

# The Case for Revising U.S. Occupational Classification Systems

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## Executive Summary

Occupational classification taxonomies in the United States support a wide range of important decisions, including career choices, disability assessments and alien labor certification judgments. Current occupational classification systems are often ill-suited for the intended purpose.

Most users of occupational information in the United States need to combine three things: (1) Accurate information about current job *requirements* (what workers do); (2) accurate information about the *qualifications* that are necessary to compete for these occupational opportunities (what workers need to know or be able to do); and (3) accurate information about *projected employment prospects* in these occupations.

A case is made here for consolidating occupational classification taxonomies in the United States. This case is balanced on two foundations. One foundation is *counting statistics*—figures that are reported in occupational cells. The other foundation is *transaction uses* (for example, career counseling or assessment and referral to job openings) each of which relies upon the three components of qualification, requirement and projected opportunity. The case for consolidation is developed using examples placed in historical and conceptual context.

The paper focuses on the *Dictionary of Occupational Titles* and the *Standard Occupational Classification Manual*. The DOT taxonomy was first released in 1939 to meet the day-to-day needs of local office personnel in State employment security agencies. A revised fourth edition was released in 1991. The SOC taxonomy first appeared in 1977. The perceived need was to establish a uniform federal standard for occupational classification. The intent was to require federal agencies to use the SOC taxonomy in the presentation of occupational statistics. The current taxonomy used in the Occupational Employment Statistics program of the Bureau of Labor Statistics, U.S. Department of Labor, offers one example of an occupational classification system that is similar to, but not fully compatible with, this SOC taxonomy. The 1991 revised fourth edition DOT describes nearly 13,000 occupations. The 1980 revised SOC manual collapses these into 663 occupational categories.

The 1991 *Dictionary of Occupational Titles* does not satisfy user needs with regard to the current job *requirements* and candidate *qualification* standards. Furthermore, incompatibilities in occupational classification taxonomies that appear in the Census, Standard Occupational Classification, Occupational Employment Statistics classification, and *Dictionary of Occupational Titles* classification, severely limit a user's ability to combine historical and projected occupational employment estimates with information about job requirements and expected employee qualifications.

A major goal of a coordinated DOT-SOC revision process will be to squeeze more value-added out of the combination of counting capability and definitional detail. The potential value-added that looms on the horizon appears particularly inviting this year, given the Clinton Administration's proposed initiatives to enhance the productivity of the Nation's workforce.

The transformation of potential value-added into an actual flow of benefits must involve collaboration between the Federal Government's primary producers of occupational employment *counting statistics* (the U.S. Department of Labor's Bureau of Labor Statistics and the U.S. Department of Commerce's Bureau of the Census) and the Federal Government's primary advocates on behalf of occupational information *transaction users* (the U.S. Department of Labor's Employment and Training Administration and the National Occupational Information Coordinating Committee).

Currently, two continuums of occupational information quality prevail—a *counting accuracy* continuum, and a *descriptive accuracy* continuum. A consolidated continuum of quality is proposed, which requires compromises between counting and descriptive priorities. Two possible alternatives to compromise are ruled out—(1) total consolidation of counting capability and descriptive elaboration, and (2) no consolidation of these two features (that is, the status quo).

The compromise proposed envisions a two-tier, partial consolidation, revision of occupational information taxonomies in the United States. Tier-one occupations would be selected for coverage in both counting and descriptive data collection activities. Transactions users could then be confident that the reported counts of actual or projected occupational incumbents can be associated

with the descriptors that are provided. Tier-two occupations would be considered for either counting or descriptive coverage, but not both.

Serious concerns would remain to be resolved. Reported occupational employment figures are derived from one set of establishment and household sources in a particular time pattern of collection and processing. Descriptors of job requirements and candidate qualifications are derived from different sources in a different time pattern of collection. This means that quality control audits would be required to assure that acceptable tolerances for these differences of origin are met.

Also, if descriptors drawn from a regularly updated database are associated with occupational employment figures derived from establishment and household sources, then the integrity of time-series data will be jeopardized.

Some tier-two (counting or descriptive coverage only) occupations might be retained for uses that are less demanding of precision in the representation of job requirement, candidate qualification or employment opportunity. The point here is that vendor or consumer combinations of such occupational information would be explicitly recognized as "forced fits."

Once a preliminary assignment of occupations to tier-one or tier-two status has been accomplished, the burden-of-proof will lie with user-advocates who seek the elevation of a tier-two occupation to tier-one status, or the retention/creation of an occupational designation in tier-two. A value-added standard should be used in reaching a decision about such appeals. Why, for example, retain counts without descriptive content, or why describe without an ability to quantify in actual or projected employment terms?

Adoption of the proposed two-tier approach to consolidation of occupational information taxonomies in the United States would trigger an immediate need to develop criteria for assigning occupational categories to one of three segments of the occupational spectrum—(1) a consolidated counting and descriptive quality segment; (2) an either-or segment, which will allow "forced fit" combinations that will be clearly recognized as such; and (3) a "do not retain or introduce" segment. These criteria will simultaneously reflect and motivate the value-added calculus that will be involved.

The dialogue must continue between competing claimants on the Federal funds that might be made available for revising occupational classification taxonomies in the United States, which will pit counting accuracy advocates against descriptive detail advocates. Strong leadership will be required to guide this debate to a timely and stable resolution. Few steps along the revision path should be taken until this issue is addressed.

The implications of the case for a consolidated revision of occupational information taxonomies in the United States are straightforward. It would be shortsighted to proceed with aggressive investments in the development

of skill standards, apprentice bridges between school and work, and renewal opportunities for displaced adults without providing an appropriate signal of Federal government commitment to the importance of occupational information as a beacon to light the way. At the same time, the Federal Government has an obligation to provide accurate occupational information in support of already existing programs.

The U.S. Department of Labor has been given leadership responsibility for creating a more productive workforce. One essential action in carrying out this assignment must be to renew the Employment and Training Administration's once strong commitment to collaborate with the Bureau of Labor Statistics to provide high quality and timely occupational information to those who affect, and those who are affected by, momentous decisions that determine life-chances, personal growth and well-being, and national pride and prosperity.

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### Introduction

An inspection of our Nation's sources of occupational information reveals important deficiencies. Our occupational classification taxonomies support a wide range of important decisions, including career choices, disability assessments, and alien labor certification judgments. These occupational classification systems are often ill-suited for the intended purpose.

Most uses of occupational information follow a similar pattern—a person's qualifications are compared with job requirements in a context of projected opportunity. These three seemingly straightforward components of use—qualification, requirement, and need—are deceptive. It is not easy to combine any two of the three. It is particularly difficult to combine all three. Yet, all three must be combined in most uses of occupational information.

Consider the following scenario. Your daughter is being encouraged by her high-school biology teacher to consider a career in the biological sciences. During a scheduled meeting with her counselor, the *Dictionary of Occupational Titles*<sup>1</sup> is brought out. Turning to the section titled "Occupations in Biological Sciences," you are shown 28 occupational titles and definitions. These

include biologist, pharmacologist, zoologist, and herbarium worker.

You note that the date-of-last-update for 22 of these 28 occupational definitions was 1977, so you ask the counselor whether this is the most recent information that is available. The counselor pulls a copy of the *Occupational Outlook Handbook*<sup>2</sup> from a shelf, and you read that "biological scientists held about 62,000 jobs in 1990. In addition, about half as many held biology faculty positions in colleges and universities." You also read that "advances in basic biological knowledge, especially at the genetic level, have given rise to the new field of biotechnology."

Your daughter expresses particular interest in possible career opportunities in biotechnology. You ask how many of the estimated 62,000 biological scientist jobs in 1990 were in this emerging specialty. Reference to newly available 1990 census data is disappointing—all "biological and life scientists" are grouped together in a single occupational category.

Unable to acquire a more precise understanding of job opportunities in the biotechnology field, your daughter asks what preparation is required to become a "biological or life scientist." Referring back to the *Dictionary of Occupational Titles*, the counselor finds that the 28 occupations in biological sciences indicate a preparation time ranging from "over 6 months up to and including 1 year" to "over 10 years." You ask whether this means years of schooling, and are told that it includes any combination of vocational education, apprenticeship training, in-plant training, on-the-job training, and essential experience in other jobs.<sup>3</sup>

By now, your daughter is confused and frustrated.

Recalling the past year's rhetoric about the importance of the Nation's workforce competencies, is it possible that so little can be said about career opportunities in such an important field? Yes, it is possible, for this and most other sectors of the economy.

It is not easy to obtain accurate information about job requirements.<sup>4</sup> It is difficult to acquire up-to-date information about how people qualify to enter many occupations. And, even when information about requirement and qualification is available, it often is impossible to determine what opportunities are projected to be available for those who choose a particular career path.

This paper builds a case for consolidating U.S. occupational classification systems. Like a catamaran, this case rests on twin hulls. One foundation is *counting statistics*—figures, such as census data, that are reported in occupational "cells." Published occupational figures mask within-cell differences that cannot be detected in a practical way using today's collection methods and classification systems.

The other foundation is *transaction uses*—such as career counseling, assessment and referral to job openings, and alien worker certification, each of which relies upon

the three components mentioned earlier (personal qualification, job requirement, and projected opportunity).

Today's hulls don't match. The occupational information vessel is not seaworthy. This isn't surprising. Independent design teams, with different specifications, worked on each hull. Therefore, this paper also builds a case for future collaboration between the Federal agencies that have primary responsibility for counting statistics and transaction uses, respectively.

The case for consolidation and collaboration is built through a series of examples placed in historical and conceptual context. We begin with some basics—brief descriptions of the *Dictionary of Occupational Titles* (DOT) and Standard Occupational Classification (SOC) systems.

### The 9-digit Dictionary of Occupational Titles taxonomy

The first edition of the DOT appeared in 1939. It was created to meet the day-to-day needs of local office personnel in State Employment Security Agencies, who record the qualifications of job-seeking registrants and the requirements of employers who submit job orders. This first edition contained approximately 17,500 occupational definitions.

A second edition of the DOT was released in 1949, providing first-time coverage of new occupations that had emerged during and immediately after World War II. A third edition appeared in 1965. It substituted the current "nature of the work performed" classification criterion for a previous three-tier pyramid of skill level.<sup>5</sup> A fourth edition was published in 1977. It introduced several thousand new occupational definitions and modified others based on extensive job analyses. Two supplements to this fourth edition, which appeared in 1982 and 1986, continued the effort to provide up-to-date modifications and additions of occupational descriptions. A revised fourth edition, released in 1991, consolidated the 1977, 1982, and 1986 releases, and provided additional definitional revisions. Currently, this revised fourth edition contains 12,741 occupational base titles and definitions.

The first three digits of a DOT code indicate an occupational group. The first digit represents nine "categories," the first two digits together represent 83 occupational "divisions," and the first three digits together represent 564 "groups." For instance, the three-digit DOT code 816 appears in the one-digit occupational category 8—"structural work occupations;" in the 2-digit occupational division 81—"welders, cutters, and related occupations;" and in the 3-digit occupational group 816—"thermal cutters and arc cutters."

