools and to provide important information to users for career exploration, the National O*NET Consortium also wanted to provide information about vocational preparation requirements across occupations. To maximize the value of these tools in this regard, the Consortium sought a vocational preparation taxonomy operating similarly as it classified both occupations and people. As envisioned, once developed, this vocational preparation information could be directly accessed through O*NET 98 (USDOL, 1998) as well as serving a prominent role with the O*NET Career Exploration Tools.

To address these needs, the National Center for O*NET Development contracted with the Human Resources Research Organization (HumRRO) to develop a means of stratifying occupations in terms of their level of required vocational preparation. A structure of this type would allow users of these assessment tools to focus on the occupations that fit with their current or planned levels of vocational preparation. Since the *Dictionary of Occupational Titles* (DOT) provides ratings for several occupational attributes that might drive vocational preparation requirements, the stratification effort first sought ways to compare such ratings. One of these DOT ratings (Specific Vocational Preparation or SVP) was found to capture the essential attribute desired for the stratification. To see if other DOT ratings might add substantially to the information conveyed by SVP, HumRRO analysts investigated quantitative relations between SVP and composite metrics (built by adding other ratings to SVP). They also examined the distributional properties of these metrics. At least one interpretation of these analyses suggested that SVP alone would be similarly as effective (in stratifying occupations) as the more complicated composites. Given: 1) the desire to stratify with as simple a system as possible (to enhance communication to the user), and 2) the desire to use a metric equally applicable to both occupations and people, SVP alone was chosen as the stratification method.

The next step in developing the level of preparation variable involved moving the analysis from the highly specific DOT job codes (over 12,000 in number) to the broader O*NET occupational units or OUs (1,122 in number). Previous research provided the associations between the two occupational classification systems (i.e., the way the 12,000+ DOT codes fit under the 1,122 OUs). Principal components analysis was then used to identify at least 25 percent of the DOT codes (associated with each OU) thought to reflect the *core* or essence of each OU in terms relevant to vocational preparation. The SVP ratings for each OU's core DOT codes were then averaged, and this average was assigned as an SVP rating for the associated OU. These ratings were used to sort the OUs into five Job Zones defined as: 1) Little or No Preparation Needed, 2) Some Preparation Needed, 3) Medium Preparation Needed, 4) Considerable Preparation Needed, and 5) Extensive Preparation Needed.

To preliminarily assess the validity of this five zone SVP-based approach, a dual-panel rational review of the entire list of 1,122 O*NET occupational units was conducted. Its specific task was to identify obvious misclassifications (i.e., to find occupations where the OU-aggregated SVP ratings resulted in an inappropriate Job Zone assignment). Ninety-seven percent of the OUs

were found to be reasonably classified using averaged SVP alone. This report provides tables listing the 33 OUs identified as clear misclassifications and how this information was applied in developing particular O*NET tools (e.g., whether these OUs were maintained or replaced in O*NET score reports).

Chapter 1. Introduction

Objectives and Overview of the O*NET Career Exploration Tools

A major objective of the O*NET Career Exploration Tools is to allow users to learn information about themselves that they can use to focus their career search. These tools attempt to direct users to explore occupations so as to maximize the joint probability that they a) have (or can learn) the knowledges and skills necessary for the occupation, b) have the basic interests that characterize people in that occupation, and c) place a high value on work outcomes that the occupation will provide.

To achieve this focused career exploration, information pertaining to the three areas just described (i.e., abilities, interests, and valued work outcomes) must be available for users and occupations. To help determine the user's standing on abilities, interests, and work values (respectively), the O*NET tools provide the user with a choice of three assessment instruments: a) an ability profiler, b) an interest profiler, and c) a work importance (i.e., work values) profiler. The ability profiler must be administered by a counselor or test administrator, but the interests and work values instruments are self-assessment tools. In addition, the interests and work values instruments are available in both computerized and paper-and-pencil versions. All of these instruments provide users with self-interpretable score reports.

O*NET's Occupational Unit (OU)

The occupations in O*NET are the 1,122 occupational units (OUs) identified by the North Carolina Occupational Analysis Field Center during the *Dictionary of Occupational Titles* (DOT) Conversion Project (NCOAFC, 1995). The OUs represent a refinement of the Occupational Employment Statistics occupational classification structure. The OUs were created by giving prime consideration to the DOT occupations that had similar work content and similar education and training requirements. Many OUs are one-to-one translations of DOT occupations, whereas other OUs comprise hundreds of DOT occupations.

Occupational information for each of the OUs is available from the Occupational Information Network (O*NET 98), a computerized, multi-dimensional occupational information database that replaces the DOT (please see www.onetcenter.org/product.html) O*NET presents occupational information in several areas: 1) worker characteristics, 2) worker requirements, 3) experience requirements, 4) occupation requirements, 5) occupation specific requirements, and 6) occupation characteristics. Each of these six main areas contain many variables that are identified in O*NET (e.g., certification/licensure requirements, work context, etc.).

O*NET 98, however, will evolve. The current version of O*NET 98 has been built partially from occupational information in the DOT, which provides a rich data source upon which to build O*NET. This information will be supplanted by updated occupational information (gathered from incumbents) as it becomes available (e.g., initial incumbent data collection for O*NET in 1999 with subsequent additional sampling annually).

The Need for Stratification by Level of Vocational Preparation

To facilitate the career exploration process, the O*NET Career Exploration Tools should allow users to consider the extent of their own current or future vocational preparation. For one thing, this gives the user a reasonable degree of control over the level of occupations to be explored. For another, it reflects reality: it is the specific vocational preparation that a user undergoes which leads to acquisition of essential job knowledge and skills. Therefore, consideration of specific vocational preparation has a high priority within O*NET. Without the necessary job knowledge and skills that are developed by education, training, and experience, the individual will not be able to function effectively in an occupation. Having discordant interest patterns, value preferences, or even ability profiles would not necessarily preclude one from being able to work in the occupation, *if* the necessary knowledge and skills had been mastered through an individual's own remedial or compensatory strategies (Harvey, 1991). As such, the U.S. Department of Labor's (USDOL's) own job analytic work has always placed a high emphasis on differentiating among occupations in terms of their specific education and training requirements—and doing so in a way that is equally applicable to occupations and people.