The next three digits of a DOT code represent three Worker Function ratings of the tasks performed in an occupation—how an employee's responsibilities translate into data, people, and things relations (for example, comparing, compiling, or synthesizing data; helping, super-

vising, or mentoring *people*; and handling, driving-operating, or setting up *things*.)<sup>6</sup> For example, DOT code 816.364—arc cutter, requires compiling, speaking-signaling, and manipulating; while DOT code 816.482—thermal-cutting machine operator, requires computing, taking instructions-helping, and operating-controlling.<sup>7</sup>

The last three digits of a nine-digit DOT code represent a specific occupational base title.<sup>8</sup>

### The 4-digit Standard Occupational Classification taxonomy

Even before the first edition of the DOT appeared in 1939, work had begun on providing a translation “bridge” between this new occupational classification system and the 1940 census classification that would be used to organize the counting statistics that were about to be collected.<sup>9</sup>

Coincident with the appearance of the third edition DOT in 1965, the then Bureau of the Budget conducted an interagency survey that sought opinions on the need for a Standard Occupational Classification. The key word here is “standard.” The perceived need was to establish a uniform Federal standard for occupational classification, which would be comparable to the Standard Industrial Classification taxonomy. The intent was to require Federal agencies to use the proposed SOC taxonomy in the presentation of occupational statistics.<sup>10</sup>

Over the next decade, largely independent workgroups assembled the components of what would become the first SOC taxonomy, which was released in 1977. The workgroups had access to valuable reference materials, including the deliberations of the government-wide committee that designed the 1970 Census occupational classification system,<sup>11</sup> Canada’s *Classification and Dictionary of Occupations* that was first published in 1971,<sup>12</sup> the civil service classification, and the National Science Foundation’s classification of occupations in the sciences.

The resulting taxonomy<sup>13</sup> includes four levels: 22 divisions, 62 major groups, 214 minor groups, and 537 unit groups. Each of the 1977 fourth edition DOT base codes appears under one SOC major group, minor group, or unit group.

The level of detail provided is uneven.<sup>14</sup> For example, 10 percent of the unit groups (54 out of 537) are machine operators and tenders, while only 2 percent (13 out of 537) are technologists and technicians. The SOC division level category *Health Technologists and technicians* contains just one major group, six minor groups,<sup>15</sup> and no unit groups. All 13 of the technologist and technician unit groups referred to above appear in a different SOC division—“technologists and technicians, except health.” This contrasts with the SOC division level category “production working occupations,” which provides five major groups, seven minor groups, and 104 unit groups (more than half of which are the 54 machine operator and tender occupations referred to above).

Health technologist and technician jobs, and machine operator and tender jobs, have changed since the 1980 *Standard Occupational Classification Manual* was released. Each offers a compelling example of why it is time to revisit the SOC taxonomy.

Transaction uses of available occupational information, which range from career counseling, through disability determination and vocational rehabilitation planning, to alien labor certification, require more than a balanced representation of today’s occupations. Also needed are updated descriptions of the requirements of these occupations, and of the qualifications<sup>16</sup> that are necessary to be hired, retained and promoted. It is time to revisit the DOT taxonomy, too.

### The Need to Consolidate U.S. Occupational Classification Systems

The 1991 revised fourth edition DOT describes nearly 13,000 occupations. The 1980 revised SOC manual collapses these into 663<sup>17</sup> occupational categories. If the DOT occupations were distributed evenly among these SOC categories, then 19 DOT occupations would appear in each of the SOC’s occupational cells.<sup>18</sup>

The need for consolidation is illustrated with two examples. One example focuses on the difficulty that is encountered in trying to use occupational employment trend estimates for career counseling purposes. The second example looks at the problems that arise in trying to extract useful information about required competencies from available counting statistics. These are simply different perspectives on the fundamental problem that was identified at the beginning of the paper—the barriers that are encountered in trying to combine information about job requirements, candidate qualifications, and employment opportunity.

#### Example one

The 1980 *Standard Occupational Classification Manual* contains unit group 1636 computer engineers, which displays three DOT occupations.<sup>19</sup> None of these three DOT codes appears in the 1991 revised fourth edition *Dictionary*. Instead, the 1991 *Dictionary* presents a new division 03 computer-related occupations, which contains five new three-digit occupational groups.<sup>20</sup>

An alert user might be persistent enough to discover that one of the new three-digit occupational groups contains 9-digit occupational code 033.167–010. This 9-digit code displays a base title of computer systems hardware analyst. Alertness is required because three alternate titles are listed in lower-case print after the bold upper-case base title. One of these alternate titles is computer systems engineer.<sup>21</sup>

Can the 1991 *Dictionary*’s descriptions of requirements and qualifications<sup>22</sup> for code 033.167–010 be combined

with germane information about relevant occupational employment trends? The next four pages reveal how difficult it is to combine information about job requirement, candidate qualification, and employment opportunity.

The Division of Occupational Outlook, Office of Economic Growth and Employment Projections, Bureau of Labor Statistics, in the U.S. Department of Labor, prepares occupational projections using a six-step approach that begins with estimates of population and labor force participation rates, the size of the labor force, and assumptions about the Nation's aggregate economy, to produce industry-specific final demand estimates. These estimates are then used to drive an input-output model to derive industry-specific output estimates. These estimates, in turn, are used to derive industry-specific *employment* estimates, which are combined with occupational staffing pattern figures in an industry-occupation matrix to finally derive occupational employment estimates.<sup>23</sup> The Bureau's Occupational Employment Statistics (OES) program compiles the occupational staffing pattern information in cooperation with State Employment Security Agencies. A survey of establishments is conducted over a recurring three-year cycle, which covers the Nation's major industry sectors. This core source of information about wage and salary workers is supplemented by information about the self-employed that is collected in the Current Population Statistics program, and by other sources of occupational employment data.

The occupational designation of computer engineer was introduced as a new OES survey category in 1989. The 1989 version of the OES survey's 3-year cycle covered the mining, construction, finance, and services sectors. In the previous 2 survey years of 1987 and 1988, computer engineers were "hidden" within the then-existing alternative occupational categories of electrical and electronic engineers, and systems analysts and other engineers.

The Office of Employment Growth and Employment Projections in the Bureau of Labor Statistics published a 1990 occupational employment estimate of 346,855 other engineers. This includes an undisclosed number of computer engineers. This published category, other engineers, is a summation of seven occupational categories that are identified individually in the Bureau's industry-occupation matrix. These seven occupational categories are: Agricultural engineers, all other engineers, computer engineers, engineers, marine architects, marine engineers, and safety engineers-except mining.

It is possible, if one has access to the information maintained by the Bureau, to derive an estimate of employment for the occupational category computer engineers.<sup>24</sup> But, even if this step is successfully completed, there is still no direct link between this employment estimate and the *Dictionary's* descriptors of the occupational requirements for computer engineers, or with the

*Dictionary's* descriptors of the qualifications that are needed to become a computer engineer.

Recall that the 1980 *Standard Occupational Classification Manual* lists three DOT codes and titles for SOC unit group 1636 computer engineers, none of which was retained in the 1991 *Dictionary*. A cross-reference between the Occupational Employment Statistics program codes and the 1991 DOT codes provides some help. Two DOT occupational base codes and titles appear under the OES category 22127 computer engineers: DOT code 030.062-010 software engineer, and DOT code 033.167-010 computer systems hardware analyst.

Based on nothing more than the brief description of the 9-digit DOT taxonomy that was provided earlier in this paper, the following observations can be made.

- Both occupations appear in the same 2-digit DOT occupational division—computer-related occupations.
- The 3-digit DOT occupational group 030 includes occupations in systems analysis and programming.
- The 3-digit DOT occupational group 033 includes occupations in computer systems technical support.
- The 3-digit representation of work functions—the data, people, and things digits—indicates requirements of synthesizing, speaking-signalling, and operating-controlling for the software engineer occupational group, and coordinating, speaking-signalling, and handling for the computer systems hardware analyst occupational group.

We have no direct way to decide how to allocate a projected employment estimate for computer engineers between these two occupational groups. This is a serious limitation from a career counseling standpoint. The specific vocational preparation (SVP) designations for these two occupations are different, "more than 2 years up to and including 4 years" for the computer systems hardware analyst, and "more than 4 years up to and including 10 years" for the software engineer. The Guide for Occupational Exploration codes that have been assigned to these two occupations are different—with the first two digits indicating a "mechanical" interest area for a computer systems hardware analyst, and a "leading-influencing" interest area for a software engineer.<sup>25</sup>

This example reveals how difficult it is to combine the DOT's descriptive detail with the OES program's projection of future employment opportunity. From a transaction user's standpoint<sup>26</sup> access to either one alone is like trying to pilot a catamaran with only one hull.

The following barriers to a smooth combination of the three requirement, qualification, and opportunity components have been identified here:

- (1) The 1980 *Standard Occupational Classification Manual* does not provide an accurate list of currently available occupational codes, titles and

descriptors that are found in the 1991 *Dictionary of Occupational Titles*.

- (2) The 1991 *Dictionary* provides occupational descriptions that were last updated at different times between 1977 and 1990. Many of these descriptions were last updated in 1977. This is not considered to be "current" information by many transaction users of the information (for example, career counselors).<sup>27</sup>
- (3) The Bureau of Labor Statistics' Occupational Employment Statistics program does not provide published occupational employment projections at a level of detail that is consistent with the *Dictionary's* occupational groups, and occupational base titles and descriptions.
- (4) The Current Population Survey, and the decennial Census, are household surveys. These are relied upon for information about the self-employed, unpaid family workers, and wage and salary workers in agriculture, forestry, and fishing-hunting-trapping. Each provides less occupational detail than is possible through the establishment-based Occupational Employment Statistics survey.<sup>28</sup>

The first barrier mentioned above is trivial. It would be a straightforward task to list all of the DOT codes that have been created since 1977 in a new edition of the *SOC Manual*; particularly since an SOC code has already been assigned to each of these DOT codes (see endnote 11). But, remember that the SOC taxonomy is the Federal Government's standard for occupational classification. The SOC taxonomy itself cannot be changed without extensive interagency consultation. So, if today's computer-related occupations don't "fit" smoothly into an occupational classification taxonomy that hasn't been updated in 14 years, then a more complicated revision process must be considered. This is why "it is time to revisit the SOC taxonomy."

The second barrier, date-of-last-update of the *Dictionary's* occupational descriptions is the reason many experts advocate a "database" approach to revising the DOT's occupational descriptions. Today's electronic transmission capabilities would permit routine updating of occupational descriptions as new information is collected.<sup>29</sup>

The third barrier, incompatible occupational categories used in the presentation of occupational employment trend estimates and the *Dictionary's* descriptions of tasks and qualification requirements, highlights an inevitable tension among three considerations: (1) Limitations on the accuracy of occupational classification that arise when occupational information is collected;<sup>30</sup> (2) the level of aggregation, and related commitment of resources to data collection and processing, that is "satisfactory" to meet the needs of users of *counting statistics* only;<sup>31</sup> and (3) the level of aggregation, and related commitment of resources to data collection and processing, that is "satis-

factory" to meet the needs of users of occupational information for *transactions* purposes. This inevitable tension is a primary justification for advocating a carefully orchestrated collaboration among the producers and users of occupational information in undertaking a consolidated revision of U.S. occupational classification systems.

The fourth barrier, an inability to accurately represent the self-employed, and other groups, at a level of aggregation that is useful for transaction users of occupational information, might seem to pale in importance relative to the second and third barriers that have already been examined.<sup>32</sup> Caution should be exercised in reaching a hasty conclusion about the relative importance of the self-employed. The decennial Census and monthly Current Population Statistics data collection programs provide most of what is known about the self-employed in the United States. These data sources support limited comparative analyses of the educational attainment of self-employed and wage-and-salary incumbents in available occupational categories. But, because of the other barriers that have been described here, these investigations provide limited help for career counselors.

A consolidated revision of the occupational category computer engineer would involve a determination of what level of detail can be collected in self-reporting, proxy respondent, household interview,<sup>33</sup> and establishment reporting settings; and what task requirement and employee qualification descriptors are needed to satisfy transaction user needs (for example, career counselors, job placement specialists, and alien worker certification personnel). More is said about these two criteria for a revision of U.S. occupational classification systems in a later section of this paper.

### Example two

The previous section focused on the current inability to align counting statistics derived from the Census, Current Population Statistics, and Occupational Employment Statistics programs, with requirement and qualification descriptors that appear in the 1991 *Dictionary of Occupational Titles*. This second example adopts a different perspective to highlight a complementary reason why a consolidated revision of occupational classification taxonomies is needed. Currently, quite different combinations of task requirement and employee qualification are hidden beneath the surface within available counting statistics "cells."<sup>34</sup>

No one disagrees with the principle of within-group homogeneity, and its corollary of between-group difference. The important question is "homogeneous with respect to what?"<sup>35</sup> The Bureau of Labor Statistics<sup>36</sup> describes the problem.

Even with the knowledge of what SOC category a DOT occupation is in, users may not be able to relate the characteristics information from that DOT to specific SOC categories in many cases . . . [W]hen the

*DOT occupations equivalent to an SOC occupation contain heterogeneous job characteristic information (educational development, training requirements, language and math skills needed, physical requirements, etc.) there is no way to assign a characteristic at the SOC level (emphasis added).*<sup>37</sup>

This example uses the 1991 *Dictionary of Occupational Titles* 2-digit occupational division 81 welders, cutters, and related occupations. This occupational division contains eight 3-digit occupational groups and 55 9-digit occupational base titles and descriptions.

At the outset of presenting this example a second illustration of the "aggregation problem" is provided. The 1980 *Standard Occupational Classification Manual* separates the 53 out of 55 occupations that are grouped together in the 1991 *Dictionary's* 2-digit division into three 2-digit major groups and six 4-digit unit groups.<sup>38</sup> The distribution of DOT codes among these six unit groups ranges from 23 (43 percent) in one of the SOC's unit groups to 4 (7½ percent) in another of the SOC's unit groups.<sup>39</sup>

This aggregation and uneven distribution of more detailed occupations might not affect some transactions users if accurate *Dictionary* descriptors are available that indicate similar requirement and qualification levels for the "hidden" occupations.<sup>40</sup> Unfortunately, this is not the case for the *Dictionary's* 2-digit division 81 welders, cutters, and related occupations.

A tabulation of the *Dictionary's* record of date-of-last-update reveals that 47 out of the 55 occupations in this division (85 percent) have not been updated since 1977. Only four have been updated in the past 5 years. Technological progress and changes in the organization of work that have occurred over the 15 years that have elapsed since the last update of the 47 occupations are cause for skepticism about the accuracy of the descriptors that appear in this division of the 1991 *Dictionary*.

Each of the occupational descriptions in the 1991 *Dictionary* includes a specific vocational preparation (SVP) level, which "is defined as 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."<sup>41</sup> This is a nine-level scale, which ranges from "short demonstration only" to "over 10 years."

The 55 DOT codes that are collapsed into two 1990 Census codes, and which are aggregated into three published OES categories, reveal the following distribution of specific vocational preparation (SVP) values.

10 DOT codes (18 percent)	"anything beyond short demonstration up to and including 1 month"
2 DOT codes (4 percent)	"over 1 month up to and including 3 months"

8 DOT codes (14 percent)	"over 3 months up to and including 6 months"
15 DOT codes (28 percent)	"over 6 months up to and including 1 year"
9 DOT codes (16 percent)	"over 1 year up to and including 2 years"
9 DOT codes (16 percent)	"over 2 years up to and including 4 years"
2 DOT codes (4 percent)	"over 4 years up to and including 10 years"

Think about how a career counselor might be expected to react to the first three observations in this occupational example—85 percent of the pertinent occupations were last updated 15 years ago; SVP values represent a composite of vocational education, apprenticeship training, in-plant training, on-the-job training, and essential experience in other jobs; and the recorded SVP values range from "anything beyond short demonstration to 10 years." Consider the technological and organization of work changes that have occurred in recent years<sup>42</sup> during this thought experiment.

The *Dictionary's* occupational division 81 welders, cutters, and related occupations provides an excellent example of one important aspect of the organization of work issue,<sup>43</sup> as it affects the design of an occupational classification taxonomy—there is growing documentation of a wedge being driven between technician and supervisory knowledge.<sup>44</sup> This has two implications for occupational classification.

First, it suggests that historical promotion paths from craftsperson to supervisory status are being severed. Supervisors often no longer understand, nor can they perform, many of the tasks required of their subordinates. New legitimacy criteria must emerge to replace the previous awareness that the supervisor had once been a peer. Mobility chains are alleged to have changed dramatically. Little, if any, of this is reflected in the 1991 *Dictionary*. Supervisor, inspector, machine setter, machine operator, production line welder/solderer/brazer, and apprentice occupational descriptions each appear with a date-of-last-update of 1977. Furthermore, in moving from the *Dictionary's* codes and titles to the Census or OES sources of historical and projected employment figures, all of these are grouped together.<sup>45</sup> The realignment of mobility paths is occurring at both ends of a seniority/responsibility continuum. The new Administration proposes to substantially alter the entry-level apprentice's role in the U.S. economy. This increases the urgency of updating and reclassifying these segments of workforce responsibility.

The second implication of the wedge effect for occupational classification is that the craft occupations themselves have evolved to require more self-reliance and discretionary responsibility. Each of the 12,741 occupational definitions that appear in the 1991 *Dictionary* in-



clude a "definition trailer."<sup>46</sup> Two components of this definition trailer have already been introduced above: date-of-last-update, and specific vocational preparation. A third component of this definition trailer is General Educational Development (GED).<sup>47</sup>

General educational development embraces those aspects of education (formal and informal) which are required of the worker for satisfactory job performance. This is education of a general nature which does not have a recognized, fairly specific occupational objective. Ordinarily, such education is obtained in elementary school, high school, or college. However, it may be obtained from experience and self-study.

The GED scale is composed of three divisions: Reasoning development, mathematical development, and language development.

The GED ratings of the 55 occupations in the *Dictionary's* division 81 welders, cutters, and related occupations are presented below. The reasoning development and mathematical development scales have six levels, with 1 representing the least demanding requirement and 6 representing the most demanding requirement. The language development scale only has five levels.<sup>48</sup>

#### Reasoning development

Level 4	20 DOT codes	(36 percent)
Level 3	23 DOT codes	(42 percent)
Level 2	12 DOT codes	(22 percent)

#### Mathematical development

Level 4	9 DOT codes	(16 percent)
Level 3	27 DOT codes	(49 percent)
Level 2	14 DOT codes	(26 percent)
Level 1	5 DOT codes	( 9 percent)

#### Language development

Level 3	33 DOT codes	(60 percent)
Level 2	18 DOT codes	(33 percent)
Level 1	4 DOT codes	( 7 percent)

This distribution of GED levels provides a compelling example of how much occupation-specific descriptive content is lost when an attempt is made to combine the *Dictionary's* components with the *Standard Occupational Classification Manual's* aggregated classification of historical and projected employment figures.

Two additional observations warrant mention here. Continuing changes in the organization of work in the United States, which manifest themselves in the increased importance of employee self-reliance and discretionary authority, produce deep concern about transaction users of the *Dictionary* relying upon occupation-specific GED level requirements that were assigned 15 years ago (for 85 percent of the DOT codes in this example). And, the *Dictionary's* statement that "the description of the

various levels of language and mathematical development are based on the curricula taught in schools throughout the United States"<sup>49</sup> raises questions about the accuracy of representation of candidate qualification that results from continued use of the current GED scales; given well-documented differences in student performance across the Nation's school systems.

This example has documented three more barriers that affect the ability of transactions users of the Nation's occupational information to carry out their professional responsibilities in an effective and efficient manner.

- (1) The composite specific vocational preparation (SVP) component of the *Dictionary's* definition trailer exhibits substantial variance across DOT occupational categories that are aggregated within SOC occupations,<sup>50</sup> where this variance "disappears" from user accessibility.
- (2) The three-part scaling of general educational development (GED) also exhibits substantial variance across the DOT's occupations that are grouped into SOC, Census, and OES classifications of historical and projected occupational employment levels. These occupation-specific differences are therefore "hidden" from user view.
- (3) In many cases, it has been 15 years since these, and other descriptive components (for example, physical demands-strength ratings), have been updated.

The "lost variance" barriers arise when the *Dictionary's* occupational descriptors are hidden within less detailed occupational cells that are used in presenting historical and projected employment figures to the public. This is why immediate action to achieve compatibility of U.S. occupational classification taxonomies is endorsed.<sup>51</sup>

The consequences of the "outdated descriptive components" barrier are apparent to anyone who has made a decision, or influenced someone else's decision, based on currently available occupational information sources in the U.S.—whether this decision was with respect to a career path, a disability determination, a vocational rehabilitation plan, an alien worker certification judgment, a job referral opportunity, or a research investigation that might affect national policy.

The uneven pace of technological change across sectors of the U.S. economy, which has been accompanied by many sector-specific changes in the organization of work, combine to provide a compelling case that the *Dictionary's* current descriptive components are likely to be obsolete. This might have been acceptable in a less turbulent<sup>52</sup> period. It cannot be tolerated at a time when the Nation is about to embark on a new era of aggressive government investments in apprentice and displaced worker competencies.



## A synthesis of the examples

Two, very different, occupations were selected to illustrate the barriers that arise in daily use of U.S. occupational information sources. The computer engineer example illustrates the rapidly changing occupational category of professional, technical, and managerial occupations. The welders, cutters, and related occupations example reflects the equally turbulent occupational category of structural work occupations.

These two examples represent the targets of two initiatives of the new Administration in the United States, which will affect U.S. Department of Labor priorities: (1) Increased investment in life-long learning, which addresses the needs of displaced workers; and (2) increased investment in apprentice "bridges" between school and work, many of which will affect future entry paths into the structural work occupations. These are not aberrant cases. Other examples could have been substituted for these two.<sup>53</sup>

The following lessons have been highlighted up to this point.

- (1) Most users of occupational information in the U.S. need to combine three things: (1) Accurate information about current task requirements (what workers do); (2) accurate information about the qualifications that are necessary to compete for these occupational opportunities (what workers need to know or be able to do); and (3) accurate information about projected employment prospects in these occupations.
- (2) The 1991 *Dictionary of Occupational Titles* does not satisfy user needs with regard to the first two of these three requirements.
- (3) Incompatibilities in occupational classification that appear in the Census, Standard Occupational Classification, Occupational Employment Statistics classification, and *Dictionary of Occupational Titles* classification, severely limit a user's ability to combine historical and projected occupational employment estimates with information about job requirements and expected employee qualifications.

These facts, by themselves, constitute a strong case for revising U.S. occupational classification taxonomies. Additional reasons for acting now are provided in the following pages.

## More Reasons to Begin the Revision Process

### "Nature of the work performed" as a primary classification principle

Previously, in the second paragraph of page 3, it was noted that the 1965 third edition of the U.S. *Dictionary*

of *Occupational Titles* introduced a "nature of the work performed" criterion for classification, as a substitute for earlier reliance on a three-tier hierarchy of skill level. There is not universal agreement that this is a practical classification criterion. For example, Brian Embury, a principal member of the team that created Australia's Standard Classification of Occupations (ASCO), asserts that "there is no commonly accepted operational interpretation of this concept and hence classifications which claim to be based on this criterion vary widely in their structures."<sup>54</sup>

A 1992 paper released by Michigan's Occupational Analysis Field Center<sup>55</sup> notes that:

"The work performed components of the DOT are worker functions [data, people, and things], work fields, and materials, products, subject matter, and services (MPSMS). *The SOC does not define work performed, thus a consistent definition of work performed will be needed for a new, coordinated [occupational classification] system.* Although the classification principle of work performed applies to both the SOC and DOT, there are substantial differences between the systems. The current DOT separates occupations when the skill level, as indicated by worker functions GED, SVP, and other characteristics differ substantially. The current SOC has a hierarchy by skill level and groups some occupations in the same unit group that the current DOT considers to be at a substantially different level. Agreement will be needed on the work performed and/or descriptor factors which determine skill level, and how much similarity is required to assign occupations to the same group (emphasis added)."