This emphasis also reflects O*NET's desire to make explicit the advantages of additional vocational preparation. In other words, O*NET users will be able to see the value of pursuing additional vocational training, improving their vocational skills, and obtaining relevant experience.

The following sections contain descriptions of: a) alternative ways of defining occupational level, b) the chosen method and its rationale, c) variations on the chosen method that were considered, d) the method by which occupations were assigned to levels, and e) a dual-panel rational review of the 1,122 stratified occupations providing some preliminary validation of the total effort.

Chapter 2. Alternative Metrics

Introduction

This chapter compares occupation stratification approaches based on the acquisition of vocationally-relevant skills and knowledge, then describes the specific quantitative composite metrics considered for O*NET OU stratification. This chapter concludes by describing the quantitative relations between these candidate composite metrics and the most relevant DOT index: specific vocational preparation (SVP).

Fundamental Stratification Approaches Related to Knowledge and Skill

There are many ways to represent the dimension of required knowledge and skill. This analysis considered complexity requirements and the alternative views of how one attains the capacity to cope with the complexity level of occupational demands (as in cognitive ability versus specific vocational preparation).

General cognitive ability (g)

Some researchers (e.g., Gottfredson, 1986) want to use general cognitive ability (*g*) to represent levels of required job knowledge and skill. Measures of *g* can be obtained from various aptitude or ability instruments like the General Aptitude Test Battery (GATB; USDOL, 1983a). However, *g* is not (arguably) a *direct* determinant of being able to perform successfully in an occupation. It does predict (with varying efficacy) individual degrees of success in the acquisition of knowledge and skill, which are presumably more direct causes of performance. Measures of *g* also have the unfortunate property of emphasizing large, arguable, and sporadically irrelevant subgroup differences (Flynn, 1997).

Complexity Indices

Another possible alternative metric is some measure of occupational complexity (where high complexity infers a lack of routine repetitive work in favor of work involving high intellectual demands and/or frequent changes in task-related requirements—often involving the synthesis or interpretation of complex data—please see Cain, 1980). Hunter (1986) asserted that complexity was the dimension that a) was common to the five job analysis approaches applied to the U.S. Employment Service validation data base (e.g., DOT estimated GATB means for incumbents, analysts' judgments of aptitude requirements by job, "Data, People, Things" etc.—please see USDOL, 1983a) and b) moderated the validity of cognitive ability for predicting job performance ratings (the validity is lower for lower complexity jobs than for higher complexity jobs). As this latter statement implies, complexity usually shows a significant correlation with averaged incumbent *g*. Occupational complexity is perhaps reasonably indexed in the DOT by the Data dimension, but there is no analog among user characteristics with which this can be cleanly matched.

Specific Vocational Preparation

The necessary level of knowledge and skill for an occupation also could be represented by the amount of occupation-specific education, training, and experience that is required to perform successfully in the occupation. The DOT rating of Specific Vocational Preparation (SVP) is intended to be a measure of the required level of specific occupational training and experience. The definition of SVP given by *The Revised Handbook for Analyzing Jobs* (U.S. Department of Labor, 1991b) is

> "the amount of lapsed time required by a typical worker to learn the techniques, acquire the information, and develop the facility needed for average performance in a specific job-worker situation" (please see Figure 2 for more information and the rating scale that is used).

An applicant's, user's, or student's investment in a given degree of specific vocational preparation does not assure adequate acquisition of the necessary knowledge and skills, but among DOT indices, SVP is arguably the most direct reflection of the time investment required.[2]

The SVP rating has two important advantages, as compared to other metrics in the DOT. First, the level of the SVP requirement for an occupation can be directly linked to the level of specific occupational education and training achieved by a person. It also can be used to describe the future level of SVP that a person might intend to achieve. Consequently, people also can ask what new occupations they should explore *if* they are planning to pursue certain education/training opportunities. This could be used to illustrate in a very concrete way the value of additional training. Any method used by O*NET to stratify occupations should provide this illustrative capability. For present purposes, it was also a key criterion that the selected stratification method "would be easily communicated as user-relevant."

Secondly, using SVP rather than *g*-laden requirements or "complexity" reduces the direct effects of *g* on the procedure for linking individuals to occupations. Although there is a significant correlation between general cognitive ability and the level of training achieved by individuals, there are many other determinants of education and training success (e.g., motivation). Stratifying occupations on SVP first would reflect these other determinants while reducing the degree to which the occupational linkage was a direct function of *g*.

Several variations to SVP alone could be envisioned, using data from the *DOT*. Various metrics for measuring the required knowledge or skills (associated with OUs) were created and evaluated for use with the O*NET Career Exploration Tools.

Composite Metrics Considered for OU Stratification

This section describes and compares alternative metrics that were proposed and explored for use in OU stratification—metrics based on combinations of variables in the existing DOT data base.

[2] One alternative, General Educational Development (GED), is inadequate because it does not cleanly reflect all forms of training and experience.

Also provided is the rationale guiding the final determination that Specific Vocational Preparation (SVP) was the most appropriate metric for OU stratification.

For each OU, six metrics for general occupational level were calculated, all using data from the DOT*:*

Metric 1 = SVP + Reasoning – Data;
Metric 2 = SVP – People;
Metric 3 = SVP;
Metric 4 = SVP – Data;
Metric 5 = SVP + Reasoning;
Metric 6 = Metric 1 – Metric 2 = Reasoning – Data + People.

Please notice that the six metrics considered for this stratification incorporated some subset of the following variables:

Reasoning

High Reasoning scores apply to those occupations requiring a high level of abstract and/or scientific reasoning. In contrast, low Reasoning scores reflect those occupations needing only the ability to follow common sense one- or two-step instructions. Metric 5 combines SVP and Reasoning.

Data

The Data variable rates worker functions that involve information, knowledge, or concepts. Data therefore has partial overlap with Reasoning, but is sufficiently different to make its own contribution in distinguishing among occupations. Occupations with low Data scores are more complex on this dimension (e.g., synthesizing, coordinating) than jobs with high Data scores (e.g., copying, comparing). Metric 1 combines SVP with Reasoning and Data, such that high scores reflect high SVP, high amounts of reasoning, and high involvement with data (see comments below concerning the direction of coding, i.e., addition and subtraction). Metric 4 combines SVP and Data. Both Metric 1 and Metric 4 are measures of general occupational level that include "technical" aspects of an occupation.