### The relevance of industrial affiliation<sup>56</sup>

The 1991 *Dictionary of Occupational Titles* continues a tradition of using a DOT-specific coding of industry.<sup>57</sup> If a revision goal is a compatible classification of U.S. occupations, then continued use of a DOT-specific industry designation should be questioned. The Standard Industrial Classification (SIC) taxonomy should be considered as a substitute approach.

### Occupational "cell" size as a classification criterion

The 1991 *Dictionary's* 12,741 occupational definitions have been criticized for providing too many separate definitions for some occupational categories, and too few definitions for others.<sup>58</sup> Some experts have proposed that the Bureau of Labor Statistics' Occupational Employment Statistics program industry-occupation matrix should be used as one basis for assigning revision priorities to specific occupational "cells."

### Value-added versus value-lost

Any substantial revision of the Nation's occupational classification taxonomies will simultaneously diminish the

value of some current government and proprietary products and services and create many new opportunities to pursue value-added ventures.<sup>59</sup> The time lapse between a decision to revise and the ultimate appearance of new compatible occupational classification taxonomies will provide ample opportunity for inventories of current products to be depleted, and for investments to shift in anticipatory directions.

A major goal of a coordinated DOT-SOC revision process will be to squeeze more value-added out of the combination of counting capability and definitional detail. The latent value-added that looms on the horizon appears particularly inviting this year, given the new Administration's proposed initiatives to enhance the productivity of the Nation's workforce.

The transformation of latent value-added (a hypothetical quantity) into an actual flow of benefits must involve collaboration between the Federal Government's primary producers of occupational employment *counting statistics* (the U.S. Department of Labor's Bureau of Labor Statistics, and the U.S. Department of Commerce's Bureau of the Census), and the Federal Government's primary advocates on behalf of occupational information *transaction users* (the U.S. Department of Labor's Employment and Training Administration, and the National Occupational Information Coordinating Committee).

A long list of potential beneficiaries could be compiled. A short list of those who will produce the value-added data, if they are given access to higher quality occupational information than now exists to support their activities, includes career counselors, job placement personnel,<sup>60</sup> certification specialists, attorneys, advocacy groups, researchers, evaluators, planners, and managers.<sup>61</sup>

Up to this point, ad hoc examples of "transaction users" of occupational information have been introduced. The case for revising U.S. occupational classification systems is advanced in the next section by focusing on four "hot" initiatives—(1) the development of national skill standards and refinement of competency measurement instruments; (2) the refinement of occupational information system (OIS) and labor market information (LMI) content and availability; (3) improvement of disability determination and vocational rehabilitation assessment and counseling services; and (4) progress in carrying out alien worker certification procedures in a timely and fair way.

## Use-Specific Reasons to Act Now

### Skill standards and competency measurement initiatives

The U.S. Department of Labor and U.S. Department of Education recently commissioned 12 industry projects to demonstrate whether, and how, skill proficiency standards and measurement systems can be established for

selected occupations within the chosen industries.<sup>62</sup> If one or more of these demonstrations develops a prototype for routine adoption, then the career and vocational counseling community will want to combine evidence of occupation-specific imbalances in supply and demand flows with definitional detail reflecting current and projected job requirements and employee qualification expectations.

Skill proficiency standards inevitably reflect recent supply-demand dynamics. The qualifications of employees in "world class" enterprises are both a cause and an effect of the leadership designation. Incumbent qualifications are likely to be higher than the threshold requirement necessary to extract the same level of productivity—everybody loves a winner. However, from a career and vocational counseling perspective, it is necessary to project what qualifications will actually be required in a time- and place-specific context that is appropriate for a particular client. Credible projections of occupational employment and of the component descriptors of these occupations will be equally important for these users of occupational information. It would be unconscionable to proceed with initiatives of this kind without improving the management information that is available to allocate the new resources.<sup>63</sup>

### Labor market information (LMI) and occupational information system (OIS) refinements

The *Dictionary of Occupational Titles* has been of little relevance for the LMI community in the past, because of the inability to combine the descriptive richness of the DOT with the essential ability to distribute historical and projected employment estimates by these codes. Much of the speculation about structural changes in the U.S. economy, and what these changes mean for particular groups, has relied upon assembled data sources that are often poorly suited for the application.<sup>64</sup>

The proposed apprentice, skill standards, displaced worker, and life-long learning initiatives raise the stakes for those who manage the Nation's public and private LMI and OIS activities—the payoff to providing timely and accurate information will be higher than ever before, but so will the costs of inaction. The implication is clear; act quickly.

### Disability determination and vocational rehabilitation

The Americans With Disabilities Act of 1990 (ADA) requires affected employers to make reasonable accommodations to permit individuals with disabilities to compete for positions if they can perform the *essential functions* of the position.<sup>65</sup> This increases interest in the position-specific differences that are masked in the DOT's aggregation of on-site job analyses to occupations.

Even before the ADA's position-specific requirements, there has long been a need to assess the extent and consequences of a loss of occupational capacity. Assessment of the "extent of loss of occupational capacity"

requires accurate information about the essential tasks that must be performed, and the discretionary tasks that might be transferred to another employee if they cannot be performed by the person whose diminished occupational capacity is being assessed.

The determination of "loss of occupational capacity" is the first step of a two-step assessment process. The second step is to devise a vocational rehabilitation plan. This requires a direct blending of knowledge about the DOT's definitional components with employment estimates for occupations that display the relevant values of these factors. Such information is not currently available in the United States. It doesn't matter how many similar employment opportunities have been lost in the first step "loss of occupational capacity" determination. But, when rehabilitation need is on the table, a credible estimate of projected occupational employment possibilities should be available to those who must decide what action to take.

None of the U.S. occupational classification taxonomies is intended to provide the position-specific detail that is required by a disabled client's vocational rehabilitation counselor. However, compatibility of these occupational classification taxonomies would permit such counselors to combine estimates of future occupational employment opportunities with the essential descriptors of task and employee qualification requirements. This combination of the three fundamental components of transaction use is not possible today.

The Americans With Disabilities Act of 1990 created a unique criterion for occupational classification in the United States. This provides an impetus for revision that is not found in other countries. At the same time, it presents an opportunity to demonstrate to the international community how a truly pioneering advance of occupational classification taxonomies can be accomplished.

### Allen worker certification

This use of occupational information combines information about candidate qualification and employer requirement in a place-specific context, which is a detail-intensive application. The precision of classification is crucial to the determination of certification eligibility. The certification decision depends upon the absence of evidence of other available qualified resident candidates for the position, and upon documentation that the compensation offered is consistent with the prevailing level in the particular local labor market. Any redefinition of current occupational classification taxonomies will affect the alien labor certification procedure.<sup>66</sup>

This transaction use of occupational information is particularly interesting because the documentation of candidate qualification comes from non-U.S. sources in most cases. This means that the alignment of job requirement and candidate qualification is even more difficult than it is for students who are emerging from the Nation's

diverse school systems, or for displaced workers who have varied work histories with poorly documented formal and informal work-based learning records.

### From compelling problem to a proposed response

Up to this point, evidence has been assembled to make the case for updating and increasing the compatibility of the Nation's occupational classification taxonomies. This case has used examples of our current inability to combine information about job requirements, candidate qualifications and employment opportunity—that is, to combine actual counts, or estimates, of occupational opportunities with descriptors of requirements that must be met to qualify for these opportunities and of candidates whose qualifications satisfy these requirements.

The next section explores actions that can be taken to advance the compatibility of occupational classification taxonomies in the United States. This section elaborates upon a theme that was expressed earlier in this paper—*"... to squeeze more value-added out of the combination of counting capability and definitional detail,"* (emphasis added).

## Toward Compatible Occupational Classification Taxonomies

### A conceptual framework for thinking about alternative approaches

Assume that the amount of money that will be available for revising and maintaining new occupational classification taxonomies in the United States is known. This simplifies matters here because it does not allow funding to be contingent on the approach that is promoted.

The availability of a known budget allocation forces us to think in terms of tradeoffs. All actions have cost consequences. Each decision to enhance one component of occupational information availability means that other features will be left alone.

Now, visualize a linear peg-board of all occupations in the United States, with *counting accuracy* at one end and *descriptive detail* at the other end. There are two rows of occupational pegs. In one row the occupational pegs nearest to the *counting accuracy* end of the peg-board exhibit the most accurate (timely and precise) information about employment opportunity in the represented occupations.<sup>67</sup> In the second row the occupational pegs nearest to the *descriptive detail* end of the peg-board exhibit the most comprehensive understanding of job requirements and candidate qualifications. Some occupational categories appear in both rows, but there are many empty holes in each of the rows. These empty holes indicate that no counting information, or no descriptive detail, is available for these occupational categories.

This peg-board metaphor highlights the fixed-budget tradeoff between these two features of occupational infor-

mation in the United States. The catamaran metaphor expressed this tension by identifying two competing interest groups—those who want accurate occupational employment figures (the counters), and those who want extensive descriptive information about these occupational employment cells (the transaction users).

Pursuit of a routine capacity to combine information about job requirements, candidate qualifications and employment opportunity can be thought of as rearranging the pegs on this *counting accuracy-descriptive detail* peg-board. However, all combinations along the peg-board are not accessible. There is an important constraint that has not been mentioned—there is a practical limit on the level of occupational detail that can be used in different data collection approaches.<sup>68</sup> Think of this limit as identifying one occupational peg somewhere along the board, which will serve as a “marker,” or locked-gate, that cannot be passed. The location of this choice might be advanced toward the *descriptive detail* end of the board by increasing the budget for data collection, but a decreasing marginal returns phenomenon would be expected to limit the range of possible advance in this direction.

Another important feature of this occupational peg-board should be revealed. The location of each occupational peg on the board is not predetermined. Given a known budget allocation, and cost estimates for different mixes of data collection approaches, it is possible to derive an estimate of *how many* occupational employment estimates can be provided. However, this does not reveal *which* occupational incumbents are to be covered.<sup>69</sup> The peg that serves as a locked-gate only determines how many occupational categories can be covered in the counting statistics, not which occupations are covered.

### Placing SOC and DOT occupational pegs on a new board

Currently, two different quality continuums (rows of occupational pegs) appear on the United States’ occupational peg-board. One continuum of quality (row of pegs) records *counting* accuracy. A second continuum of quality (row of pegs) records *descriptive* accuracy. A third continuum of quality can be created by combining each of these. However, again, an important constraint must be acknowledged—relatively few “clean” combinations exist. The examples presented earlier in this paper document the problem. Even the “clean” combinations that can be accomplished are artifacts of past decisions that may bear little relevance to today’s needs and to future priorities.

Consider, then, moving occupational pegs from the current board to a new peg-board that has only one row of holes. On this new board there is only one continuum of quality—a combination of counting accuracy and descriptive detail. Since some occupational categories are currently represented by two pegs—one that indicates

the quality of counting measurement, and a second that measures the quality of descriptive detail, a decision-rule must be established for this substitution of a single quality priority for the previous two (see below). Many occupational categories are currently represented by only one peg—*either* a counting continuum peg, *or* a descriptive detail peg; but not both.

Some pegs will be moved as is (that is, their definitions will not be changed), albeit to a different position in many cases. Some, perhaps many, occupational pegs will be left behind. New occupational pegs will be designated; sometimes as substitutes for combinations of those that are to be left behind.

Decision-rules are needed. Two possible decisions are ruled out here.

- (1) *Full Consolidation* (of counting capability and descriptive elaboration), which is ruled out because of the high costs and limited benefits that would result from this approach. The accuracy of data collection constraint would combine with a plausible estimate of available funds to limit the number of occupational categories to a level that would be unacceptable to current users of counting statistics or to transactions users. Consider two ways in which full consolidation might be attempted.
  - (a) Provide for a *small* increase in the number of occupational counting cells (from the current level of 775 Occupational Employment Statistics survey categories, plus the Current Population Survey and decennial Census categories that are relied upon) combined with a *drastic* cut in the *Dictionary’s* number of occupational descriptions.
  - (b) Provide for a *major* increase in the number of occupational counting cells combined with a *major* decrease in the number of *Dictionary* occupational descriptions.

It is unlikely that either of these approaches will attract widespread support. The first will be resisted by transactions users, and perhaps by some vendors of *Dictionary*-dependent products and services (although other vendors will see an opportunity here). The second will be resisted by the agencies that are responsible for collecting occupational employment data, who will question the ability to maintain appropriate quality standards, and who will be skeptical of Congress’ willingness to provide the necessary resources to carry out such an expansion.

- (2) *No Consolidation* (of counting capability and descriptive elaboration), which is ruled out for the reasons that have been developed throughout this paper—transaction users require information about employment opportunity, job requirement and candidate qualification. There are many uses of count-

ing statistics that do not require descriptive elaboration, but there are few, if any, transaction uses that do not require some measure of employment opportunity.

A third, compromise, approach is likely to receive widespread endorsement.

- (3) *Partial Consolidation* (of counting capability and descriptive elaboration), which would result in a two-tier production of occupational information in the United States.

(a) *Tier One.* Occupations would be selected for coverage in both *counting* and *descriptive* data collection activities. Possible criteria for choosing such occupations are introduced below. Transactions users could be confident that the reported counts of occupational incumbents can be associated with the descriptors that are provided. Serious concerns remain to be resolved if this approach is to be recommended for adoption by the Federal Government.

(1) The counts of occupational incumbents are derived from one set of establishment and household sources in a particular time pattern of collection and processing, and the descriptors are derived from different sources in a different time pattern of collection. This means that quality control audits would be required to assure that acceptable tolerances for these differences of origin are met.

(2) To the extent that descriptors drawn from a routinely updated database of occupational information are associated with occupational employment counts, the integrity of time-series data will be jeopardized.<sup>70</sup>

(b) *Tier Two.* Remaining occupations would be considered for *counting* or *descriptive* coverage, but not both. A rigorous review of these occupational categories would be undertaken with two objectives.

(1) Some occupations that did not make the cut for truly consolidated coverage in both counting and descriptive respects might be selected for counting or transaction uses that are less demanding of precision in the representation of job requirement, candidate qualification, or employment opportunity.<sup>71</sup>

(2) Other occupations that did not make the cut for consolidated coverage, or even for less-precise applications that require both counting coverage and descriptive representation, might warrant continued attention. The burden of proof in this

case lies with the users of such information—why retain counts without descriptive content, and why describe without an ability to quantify in employment terms?

### Criteria for assigning occupational classification priorities

A chicken-and-egg dilemma arises here—it would be nice to have better information to support the decisions that must be made to improve the quality of available occupational information in the United States!

The *size of an occupational employment cell* is one obvious criterion to consider for deciding whether an occupation should be elevated to the proposed new peg-board's consolidated segment. This is the preferred assignment in the Nation's future occupational classification taxonomies. It means that an occupation is thought to be important enough to invest in acquiring accurate information about job requirements, candidate qualifications, and employment opportunities. The problem is that the current, often incompatible, occupational classification taxonomies do not allow us to determine the current or projected employment levels for many occupations that might be considered to be candidates for this elevated status in a new consolidated taxonomy.

This is just one manifestation of the difficulty that arises in trying to calculate the value-added payoff to specific choices of occupations that would be given preferred status in the new consolidated occupational taxonomy. It is somewhat easier to establish rankings of priorities within use-specific applications of occupational information than it is to compare across these rankings. And, even within a given use-specific ranking, it is difficult to apply such metrics as "twice as important."

High school career counselors seek accurate counting and descriptive information about entry-level opportunities, but with what geographic and time parameters? And with what combinations of high school curriculum, competency attainment, postsecondary educational pursuit, and coincident or sequential work-based learning?

Counselors of adults who have lost their jobs, or who are in real or imagined jeopardy, seek related, but somewhat different occupational information. They want to know more about school-based and work-site learning opportunities, both separately and as packages. They want to know more about how previous employee responsibilities might be used in a new work setting.

Both of these types of counselor want to know about mobility paths beyond the entry-level gate into new employment. What are the prospects for promotion, and what can be done to enhance these prospects? How can clients protect themselves from the threat of layoff; or, once separated, improve their likelihood of finding another job quickly?

Another criterion for selecting preferred occupational categories for consolidation is the *probability of multiple uses* of the improved data. This would inevitably require the implicit or explicit assignment of relative importance to particular uses of occupational information.

### Required actions

It seems unlikely that available funds will be concentrated on consolidated occupational categories alone, although substantial attention to this effort is endorsed. Similarly, it appears to be unlikely that total inaction on the consolidation front will continue. This leaves the two-tier partial consolidation approach as the likely choice for Federal action.

Selection of the two-tier partial consolidation approach will trigger an immediate need to develop criteria for assigning occupational categories to one of three segments of the occupational continuum:

- (1) The consolidated segment;
- (2) A "retain for less precise forced-fit of counting statistics and occupational descriptors" segment; and
- (3) A "consider for termination" segment.

Two such criteria, albeit imperfect ones, have been identified here:

- (1) Current or projected estimates of occupational employment cell size; and
- (2) Probability of multiple uses.

At the same early stage of the revision process, a start must be made on calculating net value-added estimates for particular assignments of occupational categories to each of these three segments. This will not be easy. Costs of data collection with respect to any one occupational category will be dependent upon decisions that are unlikely to be made this early in the process—such as technologies to be adopted, frequency of collection, quality control standards to be imposed, and cost-sharing prospects within the Federal Government, and between the Federal Government and other governmental levels, vendors and users of occupational information.

The dialogue about counting accuracy versus descriptive detail, between competing claimants on available funds, will be contentious. Strong leadership will be required to guide this debate to a timely and stable resolution. Few steps along the revision path can be taken until this issue is addressed and a decision is made.

## Classification Problems, Consequences, and Implications

This paper has built a case for revising U.S. occupational classification taxonomies by documenting fundamental problems that arise from today's incompatible classification systems.

The case was then strengthened by providing use-specific examples of the consequences of these deficiencies. A diverse range of examples has been provided, covering national skill standards and competency measurement initiatives; labor market information and occupational information system shortcomings; disability determination and vocational rehabilitation needs; and alien worker certification regulations and procedures.

The implications of this case are straightforward. It would be shortsighted to proceed with aggressive investments in the development of skill standards, apprentice bridges between school and work, and renewal opportunities for displaced workers without providing an appropriate signal of Federal Government commitment to the importance of occupational information as a beacon to guide the way. At the same time, the Federal Government has an obligation to provide accurate occupational information in support of already existing programs.

The U.S. Department of Labor has been given leadership responsibility for creating a more productive workforce. One essential action in carrying out this assignment must be to renew the Employment and Training Administration's once strong commitment to collaborate with the Bureau of Labor Statistics to provide high quality, and timely, occupational information to those who affect, and those who are affected by, momentous decisions that determine life-chances, personal growth and well-being, and national pride and prosperity. Each of us has heard the sagas of military maneuvers that succeeded or failed based on the quality and timely availability of intelligence. Managers of non-military advances, too, must have better intelligence than their adversaries.

## Notes

<sup>1</sup> Employment and Training Administration (1991), *Dictionary of Occupational Titles*, Revised Fourth Edition, Volume I, Washington, DC: U.S. Department of Labor, pp. 48–50.

<sup>2</sup> U.S. Department of Labor, Bureau of Labor Statistics (1992), *Occupational Outlook Handbook*, 1992–93 Edition, Bulletin 2400, May 1992, Washington, DC, pp. 89–91.

<sup>3</sup> *Dictionary of Occupational Titles* (1991), Volume II, appendix C: "Components of the Definitional Trailer," p. 1009.

<sup>4</sup> The *Occupational Outlook Handbook's* coverage of biological scientists includes a section titled "Sources of Additional Information," which lists the names and addresses for six professional associations (for example, the American Society for Biochemistry and Molecular Biology, and the American Society for Microbiology). Similar information is presented for each of the occupations that are highlighted in the *Handbook*.

<sup>5</sup> The director of the early research that was undertaken to develop the third edition of the *Dictionary of Occupational Titles* published his thoughts about the importance of the "nature of the work performed" criterion for classification. Sidney A. Fine (1968), *The 1965 Third Edition of the Dictionary of Occupational Titles—Content, Contrasts, and Critique*, Kalamazoo, MI: The W.E. Upjohn Institute for Employment Research, pp. 4–5, reports that (the first three digits of the third edition DOT code) "describes what gets done in the world of work. The second three digits classify people functioning in technology, that is, what workers do. This is the first major new development. Until the publication of the third edition of the *Dictionary*, all occupations were classified as though they were completely and totally dominated by technology. In the new *Dictionary*, the classification of people functioning is integral to the basic classification system—thus it is a classification of human involvement in work as well as of technology. This is a major change of great importance. People have been put back into jobs. Jobs are now job-worker situations. The full impact of this change is likely to take years to be appreciated fully—and also years to be developed further."

<sup>6</sup> The revised fourth edition *Dictionary of Occupational Titles*, Volume I, p. xix, reports that "as a general rule, Worker Functions involving more complex responsibility and judgment are assigned lower numbers in these three lists while functions which are less complicated have higher numbers." Karl F. Botterbusch (1992), "Suggestions for Revisions in the *Dictionary of Occupational Titles*," Menomonie, WI: Vocational Counseling Associates, p. 5, provides the following insights about the data, people, and things worker functions: (1) The data scaling is a single hierarchical continuum, the people scaling is not a hierarchy at all, and the things scaling is actually two hierarchies; (2) it cannot be assumed that the assignment of a lower number (that is, a "higher" rating) on any of these can be presumed to indicate competence at a higher number (that is, a "lower" rating); and (3) summations across these independent scalings are inappropriate. These cautions are not followed by many, even expert, users of the *Dictionary*.

<sup>7</sup> Actually, these were the requirements in 1977, which is the date-of-last-update for each of these occupations. Fifteen years of technological progress and reorganization

of work settings have elapsed since these field observations were made.

<sup>8</sup> Combinations of the last three digits of a DOT code are sequenced in multiples of four, beginning with 010, alphabetically for those occupational base titles that existed when the fourth edition DOT was prepared in 1977, and sequentially thereafter for base titles that have been added since then. For example, DOT code 692.682 includes occupations in the fabrication of products from assorted materials, which require the worker functions of comparing data, taking instructions from and helping people, and operating-controlling things. Sixteen different occupational base titles and definitions appear in the revised fourth edition *Dictionary of Occupational Titles*, Volume II, pp. 669–670, for code 692.682. These range from 692.682–010 ankle-patch molder to 692.682–070 twisting-machine operator. Broken sequences of the "multiple of four" rule in the 1991 revised fourth edition *Dictionary* indicate that some occupational base titles that appeared in the 1977 fourth edition *Dictionary* have been deleted.

<sup>9</sup> See: Gladys L. Palmer (1939), "The Convertibility List of Occupations and the Problems of Developing It," *Journal of the American Statistical Association*, 34:208 (December 1939), pp. 693–708.

<sup>10</sup> The manager of the original SOC recalls, in personal correspondence addressed to the author dated February 1993, that "I wrote a directive that requires agencies to use the SOC in data collection programs, but also states that use of the SOC for programmatic use is at the discretion of the agency. I do not remember any opposition to the directive."