People

The People variable is loosely hierarchical, where low People scores are associated with occupations dealing with the most complex interpersonal activities (e.g., mentoring, negotiating), high People scores with the least complex interpersonal activities (e.g., taking instructions/helping, serving). Metric 2 combines SVP and People, and is a measure of general occupational level that includes "interpersonal" aspects of the occupation.

Relations Between Composite Metrics and Specific Vocational Preparation

Metric 1 through Metric 5 were based on the simple addition and subtraction of their constituent DOT variables, once they were standardized (i.e., mean = 0, SD = 1). Subtraction was necessary for the Data and People dimensions, given that lower scores represent greater complexity.

As Table 1 shows, the composite metrics were highly correlated with one another (without accounting for systematic errors, method variance, or measurement unreliability) with zero-order correlations ranging from .83 to .98 (k = 1,116 OUs). The pattern and magnitude of correlations were much the same when the data were disaggregated to the DOT level (k = 11,422). Of course, Metrics 1 through 5 shared at least the SVP variable, so very high intercorrelations were expected.

Metric 6 was created by subtracting Metric 2 from Metric 1. Metric 6 does not involve SVP, but instead creates a bipolar continuum from the more "interpersonal" occupations to the more "technical" occupations. If an occupation is a balance of similar degrees of interpersonal and technical characteristics, no matter what the level of each, then that occupation will be situated in the middle of the Metric 6 continuum. The zero-order correlations of Metric 6 with the other five metrics (ranging from -.20 to .32) suggest that it is relatively independent of these alternative metrics (or that its relations with the other metrics are either non-linear or ill-defined).

The distributional properties of each metric were explored. That is, each metric was examined for how well it differentiated occupations with respect to the variables the metric was intended to represent. In particular, we examined the titles of 50 OUs that fell within the highest, middle, and lowest ranges along the distribution of each metric. The results were reasonable, in that the more technical metrics had more technical occupations at the high end (e.g., environmental scientist, astronomer, biochemist), whereas the more "interpersonal" metrics had more interpersonal occupations at the high end (e.g., clergy, psychiatrists, judges), and the bipolar technical/interpersonal metric had technical occupations at the high end and interpersonal occupations at the low end.

Table 1
Zero-order Correlations Between* DOT *"Complexity" Metrics (at OU level; k=1,116)

	Metric 1	**Metric 2**	**Metric 3**	**Metric 4**	**Metric 5**	**Metric 6**
Metric 1	1.00					
Metric 2	.86	1.00				
Metric 3	.94	.83	1.00			
Metric 4	.99	.85	.96	1.00		
Metric 5	.99	.86	.96	.96	1.00	
Metric 6	.32	-.20	.26	.32	.29	1.00

Note. All correlations have a two-tailed $p < .001$ when testing the null hypothesis: correlation = 0.
The reader should note again that Metric 6 = Reasoning – Data + People (but since the latter two are reverse-coded, Metric 6 is more easily thought of as "technical" minus "interpersonal").

The importance of technical and interpersonal skills and requirements across a wide variety of occupations cannot be denied, and perhaps these facets eventually will be incorporated into later versions of the O*NET Career Exploration Tools. However, several considerations influenced the final decision to adopt SVP as the measure of general occupational level. Briefly, these considerations included the following:

1. SVP is measured in a straightforward way and can be obtained from both individuals and occupations. The metric is the same for individuals and occupations, thereby facilitating the linking process. People easily can set realistic career planning goals by determining how discrepant they are from a given class of occupations in terms of the required training or education time specified by SVP. This would not be possible if one of the alternative metrics—even those that included SVP—were used to stratify OUs. Further, Data, People, and Reasoning variables are measures of occupational characteristics that have no analogs in the existing user measures, which would make linking users and OUs (on vocational preparation level) more difficult.

2. General occupational level, as the term implies, is a broad way to group OUs before proceeding with a more detailed analysis of the similarity between the interest, work values, and ability profiles of individuals and occupations. In contrast with SVP, technical and interpersonal aspects of occupations may be better represented multidimensionally (as the interest, work values, and aptitude variables are). Data, People, and Reasoning variables are probably not sufficient technical and interpersonal measures of occupations for the purposes of the O*NET Career Exploration Tools.

3. Related to point 2, the overall power of each metric (other than Metric 6) for differentiating occupations was not much different than that for SVP. Although the metrics identified highly technical and interpersonal occupations in the extreme tails of the distributions, most occupations (i.e., those in the middle range of the distribution) were not substantively affected. Table 1 shows that correlations between all of the five main metrics were quite high. Metric 6, which had lower intercorrelations with SVP, also was not selected due to its weak power to differentiate most occupations. It also was complex in structure (i.e., it involved subtracting two composite metrics to create a single bipolar technical/interpersonal continuum). As mentioned in the introduction, the ease of communicating the chosen stratification logic (as being user-relevant) was a key criterion. The complexity of Metric 6 (especially if applied in weighted combination with SVP) did not seem compatible with this criterion. This issue will be re-visited as O*NET continues to develop.

For the above reasons, SVP was chosen as the most appropriate variable, *from among those currently available*, with which to start the process of linking persons to occupations. In the future, as O*NET develops, other linking variables will be explored.

Chapter 3. Computing an SVP Rating for Each OU

Introduction

The previous chapter described how the measure of level of preparation (SVP) was chosen. This chapter describes the procedure for assigning a level to each OU in O*NET. The following section outlines the three-step procedure adopted for identifying the core DOT occupations within an OU—those occupations that are considered most characteristic (or representative) of the DOT occupations within a particular OU. These core occupations were the reference occupations to which an OU's SVP value was tied.

Method

The available information on SVP requirements is attached to DOT codes ("jobs"). The 12,000+ DOT codes have been further aggregated into 1,122 occupational units (i.e., clusters of DOT codes) on the basis of similar work content and similar education and training requirements (Drewes, 1995; NCOAFC, 1995). The occupational units (OUs) are the basic structure on which the O*NET database is being developed, and they are becoming the focus of a number of other career/occupation exploration systems as well—including the O*NET Career Exploration Tools. Consequently, if the DOT SVP information is to be used to aid the person/OU linkage, then two things are needed. First, each OU must be given an SVP requirement. Second, the full distribution of SVP values for the OUs must be divided into segments (i.e., strata) that make sense in terms of general levels of education and training requirements. This second step was necessary so that users could effectively understand and use SVP as part of their career search.