<sup>11</sup> This committee was a precursor of the 24-member Occupational Classification Committee that contributed to the development of the SOC taxonomy. There is a long-standing tradition of interagency collaboration in the development of occupational classification systems in the U.S. (cf., Gladys L. Palmer, *loc cit*; and U.S. Department of Labor, Bureau of Labor Statistics (1992), *Standard Occupational Classification System: Current Status and Recommendations for the Future*, Washington, DC: July 23, 1992, p. 4, which reports that "occupations added to the DOT since 1980 have been assigned SOC codes through a cooperative effort by the Employment and Training Administration (ETA) DOT staff and the Bureau of Labor Statistics' (BLS) Occupational Employment Statistics staff. These assignments have not been added officially to the SOC since no amendments or supplements have been authorized. The assignment of new DOT occupations to SOC codes has become more difficult over time. Often these new occupations involve skills and/or job duties which did not exist when the 1980 SOC was developed."

<sup>12</sup> See: David W. Stevens (1991), *Canada's National Occupational Classification Taxonomy*, Washington, DC: Advisory Panel for the *Dictionary of Occupational Titles*,



Appendix p. 1, which describes this four-level classification of approximately 7,000 occupational descriptions. Canada's aggressive labor market policies of the mid-1960's had increased interest in creating a single multi-purpose classification taxonomy. This lesson should not be ignored as the United States embarks on its own "more aggressive" workforce agenda in the mid-1990's.

<sup>13</sup>The original 1977 SOC taxonomy has been revised once—in 1980. See: U.S. Department of Commerce, Office of Federal Statistical Policy and Standards (1980), *Standard Occupational Classification Manual*, Washington, DC. U.S. Department of Labor, Bureau of Labor Statistics (1992), *op cit*, pp. 8–9, reports that "in response to the introduction of the 1980 SOC, the OES [Occupational Employment Statistics] program undertook an extensive revision of its own occupational classification system, reducing the number of occupations by more than half, from 2,000 to less than 800. The revised OES structure was designed to be compatible with the SOC, but it is not completely based on the SOC classification system. It includes emerging paraprofessional occupations as well as a number of skilled occupations in the health and computer science fields which had not been separately identified in the 1980 SOC. Occupations which have subsequently been added to the OES system have been based on occupations in the DOT."

<sup>14</sup>In some cases, such as SOC major group 24 vocational and educational counselors, or SOC major group 27 veterinarians, there is no further breakout to a minor group or unit group level. Similarly, some SOC minor groups, such as 392 air traffic controllers, or 396 legal technicians, provide no unit group detail. These examples contrast with SOC minor group 434–5 commodities salespersons, which contains 13 unit groups; and with minor group 766–7 machine operators and tenders—assorted materials, which includes 18 unit groups. DOT codes appear at the most detailed SOC level in each case. DOT codes that have appeared since the 1977 fourth edition of the *Dictionary* have been assigned SOC codes (see endnote 11), but no update of the 1980 *Standard Occupational Classification Manual* itself has been published.

<sup>15</sup>The six SOC minor group codes in the health technologists and technicians division are 362 clinical laboratory technologists and technicians, 363 dental hygienists, 364 health record technologists and technicians, 365 radiologic technologists and technicians, 366 licensed practical nurses, and 369 health technologists and technicians not elsewhere classified.

<sup>16</sup>Paul D. Geyer (1992), "Issues of Reliability and Validity in Ratings of Occupational Characteristics in the Dictionary of Occupational Titles: Draft Interim Report," Washington, DC: Advisory Panel for the Dictionary of Occupational Titles, U.S. Employment Service, Employment and Training Administration, U.S. Department of Labor, states, on p. 24, "unclear is whether or not occu-

pational requirements vary in the same ways as do human attributes. For example, should occupations be described with respect to each GOE [Guide for Occupational Exploration] Interest or each GATB [General Aptitude Test Battery] Aptitude? Initiation of a series of confirmatory factor analyses involving subsets of DOT items and scores representing corresponding human attributes would be informative in terms of the commonality of dimensions and the need to describe occupations as precisely as we are capable of describing workers." Also see: Ivar Berg (1970), *Education and Jobs: The Great Training Robbery*, New York, NY: Praeger Publishers, pp. 40–41, where it is observed that "variations in the characteristics of people performing adequately *within* occupational groups have been found to be as great as variations *among* these groups." These expert conclusions are of particular importance in the mid-1990's, when new regulations for the Job Training Partnership Act require completion of a client-specific training plan that identifies a particular occupational opportunity; when the Americans With Disabilities Act requires the identification of reasonable accommodations that will expand occupational opportunities for physically and mentally challenged people; when alien worker certification procedures require a matching of qualifications and requirements in the context of a specific local labor market; and when life-long learning is being promoted as an answer to the Nation's poor productivity record in recent decades.

<sup>17</sup>This total of 663 SOC occupational categories includes the 537 unit groups, plus 116 minor groups that are not broken out into unit groups, and the 10 major groups that do not provide any minor group detail.

<sup>18</sup>DOT occupations are distributed unevenly among the SOC *Manual's* occupational categories. Just one DOT occupation appears in SOC minor group 112 executives and general administrators—*Dictionary* code 188.117–114 City Manager; while SOC minor group 772 assemblers lists 509 DOT codes. The 1990 Census occupational code 785 assemblers illustrates still another level of aggregation, which combines the 509 DOT codes found in SOC minor group 772 with an additional 147 DOT codes that appear in SOC minor group 774 fabricators not elsewhere classified. This means that the descriptive detail of 656 DOT occupations is hidden within a single counting statistic "cell"—the number of assemblers reported in the 1990 Census.

<sup>19</sup>The three DOT occupations listed in SOC unit group 1636 computer engineers are: 003.167–062 systems engineer, electronic data processing; 020.062–010 computer-applications engineer; and 020.067–010 engineering analyst.

<sup>20</sup>The new 3-digit occupational groups that appear in the 1991 *Dictionary's* 03 division are: 030 occupations in systems analysis and programming; 031 occupations in communications and networks; 032 occupations in computer systems user support; 033 occupations in com-

puter systems technical support; and 039 computer-related occupations not elsewhere classified.

<sup>21</sup>The other two alternate titles for DOT code 033.167-010 are information processing engineer and data processing methods analyst.

<sup>22</sup>The requirements and qualifications shown for the 1991 *Dictionary's* occupational category 033.167-010 were last updated in 1988.

<sup>23</sup>See: U.S. Department of Labor, Bureau of Labor Statistics (1992), *Outlook: 1990-2005*, Bulletin 2402, Washington, DC p. 103 for a description of the data sources and procedures that are used in the last of six steps that are followed to project occupational employment by industry in the United States. Briefly, base-year occupational employment estimates reflect information about the occupational distribution of wage and salary employment that is collected by the State Employment Security Agencies through a cooperative agreement with the Bureau of Labor Statistics. This staffing pattern information is collected through surveys that are conducted on a 3-year cycle, covering approximately one-third of the Nation's economy each year. The 1992 *Outlook* volume is based on occupational staffing pattern information that was collected in "1987 surveys of wholesale and retail trade, regulated industries, and State and local governments; 1988 surveys of manufacturing industries and hospitals; [and] 1989 surveys of mining, construction, finance, and services." These surveys cover 775 occupations in 367 industries. The 1992 *Outlook* volume reports that "in developing the base-year matrix, occupations having fewer than 5,000 workers were aggregated into similar larger occupations or appropriate residuals. Also, industries employing less than 50,000 workers were aggregated into residuals within the same 2-digit SIC [Standard Industrial Classification], if their staffing patterns were comparable to the residual. As a result of this aggregation, the 1990-2005 projections cover 507 occupations in 258 industries." Furthermore, since some occupations are entered in a residual category by employers who complete the Occupational Employment Statistics survey instrument, there is a need to extract these and combine them with decennial Census employment data to achieve economy-wide employment estimates. These staffing pattern figures are applied to industry employment estimates from the Bureau of Labor Statistics' Current Employment Statistics establishment survey. The Occupational Employment Statistics surveys do not cover all sectors of the economy. Staffing pattern information for wage and salary employment in agriculture, forestry, fishing, hunting, and trapping, are drawn from the decennial Census of Population. These staffing pattern figures are then combined with base-year employment estimates derived from the Current Population Survey of households, which is conducted by the Census Bureau. Estimates of wage and salary employment in private households, the self-employed, unpaid family

workers, and Federal Government employment are also obtained from this household survey. Occupational staffing pattern information for the Federal Government is obtained from the Office of Personnel Management, which is a Federal agency. The occupational classification taxonomy used by the Office of Personnel Management is more detailed than that used by the Bureau of Labor Statistics, so aggregation is required. Aggregation is also required for estimates of self-employment and unpaid family workers, which combine Current Population Survey and decennial Census data. Richard E. Dempsey (1991), *An Appraisal of NOICC/SOICC Needs for Data from the 1990 Decennial Census*, NOICC Occasional Papers/2, Washington, DC: National Occupational Information Coordinating Committee, February 1991, p. 5, describes the use of Census data in earlier occupational projections prepared by the Bureau of Labor Statistics.

<sup>24</sup>Using unpublished BLS data, a 1990 employment estimate of 55,497 computer engineers was derived. The first step in this computation was to determine that 16 percent of total employment in the published occupational category other engineers were computer engineers. The second step was to multiply this 16 percent figure times the published figure of 346,855 for other engineers. At this point, a one-time barrier was encountered because the OES occupational category computer engineer was first introduced in the 1989 survey, which covered only the manufacturing sector, this is known to be an inaccurate estimate of economy-wide wage and salary employment of computer engineers. An additional problem arises, when it is realized that self-employed computer engineers are not represented in this estimate. The Bureau estimates that there were 12,000 self-employed other engineers in 1990, based on CPS data. This total must be allocated among the seven unpublished occupational categories identified in the text of this paper. There is no obvious rule to follow in doing so.

<sup>25</sup>These two occupations share the same General Education Development (GED) scale rating of 5, and a common strength designation of "sedentary."

<sup>26</sup>Many uses of what has been referred to here as *counting statistics* do not require a combining of historical or projected occupational employment figures with the DOT's descriptors of requirements and qualifications. For these uses the current Occupational Employment Statistics program taxonomy might be satisfactory. Examples of such non-transaction uses of occupational information include descriptions of historical trends of occupational employment; analyses of the changing demographics of occupational employment over time; and investigations of interindustry mobility patterns that include information about occupational status at both the points of origin and destination.

<sup>27</sup>Some defenders of the *Dictionary's* relevance argue that some occupations have not changed much in the past 25 years. However, no one would say this about

computer-related occupations. The 1991 *Dictionary* provides descriptions for 21 computer-related occupations, 13 of which were last updated in 1990, and 4 of which were last updated in each of the years 1989 and 1988. Even 3- to 5-year-old information about computer-related occupations is unlikely to be considered "current."

<sup>28</sup> See Richard E. Dempsey's paper prepared for the June 1993 International Occupational Classification Conference, to be convened by the Bureau of Labor Statistics, U.S. Department of Labor, for elaboration of these differences.

<sup>29</sup> Caution must be exercised in embracing the possibilities that electronic updating might offer. While there will be a growing number of occupational information users who would welcome an opportunity to subscribe to an on-line *Dictionary*, there will still be many who will remain dependent upon a print version of the *Dictionary*. This will create a two-tier system of occupational information accuracy.

<sup>30</sup> Occupational information is collected in household and establishment settings. The decennial Census produces both self-reported and proxy respondent occupational information, most in an unassisted completion of a census questionnaire, but sometimes involving a census interviewer. The monthly Current Population Survey program produces self-reported and proxy respondent occupational information in an interviewer assisted context. Occupational information is collected from establishments through the cooperative Bureau of Labor Statistics-State Employment Security Agencies Occupational Employment Statistics program occupational staffing pattern survey. Again, most responses are completed in an unassisted context, but some assistance is provided by State Employment Security Agency personnel, usually in a telephone conversation. See: Wesley Mellow and Hal Sider (1983), "Accuracy of Response in Labor Market Surveys: Evidence and Implications," *Journal of Labor Economics*, 1:4, pp. 331-344, where it is reported on p. 342 that "almost one-half of workers surveyed indicate a different detailed occupation than is reported by their employer." Richard E. Dempsey is currently conducting a research project for the U.S. Department of Labor's Western Area Occupational Analysis Field Center on the topic "Occupational Classification Systems Used to Collect Data From Households and Employers."

<sup>31</sup> See: R. Cotterman and F. Peracchi (1992), "Classification and Aggregation: An Application to Industrial Classification in CPS Data," *Journal of Applied Econometrics*, Vol. 7, pp. 31-51, which notes, on p. 31, that "... to facilitate understanding and communication, it is generally necessary to aggregate from the most detailed level, even though this may entail some loss of information. The questions then arise of how to aggregate and when to stop aggregating. That is, how does one aggregate so as to maintain important industry distinctions, and where does the information loss become great enough

to dominate the desire for additional parsimony?" An earlier monograph, which used the same statistical technique to investigate occupational classification issues, is Finis Welch and Iva MacLennan (1976), *The Census Occupational Taxonomy: How Much Information Does It Contain?*, R-1849-HEW/DOL (September 1976), Santa Monica, CA: The Rand Corporation, p. v.

<sup>32</sup> The Internal Revenue Service has recently announced a stepped-up enforcement of "independent contractor" rules, which the Service alleges have been abused by employers who seek to escape tax liabilities. Many of these independent contractors are high-skill professionals, and many observers expect rapid growth of employment opportunities of this type. This translates into a need for appropriate projections of the occupational employment of independent contractors.

<sup>33</sup> For example, some observers are skeptical of the ability of household data collection methods to distinguish among systems analysts, computer engineers, and computer scientists.

<sup>34</sup> See: Joop Hartog (1992), *Capabilities, Allocation and Earnings*, Boston, MA: Kluwer Academic Publishers, which provides theoretical and empirical contributions based on a recognition that "... the labor market should be decomposed at two sides, with supplied services distinguished according to a number of capabilities of individuals and demand according to the differential use that can be made of such services, measured by job requirements and level of job complexity" (p. 288); Alfred J. Field and Arthur H. Goldsmith, "The Impact of Formal On-The-Job Training on Unemployment and the Influence of Gender, Race, and Working Lifecycle Position on Accessibility to On-The-Job Training," in William Darity, Jr. (ed.) (1993), *Labor Economics: Problems in Analyzing Labor Markets*, Boston, MA: Kluwer Academic Publishers, which concludes that "it seems clear that people of the same age, experience, and tenure may possess significantly different skill levels as a result of differential formal on-the-job training activities. Unfortunately, no effort is made to account for this source of worker heterogeneity in current empirical work. Thus the existing research which attempts to measure both informal and formal on-the-job training with one variable (for example, age, experience, tenure) is statistically flawed" (p. 79); and Lawrence Mishel "Comment: Skill Requirements and the Workforce," (which comments on Arnold H. Packer and John G. Wirt, "Changing Skills in the U.S. Work Force: Trends of Supply and Demand"), both in George E. Peterson and Wayne Vroman (1992), *Urban Labor Markets and Job Opportunity*, Washington, DC: The Urban Institute Press, who concludes that "... there is little evidence that there has been a rapid increase in overall skill requirements in the job structure as a whole. There is also no credible evidence of a future explosion of skill requirements. ... A careful analysis of Bureau of Labor Statistics (BLS) employment projec-

tions also shows that changes in the job structure will not dramatically change skill and education requirements" (p. 72). Each of these studies highlights the barriers that are encountered in attempting to combine information about job requirements, employee qualifications, and historical/projected employment opportunities.

<sup>35</sup> Canada's National Occupational Classification (NOC) taxonomy uses an *actual mobility* criterion for grouping, with observed movement within an occupational grouping being greater than that observed between cells. Furthermore, movement between adjacent cells is more frequent than movement between cells that do not share a common boundary (in a matrix format). Australia's Standard Classification of Occupations (ASCO) is conceptually based on a *potential mobility* criterion for grouping, but exceptions to this principle have been revealed—see Brian L. Embury (1991), "The Use and Gathering of Occupational Information in Australia," (no organizational identification), which reports, on p. 22, that "the [Australian] design objective was to group occupations in such a way that any given individual would have the potential to move between occupations in the same unit group without the need for significant retraining but he or she would not have the potential to move between occupations in different unit groups without some additional training; the greater the move required, the greater the additional training necessary. Hence, one can interpret the classification as a model of potential transferability of human resource skills in the Australian economy. The qualifying word *potential* is significant. ASCO attempts to model the potential mobility of labour between occupations according to the task similarity of those occupations. It is not based on observed patterns of labour mobility in the current labour market. Hence, the model lacks empirical validation based on observed behaviour but, at the same time, it is not constrained by the institutional barriers to mobility present in any labour market. The deliberate choice of potential transferability rather than observed transferability as the focus of the model was made on the basis of the intended applications of the classification. The greatest need for statistics based on ASCO will be during times of significant structural change in the economy as a result of events such as major changes in government policy, the outbreak of war, or the collapse of our external markets. At such times, many existing institutional constraints to labour market mobility are likely to be swept away. A model which is limited by such constraints will soon become irrelevant and hence useless as a planning tool." Also see: Joe Maxwell (1992), "Review of Report on Classification and Occupational Information Systems in the Netherlands," (no organizational identification), where it is reported, on p. 8, that "The basic classification principle [in the Netherlands Central Bureau of Statistics' 1992 Occupational Classification] is transferability of skills; this is potential transferability, rather than actual

mobility among occupations." For germane theoretical treatments of this topic see: Kenneth I. Spenner (1990), "The Measurement of Skill: Strategies and Dilemmas with Special Reference to the Dictionary of Occupational Titles," Durham, NC: Department of Sociology, Duke University; Bruce McKinlay (1976), *Characteristics of Jobs That Are Considered Common: Review of Literature and Research*, Information Series No. 102 Columbus, OH: The Center for Vocational Education, p. 40, which quotes Haller and Portes (1973), "Status Attainment Processes," *Sociology of Education*, Winter 1973, p. 52, where it is observed that "for the most part there is a paucity of causal explanations of mobility at the individual level. The magnetism exercised on researchers by the mobility problem has meant almost exclusive concentration on description—analysis of conventional mobility matrices per se—to the neglect of explanation—study of the possible determinants of observed status movements." Dixie Sommers (1979), *Empirical Evidence on Occupational Mobility*, Information Series No. 193, Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University; James G. Scoville (1972), *Manpower and Occupational Analysis: Concepts and Measurement*, Lexington, MA: D.C. Heath and Company; Joyce R. Shackett and David W. Stevens (1981), "Elasticity of Substitution Across Occupations, Occupational Coding, and Accountability in Vocational Education," in National Commission for Employment Policy, *The Federal Role in Vocational Education: Sponsored Research*, Special Report No. 39, Washington, DC, pp. 215–244; and Jack E. Triplett (1990), "The Theory of Industrial and Occupational Classifications and Related Phenomena," in Bureau of the Census, *1990 Annual Research Conference: Proceedings*, Washington, DC: U.S. Department of Commerce, pp. 9–25.

<sup>36</sup> Bureau of Labor Statistics (1992), *op cit*, p. 5.

<sup>37</sup> The National Occupational Information Coordinating Committee has prepared a tabulation of these characteristics differences. It is important to understand that the differences that appear in the *Dictionary's* occupational descriptions are an artifact of the sampling protocols that were used by the Occupational Analysis Field Centers to select sites for conducting job analyses. The representativeness of the recorded characteristics is constrained by this sampling regimen.

<sup>38</sup> The six unit-group SOC occupational categories are: 7332 welding machine setup operators; 7532 welding machine operators and tenders; 7714 welders and cutters; 7333 soldering and brazing machine setup operators; 7533 soldering and brazing machine operators and tenders; and 7717 solderers and brazers.

<sup>39</sup> The 1990 Census classification of occupations groups the SOC's three 4-digit unit groups of welders and cutters (machine setup operators, machine operators and tenders, and welders/cutters themselves) into one Census code—783 welders and cutters. Similarly, the 1990 Census clas-

sification groups the SOC's three 4-digit solderer and brazer unit groups into one Census code—784 solderers and brazers. The Bureau of Labor Statistics' Occupational Employment Statistics program collects survey information for four related occupational categories—soldering and brazing machine operators and tenders; soldering and brazing machine setters and set-up operators; welding machine operators and tenders; and welding machine setters and set-up operators. However, the respective operator/tender and setter/set-up operator categories are aggregated before occupational projections are released. The counterparts of the SOC's other relevant unit groups, solderers/brazers and welders/cutters, are not identified separately in the OES program's survey; and they are grouped with 12 other occupations in published projection estimates for hand workers including assemblers and fabricators.

<sup>40</sup> See: Paul D. Geyer (1992), *loc cit*; and Ann R. Miller, Donald J. Treiman, Pamela S. Cain and Patricia A. Roos (eds.) (1980), *Work, Jobs, and Occupations: A Critical Review of the Dictionary of Occupational Titles*, Washington, DC: National Academy Press, for comprehensive examinations of the DOT's classification components.

<sup>41</sup> See: 1991 Revised Fourth Edition, *Dictionary of Occupational Titles*, Volume II, appendix C: "Components of the Definitional Trailer," p. 1009. This appendix continues that "This training may be acquired in a school, work, military, institutional, or vocational environment. Specific vocational training includes: vocational education, apprenticeship training, in-plant training, on-the-job training, and essential experience in other jobs." Australia's Standard Classification of Occupations disaggregates this composite into separate academic preparation, vocational/apprentice preparation, and on-the-job preparation components. Consider how useful this disaggregation would be if the United States adopts the major changes in its vocational education, apprentice and work-based learning investments that have been proposed by the new Administration. Also consider how the provisions of the Americans with Disabilities Act of 1990 create unique occupational classification needs in the United States with respect to the concepts of "typical worker" and "average performance."

<sup>42</sup> See: Stephen J. Barley (1991), *The New Crafts: The Rise of the Technical Labor Force and Its Implications for the Organization of Work*, Philadelphia, PA: The National Center on the Educational Quality of the Workforce, University of Pennsylvania; Sue E. Berryman and Thomas R. Bailey (1992), *The Double Helix of Education and the Economy*, New York, NY: The Institute on Education and the Economy, Teachers College, Columbia University; Commission on the Skills of the American Workforce (1990), *America's Choice: High Skills or Low Wages?*, Rochester, NY: National Center for Education and the Economy; Secretary's Commission

on Achieving Necessary Skills (1991), *What Work Requires of Schools*, Washington, DC: U.S. Department of Labor; National Advisory Commission on Work-Based Learning (1992), *Framework for Action*, Washington, DC: U.S. Department of Labor; and Peter Cappelli (1992), "Is the 'Skills Gap' Really About Attitudes?" *EQW Working Papers*, Philadelphia, PA: The National Center on the Educational Quality of the Workforce, University of Pennsylvania. Jobs have been redefined to encompass more tasks and to permit more autonomy and discretionary action. The latent capacity to act in a responsible manner when necessary is therefore a highly valued candidate qualification. One implication of this for occupational classification is that the concept of the "nature of the work performed" has to be expanded to represent the "nature of the work *that might* be performed." This, in turn, means that it is more difficult to document hypothetical performance requirements that are unlikely to be observed in a site-visit job analysis context.