In general, given multiple DOT codes for an OU, the goal was to compute the mean SVP for the DOT codes that best represented the central core, or content, of the OU. To do this, the following steps were performed:

1. For all OUs with fewer than seven DOT codes, the overall mean SVP was computed. With fewer than seven DOT codes, each job in these small OUs was argued to be a "core" job. The mean was argued to provide a less adequate summary for OUs comprising seven or more *DOT* codes.

2. For OUs containing 7-24 DOT codes, the profiles of Aptitude Requirement ratings[3] for the individual codes were analyzed via principal components to identify the first principal component for that OU. The mean SVP was computed for the six jobs in the OU that loaded highest on this first component (factor). This procedure was used to a) identify the core jobs that would best represent the OU, and b) base the SVP score for the OU on data from those core jobs.

[3] The Aptitude Requirement ratings from the DOT provide ratings of the degree of aptitude ability that an occupation requires. The aptitudes are the nine aptitudes from the General Aptitude Test Battery (GATB)—General Learning Ability (G), Verbal (V), Numerical (N), Spatial (S), Form Perception (P), Clerical Perception (Q), Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (M)—and two aptitudes considered to be of particular relevance to certain occupations: Eye-Hand-Foot Coordination (E) and Color Discrimination (C).

3. For OUs composed of more than 24 DOT codes, the array of codes was first examined for outliers by generating the distribution of SVP ratings. In general, only codes with one of the three most frequent SVP scores were retained. That is, codes with extreme SVP scores (i.e. judged to require much less or much more education/training than the bulk of the codes in the OU) were eliminated, on the grounds that they might have an undue influence on the principal component. The aptitude requirement profiles for the remaining DOT codes were then analyzed by principal components. The loadings of the codes on the first principal component were then rank-ordered. Those codes having loadings in the top 25 percent of all loadings on the first component were selected, and mean SVP was then computed for them. Again, this was all for the purpose of computing SVP for an OU in such a manner that it represented the central core of the OU.

The general rationale for the procedure is as follows[4]. First, calculating a mean profile across six or fewer occupations will yield a profile that is reasonably representative of each of the occupation-specific profiles with the OU. Using simple mean profiles for the more "occupation-abundant" OUs would not be likely to provide an adequate characterization. Thus, Steps 2 and 3 used the method of principal components analysis to identify the occupations that are most similar with an OU. Step 2 differs from Step 3 in that for OUs having from 7 to 23 occupations, more than 25 percent of the occupations within the OU constitute the core occupations. This difference allows for the rather arbitrary cut of "fewer than seven DOT codes" by permitting more of the occupations within the smaller OUs to contribute to the mean SVP score. Though chosen somewhat subjectively, all of the cut-offs described in Steps 1 through 3 above were selected so that at least 25 percent of the associated DOT codes for an OU would be directly reflected in an OU's mean SVP (while still minimizing the influence of highly unusual SVP ratings).

Stratification Outcomes

After identifying the SVP level for each of the OUs, the critical break points on the SVP scale had to be identified. These break points would then be used to define groupings of OUs that represented different levels of vocational preparation. For career exploration tools that present users with occupations simultaneously sorted by vocational preparation levels and user/applicant attributes, five levels (of vocational preparation) were deemed appropriate. More levels might make the structures too complicated to use manually or too difficult for users to interpret; fewer levels might make the structures so broad that not much differentiation would be achieved.

The SVP scale points that were used to define the five strata were chosen on the basis of a) the nature of the distribution of SVP "scores" across OUs (remember that for all OUs composed of more than one DOT code, the SVP is the mean of a number of DOT code ratings), b) the requirement to identify strata that contained approximately the same number of occupations, and c) the substantive meaning of the SVP scale itself.

[4] Admittedly, this is a rather arbitrary number. A similar methodology was used to generate the mean estimated ability profiles for O*NET OUs (see McCloy, et al, 1999).

Initial Strata

The distribution of SVP scores across strata is shown in Figure 1. The spikes at the whole integer points result, to a considerable extent, from the OUs which are composed of only one DOT code. The SVP rating is on a 1-9 scale and fractional values result from averaging across multiple codes that do not all have the same rating. The SVP scale itself is shown in Figure 2. The five strata that were identified used the following SVP critical scores:

Stratum 1: 193 OUs with mean SVPs that range from 7.5 to 9.0. This is the highest level of preparation and includes occupations that would require more than 4 years of specific education and training for achieving at least an average level of performance in the occupation. This would include most engineers, scientists, and high level professional positions, as well as directors/managers of scientific or professional personnel and occupations that require a very high level of technical skill (e.g., airline pilot, concert musician).

Stratum 2: 219 OUs with mean SVPs that range from 7.0 - 7.4. This second level includes occupations that require more than 2 years, but not more than 4, of specific training and education. A large number of professional and technical occupations fall in this category, as well as a broad range of supervisory and management positions.

Stratum 3: 298 OUs with mean SVPs that range from 5.5 - 6.9. These occupations would require from one to two years of occupation-specific training. Many different kinds of technicians, administrative personnel, and skilled machine operators fall at this level.

Stratum 4: 256 OUs with mean SVPs ranging from 3.5 to 5.4. This level includes occupations that are judged to require more than 3 months, but not more than one year, of occupation-specific training. It includes a large number of service positions, as well as clerical, maintenance, and operator positions.

Stratum 5: 150 OUs with mean SVPs ranging from 1.0 - 3.4. This is the lowest level of educational and training preparation and includes occupations that require up to 3 months of training. It includes a large number of less complex service occupations, as well as materials handlers and machine/equipment tenders or operators.

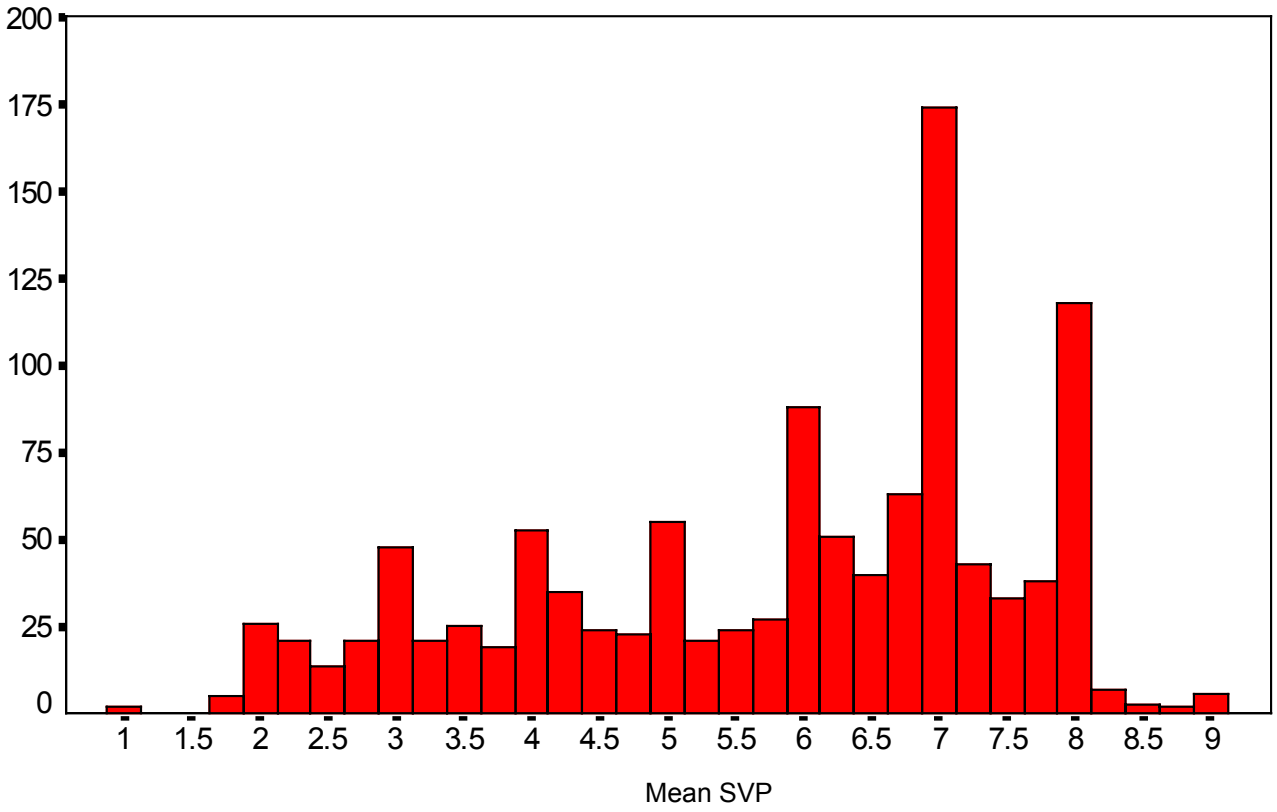

Figure 1. **Number of OUs at each possible range of mean SVP**

Operational Strata

What follows describes the conversion of the initial strata into the final operational strata used in the current O*NET tools (e.g., O*NET 98, O*NET Career Exploration Tools, etc.), including the move to estimated GATB aptitude scores, adjustment of stratification break points, and the logical reversal of stratification levels.

Aptitude Ratings vs. *Estimated GATB Aptitude Scores*. The Aptitude Rating data were used to assign an SVP rating to OUs with seven or more associated DOT job codes (see Steps 2 and 3 above in the Method section of this chapter). At the time the level metric was being identified, there were two sets of scores that were candidates for defining the ability profile for an OU: a) the Aptitude Ratings from the DOT and, b) the estimated GATB aptitude scores. Other analyses conducted during the development of the O*NET Career Exploration Tools demonstrated that GATB aptitudes could be predicted from information contained in the DOT with sufficient

Level	Time[1]
1	Short demonstration only
2	Anything beyond short demonstration up to and including 1 month
3	Over 1 month up to and including 3 months
4	Over 3 months up to and including 6 months
5	Over 6 months up to and including 1 year
6	Over 1 year up to and including 2 years
7	Over 2 years up to and including 4 years
8	Over 4 years up to and including 10 years
9	Over 10 years

[1]Time that applies to General Educational Development is not considered in estimating Specific Vocational Preparation.
Note. The levels of this scale are mutually exclusive and do not overlap.

***Figure 2*. Scale of Specific Vocational Preparation**

accuracy to justify their use.[5] It is more desirable to use the estimated GATB aptitude scores than the Aptitude Ratings to define an OU's ability profile. This is because users of O*NET can receive information about their abilities through their O*NET Ability Profiler scores (i.e., the O*NET Ability Profiler is the newest version of the GATB). Using this same type of profile to characterize the OUs means that the same ability information will be used to describe people and jobs. This makes the person/job linking process more direct.

Once it was decided to use the estimated GATB profiles, the three-step procedure described above for identifying the core DOT occupations within each multi-job OU was carried out using the estimated GATB scores in place of the Aptitude Ratings. Because the estimated profiles for each DOT occupation look a bit different from the corresponding Aptitude Rating profile, the principal component results differed across the two types of profiles. Therefore, the core DOT occupations within an OU identified when using the Aptitude Ratings were not necessarily the ones identified when using the estimated aptitude scores. Accordingly, the mean SVP value for each multiple-job OU had the potential to change. Even so, the overall distribution of SVP scores across the OUs changed very little.

[5] Regression equations were created to estimate the mean GATB aptitude scores for a *DOT* occupation from its *DOT* data. The equations were estimated using mean aptitude scores for occupations in the GATB validity database. A profile of estimated scores was generated for each *DOT* occupation.

SVP Cutoffs for Defining the Job Strata. Users of the DOT are accustomed to seeing integer values for SVP. Note that the initial strata were defined by fractional boundary SVP values (e.g., Stratum 1 contained all OUs with SVP values of 7.5 and above). Although fractional values make statistical sense, a pilot test of the system showed that they did not translate well to the operational setting. To maximize the familiarity of the strata boundaries to system users, a new stratification of OUs was conducted using integers for SVP boundaries.

In addition, the operational strata were ordered in a reverse fashion from the initial strata reported above, such that operational Stratum 1 now contains those OUs having the lowest values of SVP and Stratum 5 the highest.