<sup>43</sup> See *The Wall Street Journal*, March 10, 11 and 16, 1993, page A1 in each case, for articles in a series titled "Down the Up Escalator: Why Some Workers are Falling Behind." The titles of these three articles are compelling, "Age of Angst: Workplace Revolution Boosts Productivity at Cost of Job Security; Globalization, Automation and Shrinking Industries Spread the Fear of Firing; The Fading Era of Big Daddy;" "Hired Out: Workers are Forced to Take More Jobs with Few Benefits; Firms Use Contract Labor and Temps to Cut Costs and Increase Flexibility; Critics: Savings are Illusory;" and "Price of Progress: 'Re-Engineering' Gives Firms New Efficiency, Workers the Pink Slip; One Company After Another Redesigns Tasks to Curb its Need for Employment; But Long View is Reassuring."

<sup>44</sup> Stephen J. Barley (1991), *loc cit*. See: J.E.S. Lawrence (1990), *Occupational Information and International Development: Improving HRD Diagnostics*, Occasional Paper No. 1, Washington, DC: National Occupational Information Coordinating Committee (December 1990), for a related investigation of this topic from an international perspective.

<sup>45</sup> The 1980 *Standard Occupational Classification Manual's* stated principle is that supervisors are to be identified separately from the workers they supervise. The "Master Titles and Definitions" section of the *Manual* states, on p. 14, that "supervisors (or foremen) are classified according to the occupations of the workers they supervise. A supervising worker who primarily performs duties such as those supervised, and who may be commonly known as a group leader or leadman, is classified in the same unit group as the workers." If the documentation of actual mobility paths is chosen as an important classification criterion, then collection of updated information about changes in the organization of work

that have occurred since 1977 should be given a high priority.

<sup>46</sup> See: 1991 Revised Fourth Edition *Dictionary of Occupational Titles*, Volume II, appendix C: Components of the Definition Trailer, III "General Educational Development," pp. 1009-1012.

<sup>47</sup> Other components of the *Dictionary's* Definition Trailer are Physical Demands-Strength Rating and Guide for Occupational Exploration (GOE).

<sup>48</sup> This difference in number of GED scale levels is that "the diversity of language courses offered at the college level precludes the establishment of distinct levels of language progression for these four years. Consequently, language development is limited to five defined levels of GED inasmuch as levels 5 and 6 share a common definition, even though they are distinct levels." See: 1991 *Dictionary*, Volume II, Appendix C, p. 1012.

<sup>49</sup> 1991 *Dictionary of Occupational Titles*, Volume II, appendix C, p. 1012.

<sup>50</sup> Reduction of this variance of SVP values within SOC categories will not be an action item if the components of the SVP itself are updated and reported separately. Today, no distinction is made between, say, 2 years of community college combined with 2 years of relevant work experience, 4 years of college, and 4 years of pertinent employment, as qualifying preparation. There is no problem here, if, and only if, it really doesn't matter which route to qualification is taken. In most cases, the payoff to traveling different paths would be expected to matter.

<sup>51</sup> Compatibility is not synonymous with conformity. Conformity requires accordance with a specified standard. Compatibility is less demanding—requiring only a capability to exist together in harmony. Advocates of a coordinated revision of the 1991 *Dictionary of Occupational Titles* and 1980 *Standard Occupational Classification Manual* are positioned along a conformity-compatibility continuum, which stretches from those who advocate full consolidation of the DOT and SOC classifications into a single all-purpose taxonomy, to those who endorse co-existence without substantial elimination of the *Dictionary's* descriptive detail.

<sup>52</sup> See: Peter B. Doeringer (ed.) (1991), *Turbulence in the American Workplace*, New York, NY: Oxford University Press.

<sup>53</sup> Other examples were developed in the research that was conducted in support of this paper. These are available from the author upon request.

<sup>54</sup> Brian L. Embury (1991), *op cit*, pp. 20-21.

<sup>55</sup> See: Michigan Occupational Analysis Field Center (1992), *Standard Occupational Classification: Principles of Classification*, Detroit, MI, September 2, 1992, p.4. Also see: Michigan Occupational Analysis Field Center (1992), *Classification Issues and Options*, Detroit, MI, June 8, 1992.

<sup>56</sup> *Business Week* magazine's February 8, 1993 cover story, pp. 99-103 is titled "The Virtual Corporation". The theme of this article is that the traditional short-term strategic alliance among multiple partners in the movie-making and construction industries is expected by some observers to quickly spread throughout the economy. The vision is that "teams of people in different companies would routinely work together, concurrently rather than sequentially, via computer networks in real time." The transitory nature of the alliances that are foreseen would make the designation of industrial affiliation of employment much more difficult unless the business services sector is expanded and refined to accommodate this type of change. "Here today, gone tomorrow" is not the industrial classification specialist's favorite discovery!

<sup>57</sup> See: 1991 Revised Fourth Edition *Dictionary of Occupational Titles*, Volume II, "Industry Index", pp. 1023-1025. This *Dictionary*, Volume I, pp. xx-xxi describes the use of this industry designation. "It often differentiates between two or more occupations with identical titles and different duties. Because of this, it is an integral and inseparable part of any occupational title. While a definition usually receives the designation of the industry or industries in which it occurs, certain occupations occur in a large number of industries. When this happens, the industry assigned is a cross-industry designation. For example, clerical occupations are found in almost every industry. To show the broad, cross-industry nature of clerical occupations, 'clerical' is an industry designation in itself. Among other cross-industry designations are: 'profess. and kin.', 'machine shop,' and 'woodworking.' Occupations which characteristically occur in nearly all industries, or which occur in a number of industries, but not in most industries and which are not considered to have any particular industrial attachment, are assigned the designation of 'any industry.' In compiling information for the DOT, analysts were not able to study each occupation in all industries where it occurs. The industry designation, therefore, shows in what industries the occupation was studied but does not mean that it may not be found in others. Therefore, industry designations are to be regarded as indicative of industrial location, but not necessarily restrictive." Several occupational classification experts, who reviewed an early draft of this paper, criticized the actual historical basis for the DOT's current industry designations, and urge a serious review and revision of this occupational descriptor.

<sup>58</sup> See: Pamela Frugoli (1992), "Some Observations on the DOT as it Relates to Employment and to Required Training Time: Implications for the DOT Review," Washington, DC: National Occupational Information Coordinating Committee, p. 7.

<sup>59</sup> Time-series consistency is a major issue here. Revision of the Nation's occupational classification taxonomies will require revision of affected time-series



data sources. Both government and proprietary opportunities to provide value-added services of this type will arise.

<sup>60</sup>See, for example, Wade Lambert (1993), "No Bias Seen in Homogeneous Work Force," *The Wall Street Journal*, March 11, 1993, p. B5, which reports Judge Richard Posner's statement that "It is not discrimination, and it is certainly not active discrimination, for an employer to sit back and wait for people willing to work for low wages to apply to him, . . . . The fact that they are ethnically or racially uniform does not impose upon him a duty to spend money advertising in the help-wanted columns of the Chicago Tribune." This is cited here because it indicates a value-added opportunity to provide better information about occupational employment opportunities to job seekers.

<sup>61</sup>Many of these beneficiaries of higher quality occupational information will be able to "capture" some part of the higher value-added for themselves. This raises questions about how the costs of providing the occupational information enhancements ought to be allocated, and how the benefits should be allowed to accrue. Brief observations about these topics are made later in this paper, but each of these topics warrants further investigation.

<sup>62</sup>See: Robert G. Sheets (1992), "National Skill Standards and Certification," DeKalb, IL: Center for Governmental Studies, Northern Illinois University.

<sup>63</sup>Better information is also needed about projected changes in "institutional constraints" (for example, the dynamics of work-based learning, the growth of independent training vendors and private career schools, the evolution of community college curriculums, and new forms of employee-employer cooperation). See, for example, Sue E. Berryman and Thomas R. Bailey (1992), *loc cit*. Also see: Robert C. Dauffenbach, Jr. (1974), *The Structure of Occupational Mobility in the U.S. Economy*, Ann Arbor, MI: University Microfilms, p. 106, where the author elaborates upon the economist's distinctions among (1) an *ability* to move between occupations; (2) a *willingness* to move; and (3) an *opportunity* to move, which he explores in the context of Glen G. Cain, W. Lee Hansen and Burton A. Weisbrod's often-cited paper "Classification of Occupations: Some Problems of Economic Interpretation," in American Statistical Association (1966), *Proceedings of the Social Statistics Section*, Washington, DC, pp. 199-203. The *ability* to move is consistent with what most non-economists focus on in grouping occupations—the extent to which competencies required in one occupation qualify an individual to move to another occupation. This sets an upper limit on the amount of potential mobility. The *willingness* of incumbents to move acts as a constraint, or ceiling, below this upper limit—not everyone who is able (for example, qualified) to move is willing to change occupations. The *opportunity* to move imposes a still lower ceiling on

actual mobility—some who are both able and willing to change occupations do not have the opportunity to do so. These distinctions will be more important than ever as the Administration's new initiatives get underway.

<sup>64</sup>See: John H. Bishop (1993), *Educational Reform and Technical Education?*, Working Paper 93-04, Ithaca, NY: Center for Advanced Human Resource Studies, New York State School of Industrial and Labor Relations, Cornell University, January 3, 1993, p. 49; (1993), *Overeducation*, Working Paper No. 93-06, Ithaca, NY: Center for Advanced Human Resource Studies, New York State School of Industrial and Labor Relations, Cornell University, January 12, 1993, p. 17; and The National Center on the Educational Quality of the Workforce (1992), *A Crosswalk of National Data Sets Focusing on Worker Training*, Philadelphia, PA: University of Pennsylvania.

<sup>65</sup>See: Karl F. Botterbusch (1992), *op cit*, pp. 18-19.

<sup>66</sup>The availability of a new occupational classification taxonomy would not *automatically* translate into an immediate adoption of this revision for alien labor certification purposes. Some of the State Employment Security Agencies currently register job-seeking applicants using the 1977 Fourth Edition DOT, while accepting job orders from employers using the 1991 Revised Fourth Edition DOT.

<sup>67</sup>Here, employment opportunity does not mean awareness of a job vacancy. Instead, it refers to the frequency of appearance of a particular occupational response in completed data collection instruments.

<sup>68</sup>This is the topic of Richard E. Dempsey's paper.

<sup>69</sup>The cost of accurately recording occupational employment counts would not be expected to be constant across occupations, which means that the number of occupations that can be covered with a fixed budget is affected by which occupations are to be covered. Given a budget allocation, the number of occupations covered can be increased by concentrating on occupational categories in which incumbents can be counted at relatively low cost.

<sup>70</sup>In the approach that is being discussed here data collection instruments and instructions might accurately record changes in the job requirements and candidate qualifications of, say, secretaries; but analysts would not automatically know about these changes. Explicit provision for such awareness would have to be developed.

<sup>71</sup>This appears to provide an attractive opportunity for the Federal Government to negotiate with vendors and other interested parties who might be expected to bear some, or all, of the costs associated with continued collection of job requirement and candidate qualification descriptors for these occupation categories, which might be terminated otherwise. In other words, the future peg-board of occupations in the United States might be compartmentalized into three segments—a "must have" segment of consolidated occupational categories; a "might



want to retain" segment of occupational categories that provide either counts or descriptors, but not both; and a "consider for termination" segment of count only and descriptor only occupational categories. The boundary between the last two segments is intentionally "soft," to convey the different dialogues that would be expected to ensue between the Federal Government, vendors and users of occupational information. The burden of proof

in the "might want to retain" case would be on the Federal Government to describe why private parties should be expected to absorb some, or all, of the costs of data collection. This contrasts with the "consider for termination" case, where the burden of proof would be on the private parties to make the case for retention under any circumstances, whether there is cost-sharing or not.

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