Table 2
The Five Job Zones with Sample Occupational Units and their SVP Values

Job Zone 1: Mean SVP < 4.0 (k = 182 OUs)

OU Code	SVP	OU Title
65005	2.33	Bartenders
49017	2.33	Counter and Rental Clerks
87711	3.00	Highway Maintenance Workers
57311A	2.00	Couriers and Messengers
63021	2.00	Parking Enforcement Officers
66099D	3.00	Phlebotomists
98705	1.00	Refuse and Recyclable Material Collectors
93917A	3.00	Solderers
68021	2.00	Ushers, Lobby Attendants, and Ticket Takers
79999N	2.00	Yard Workers, Private Household

Job Zone 2: 4.0 ≤ Mean SVP < 6.0 (k = 265 OUs)

OU Code	SVP	OU Title
79017D	4.00	Aquarium Tank Attendants
87905	5.00	Blasters and Explosives Workers
97944	4.67	Crane and Tower Operators
87108	5.33	Drywall Installers
63002A	5.75	Fire Inspectors
34058E	5.50	Motor Racers
85128B	3.80	Oilers
66014	5.00	Psychiatric Aides
43008	5.50	Sales Agents, Real Estate
63032	4.25	Sheriffs and Deputy Sheriffs

Job Zone 3: 6.0 ≤ Mean SVP < 7.0 (k = 259 OUs)

OU Code	SVP	OU Title
79016	6.50	Animal Trainers
65021	6.60	Bakers, Bread and Pastry
39999C	6.00	City Planning Aides
53702	6.00	Court Clerks
32908	6.00	Dental Hygienists
79999D	6.83	Farmers
87811	6.67	Glaziers
55102	6.00	Legal Secretaries
21511E	6.50	Personnel Recruiters

Job Zone 4: 7.0 ≤ Mean SVP < 8.0 (k = 287 OUs)

OU Code	SVP	OU Title
21114A	7.83	Accountants
87102E	7.00	Boat Builders and Shipwrights
61099A	7.50	Chefs and Head Cooks
34002D	7.00	Editors
89914D	7.00	Film Laboratory Technicians
97702J	7.00	Commercial Helicopter Pilots
22135	7.50	Mechanical Engineers
43014A	7.00	Sales Agents, Securities and Commodities
31514	7.50	Vocational and Educational Counselors

Job Zone 5: 8.0 ≤ Mean SVP (k = 129 OUs)

OU Code	SVP	OU Title
27502	8.00	Clergy
15005A	8.50	College and University Administrators
27108J	8.00	Industrial-Organizational Psychologists
22308	8.00	Landscape Architects
34051	8.00	Musicians, Instrumental
97508	8.00	Pilots, Ship
32102J	9.00	Surgeons
32114B	8.00	Veterinarians
22105C	8.00	Welding Engineers

Finally, the label "Job Zone" was given to each of the strata to make the concept of job groupings more understandable to users. Thus, the five Job Zones used with the O*NET Career Exploration Tools present the user with five broad groupings of OUs that may be explored. Descriptions of the five operational strata (i.e., Job Zones) and their SVP boundaries are provided below. Sample OUs from each of the Job Zones are provided in Table 2 above. The actual Job Zone definitions that are used in the O*NET 98 Viewer and the Career Exploration Tools are presented in the Appendix.

Job Zone 1: 182 OUs {Boundary → mean SVP < 4.0}. This Job Zone represents the lowest level of educational and training preparation and includes occupations that require up to 3 months of training. It includes a large number of less complex service occupations, as well as materials handlers and machine/equipment tenders or operators.

Job Zone 2: 265 OUs {Boundary → 4.0 ≤ mean SVP < 6.0}. This Job Zone includes occupations that are judged to require more than 3 months, but not more than one year, of occupation-specific training. It includes a large number of service positions as well as clerical, maintenance, and operator positions.

Job Zone 3: 259 OUs {Boundary → 6.0 ≤ mean SVP < 7.0}. Occupations in this Job Zone require from one to two years of occupation-specific training. Many different kinds of technicians, administrative personnel, and skilled machine operators fall at this level.

Job Zone 4: 287 OUs {Boundary → 7.0 ≤ mean SVP < 8.0}. This Job Zone includes occupations that require more than two years, but typically not more than four years, of specific training and education. A large number of professional and technical occupations fall in this category, as well as a broad range of supervisory and management positions.

Job Zone 5: 129 OUs {Boundary → 8.0 ≤ mean SVP}. This Job Zone represents the highest level of preparation and includes occupations that would require more than 4 years of specific education and training for achieving at least an average level of performance in the occupation. This would include most engineers, scientists, and high level professional positions, as well as directors/managers of scientific or professional personnel and occupations that require a very high level of technical skill (e.g., airline pilot, concert musician).

Chapter 4. Preliminary Validation of SVP as a Means of Stratification

Introduction

This chapter describes a dual-panel rational review of the entire list of 1,122 O*NET occupational units that was conducted to identify misclassifications (i.e., to find occupations for which the OU-aggregated DOT-derived SVP rating resulted in a non-rational Job Zone assignment). The chapter concludes with a list of 33 such occupational units.

Rational Review—Panel I

One advantage of using a parameter such as SVP to begin the person/OU linkage is that the user may enter his or her *current* level of occupation-specific training and education, or the level that they *plan* to achieve at some future date. This helps users expand their career exploration by allowing them to explore a wide range of occupational possibilities. For example, the user can perform a certain amount of *what if* exploration (i.e., *what* occupations would open up, *if* the user reached a certain level of education and training). The "what if" speculations can be tempered by using the user's ability, work value, or interest profile to search for suitable occupations within the stratum. The Job Zones present the user with this option, thereby maximizing the capacity of O*NET to meet the user's needs.

Any advantage to using SVP in this way must be viewed with consideration given to its success at appropriately classifying occupations into Job Zones. To help assess the validity of the Job Zone assignments, a panel of occupational analysts was assembled to conduct a rational review of the Job Zone classification of each of the 1,122 O*NET occupations (OUs). Their specific task was to identify salient misclassifications. The panel had four occupational analysts and a chairperson serving as tie-breaker. Panel members reviewed materials describing the specific vocational preparation scale (U.S. Department of Labor, 1991b) used for the Job Zone classification. They also reviewed the specific criteria associated with each Job Zone—and re-visited these criteria each time they moved their attention from one Job Zone to another. Each analyst then independently examined the Job Zone level of each O*NET OU and identified misclassified occupations (first examining all available DOT-based and O*NET 98 Viewer-based information on these occupations). An occupation would automatically be considered misclassified if at least three of the four analysts identified it as such. If two of the four analysts rated the occupation misclassified, the chairperson would attempt to resolve the tie. If the chairperson could not resolve the tie, the occupation was submitted to another panel for resolution. The output of the first panel consisted of three lists: a list of 10 occupations for which three of the four analysts agreed to the nature and direction of misclassification, a list of 35 occupations for which only two of the four agreed and the chairperson was left to break the tie, and a list of 18 highly contentious occupations submitted to a second panel for resolution. This third list contained occupations for which two members of the panel felt *very strongly* about their obvious misclassification and two other members felt *just as strongly* in opposition. In sum, after the first panel, each of the 1,122 O*NET occupations identified as misclassified (by at least two panelists) ended up in one of three conditions: 10 obviously misclassified (according to

at least 3 of 4 panelists), 35 possibly misclassified (where the tiebreaking chair identified 13 as misclassified), and 18 contentious occupations (forwarded to a second panel for resolution).

Rational Review—Panel II

To address this third list (the 18 OUs in contention), a new panel was formed led by the same chair. Again, the chair was used as a tie-breaker. Ten of the 18 contentious occupations were identified as misclassified by this second panel. Adding in the 23 (i.e., 10 + 13) occupations identified by the first panel, this dual panel process identified a grand total of 33 occupations where a clear majority[6] of the evaluating analysts' assessments were indicative of clear misclassification (see Table 3). This represents less than 3% of the 1,122 occupations in the overall Job Zone classification.

The National O*NET Center considered the removal of these 33 occupations (where they were found) from the short-lists of examples[7] in the O*NET career exploration instruments and/or score reports. Only 25 of these 33 misclassified occupations were found to be in use as examples on these short-lists (see Table 4). Ultimately, they were replaced on the short-lists by occupations that were not misclassified (where such replacements were possible given the Master OU list). Where appropriate Job Zone/Value-relevant replacements were not available, the identified occupations were removed without replacement. This Job Zone classification problem forced the removal of 15 example occupations without replacement. On the positive side, this panel exercise suggests that over 97 % (or 1,089) of the O*NET occupations were reasonably classified into appropriate Job Zones by the SVP-based procedure described in this report.

[6] There were a total of nine analysts between these two panels. If the combined efforts of both panels were required to identify a misclassification (i.e., the OU was contentious), then at least five of these nine—including the chair—had to agree to the nature and direction of its misclassification. If the first panel alone accomplished the identification, then at least three of the five analysts—again including the chair—had to agree.

[7] When the full list of 1,122 OUs is sorted simultaneously by Job Zones and applicant attributes, some of these OU Job Zone/attribute clusters contain upwards of a hundred occupations. The National Center for O*NET Development prepared representative short-lists so that some users would not have to start their exploration with an overwhelming number of occupations. Master occupational lists are available to users interested in reviewing the full list of OUs sorted by Job Zone.

Table 3
Occupations Identified as Clearly Misclassified

		Suspicious Zone
85717B	Test Card and Circuit Board Repairers	1
27199B	Sociologists	3
25102	Systems Analysts, Electronic Data Processing	3
93926B	Rock Splitters	3
87808	Roofers	3
97905	Tank Car and Truck Loaders	3
87602	Carpet Installers	4
87105	Ceiling Tile Installers and Acoustical Carpenters	4
89908D	Exhibit Builders	4
89599B	Fur Garment Workers	4
89502D	Hat Patternmakers	4
89108	Machinists	4
89706	Paste-Up Workers	4
32517	Pharmacists	4
89712	Photoengravers	4
89715	Scanner Operators	4
89717	Strippers	4
34047F	Prompters	4
89905F	Potters	4
89721	Bookbinders	4
87402A	Painters, Construction and Maintenance	4
32999B	Pheresis Technicians	4
34058B	Athletic Trainers	5
89719A	Dot Etchers	5
87899C	Swimming Pool Installers and Servicers	5
22599E	Chemical Engineering Technicians	5
85999D	Gunsmiths	5
89121	Shipfitters	5
21505	Special Agents, Insurance	5
89705	Job Printers	5
92512	Offset Lithographic Press Setters and Set-Up Operators	5
92529C	Plate Finishers	5
85721	Powerhouse, Substation, and Relay Electricians	5

Table 4 ***Clearly Misclassified Occupations Found and Removed (or Replaced) from Short-Lists***

	Interests Score Report Replacement (if any)	**Values Score Report Replacement (if any)**
Test Card and Circuit Board Repairers		
Sociologists		Gamekeepers
Systems Analysts, Electronic Data Processing		Agricultural Crop Supervisor
Rock Splitters		Psychiatric Technicians
Roofers		Wine Stewards/Stewardesses
Carpet Installers		
Ceiling Tile Installers and Acoustical Carpenters		Power Distributors and Dispatchers
Machinists		Locomotive Engineer
Pharmacists	Physician's Assistants	Registered Nurses
Scanner Operators		Camera and Photographic Equipment Repairers
Prompters		
Bookbinders		
Painters, Construction and Maintenance	Petroleum Refinery and Control Panel Operators	
Pheresis Technicians		
Athletic Trainers		
Dot Etchers		
Swimming Pool Installers and Servicers		
Chemical Engineering Technicians		
Gunsmiths		Marine Architect
Shipfitters		
Special Agents, Insurance		
Job Printers		
Offset Lithographic Press Setters and Set-Up Operators		
Plate Finishers		
Powerhouse, Substation, and Relay Electricians		

Chapter 5. Summary and Conclusions

Summary of Methods and Results

The challenge was to develop a means of stratifying occupations in terms of their level of required vocational preparation. Since the *Dictionary of Occupational Titles* (DOT) provided estimated ratings for several occupational attributes that are related to vocational preparation requirements, the stratification effort first sought ways to determine which attributes best reflect vocational preparation. One of these DOT ratings (Specific Vocational Preparation or SVP) was found to capture the essential attribute desired for the stratification. To see if other DOT ratings might add substantially to the information conveyed by SVP, the analysis examined quantitative relationships between SVP and composite metrics built by adding other indices to SVP. Distributional properties of these metrics were also examined. At least one interpretation of these analyses suggested that SVP alone might be roughly as effective (in stratifying occupations) as the more complex composites. Given 1) the desire to stratify with as simple a system as possible (to enhance communication to the user), and 2) the desire to use a metric equally applicable to both occupations and people, SVP alone was chosen as the stratification method.

The next challenge involved moving the level of analysis from the highly specific DOT job codes (over 12,000 in number) to the broader O*NET occupational units or OUs (1,122 in number). Previous research provided the associations between the two occupational classification systems (i.e., the way the 12,000+ DOT codes were sorted under the 1,122 OUs). Principal components analysis (applied to Aptitude Requirement ratings associated with individual DOT job codes) was used to identify at least 25 percent of the DOT codes (associated with each OU) thought to reflect the *core* or essence of each OU in terms relevant to vocational preparation. The SVP ratings for each OU's core DOT codes were then averaged, and this average was assigned as an aggregated SVP rating for the associated OU. When parallel analysis efforts indicated that mean incumbent GATB aptitude scores could be estimated adequately from DOT data, these estimated scores were used in place of the actual DOT Aptitude Ratings. The principal components analysis just described was repeated using these estimated scores, and aggregated SVP ratings were re-calculated.

These aggregated SVP ratings were used to sort the OUs into five Job Zones defined as: 1) Little to No Preparation Needed, 2) Some Preparation Needed, 3) Medium Preparation Needed, 4) Considerable Preparation Needed, and 5) Extensive Preparation Needed (after assessing outcomes derived from alternative organizational structures). To preliminarily assess the validity of this five zone SVP-based approach, a dual-panel rational review of the entire list of 1,122 O*NET occupational units was conducted. Its specific task was to identify salient misclassifications (i.e., to find occupations where the OU-aggregated SVP ratings resulted in a non-rational Job Zone assignment).

Conclusions

After consideration of its simplicity, its equal applicability to both occupations and people, its distributional properties, and its comparability to alternative metrics, the SVP index from the DOT was found to provide an adequate means of stratifying occupations into understandable Job Zones. Likewise, incumbent GATB scores estimated from DOT data were found to be adequate for identifying representative DOT job codes for each occupational unit. Aggregate SVP ratings generated by averaging SVP ratings for the representative DOT job codes facilitated the classification of the 1,122 O*NET OUs into five Job Zones. Preliminary validation evidence for this process was provided by a dual-panel study. In this study, 97 percent of the OUs were found to be reasonably classified using aggregated SVP in a five-level stratification. From the entire set of 1,122 O*NET OUs, only 33 were identified as being improperly assigned to zones (i.e., clearly misclassified).

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Appendix

Job Zone Definitions as Presented in O*NET Tools

The five Job Zones are:

Job Zone 1 – occupations that need ***Little*** or ***No*** preparation
Job Zone 2 – occupations that need ***Some*** preparation
Job Zone 3 – occupations that need ***Medium*** preparation
Job Zone 4 – occupations that need ***Considerable*** preparation
Job Zone 5 – occupations that need ***Extensive*** preparation

Job Zone 1: Little or No Preparation Needed

Overall Experience -- No previous work-related skill, knowledge, or experience is needed for these occupations. For example, a person can become a general office clerk even if he/she has never worked in an office before.

Education -- These occupations may require a high school diploma or GED certificate. Some may require a formal training course to obtain a license.

Job Training -- Employees in these occupations need anywhere from a few days to a few months of training. Usually, an experienced worker could show you how to do the job.

Examples -- These occupations involve following instructions and helping others. Examples include *bus drivers, forest and conservation workers, general office clerks, home health aides*, and *waiters/waitresses.*

Job Zone 2: Some Preparation Needed

Overall Experience -- Some previous work-related skill, knowledge, or experience may be helpful in these occupations, but usually is <u>not</u> needed. For example, a drywall installer might benefit from experience installing drywall, but an inexperienced person could still learn to be an installer with little difficulty.

Education -- These occupations usually require a high school diploma and may require some vocational training or job-related course work. In some cases, an associate's or bachelor's degree could be needed.

Job Training -- Employees in these occupations need anywhere from a few months to one year of working with experienced employees.

Examples -- These occupations often involve using your knowledge and skills to help others. Examples include *drywall installers, fire inspectors, flight attendants, pharmacy technicians, retail salespersons,* and *tellers* .

Job Zone 3: Medium Preparation Needed

Overall Experience -- Previous work-related skill, knowledge, or experience is required for these occupations. For example, an electrician must have completed three or four years of apprenticeship or several years of vocational training, and often have passed a licensing exam, in order to perform the job.

Education -- Most occupations in this zone require training in vocational schools, related on-the-job experience, or an associate's degree. Some may require a bachelor's degree.

Job Training -- Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers.

Examples -- These occupations usually involve using communication and organizational skills to coordinate, supervise, manage, or train others to accomplish goals. Examples include *dental assistants, electricians, fish and game wardens, legal secretaries, personnel recruiters*, and *recreation workers*.

Job Zone 4: Considerable Preparation Needed

Overall Experience -- A minimum of two to four years of work-related skill, knowledge, or experience is needed for these occupations. For example, an accountant must complete four years of college and work for several years in accounting to be considered qualified.

Education -- Most of these occupations require a four-year bachelor's degree, but some do not.

Job Training -- Employees in these occupations usually need several years of work-related experience, on-the-job training, and/or vocational training.

Examples -- Many of these occupations involve coordinating, supervising, managing, or training others. Examples include *accountants, chefs and head cooks, computer programmers, historians,* and *police detectives* .

Job Zone 5: Extensive Preparation Needed

Overall Experience -- Extensive skill, knowledge, and experience are needed for these occupations. Many require more than five years of experience. For example, surgeons must complete four years of college and an additional five to seven years of specialized medical training to be able to do their job.

Education -- A bachelor's degree is the minimum formal education required for these occupations. However, many also require graduate school. For example, they may require a master's degree, and some require a Ph.D., M.D., or J.D. (law degree).

Job Training -- Employees may need some on-the-job training, but most of these occupations assume that the person will already have the required skills, knowledge, work-related experience, and/or training.

Examples -- These occupations often involve coordinating, training, supervising, or managing the activities of others to accomplish goals. Very advanced communication and organizational skills are required. Examples include *lawyers, instrumental musicians, physicists, counseling psychologists*, and *surgeons*.