Occupational Classification Systems: Analyzing the 2010 Standard Occupational Classification (SOC) Revision

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The 2010 Standard Occupational Classification (SOC) is a system for classifying all occupations in the U.S. economy. The term "occupation" refers to the "collective description of a number of individual jobs performed, with minor variations, in many establishments."[1] Individual workers in an establishment perform a specific set of tasks that is largely dependent on factors such as the employment size and industry classification of that establishment, as well as the tasks performed by other workers in that same establishment. This combination of tasks makes up an individual worker's job and while the exact group of tasks is often, but not always, unique to that worker, almost every job is similar to a number of other jobs. Occupational classification schemes organize millions of jobs into discrete groups based upon their similarities as determined by the scheme's classification principles.[2]

The SOC system "is used by Federal statistical agencies to classify workers and jobs into occupational categories for the purpose of collecting, calculating, analyzing, or disseminating data."[3] This paper discusses how a task-based system promotes consistency in the method used for classifying the 840 occupations in the 2010 SOC, and thus enhances comparability of data collected by various statistical agencies. It details the process used and the issues considered to revise the SOC system for 2010. The paper will also touch on the relation of the 2010 SOC to the International Labor Organization's International Standard Classification of Occupations (ISCO).

Types of Classification Systems

The SOC is a hierarchical classification system, as opposed to a faceted classification system. A hierarchical system requires only one overarching organizing principle, whereas a faceted classification scheme uses a number of separate hierarchies (facets) concurrently.[4] A faceted system can provide more information because each item is defined by multiple characteristics. Although faceted systems are often more voluminous, they also facilitate discovery of gaps in the system—an advantage when designers strive to capture all possible variations of the classified items. Under the hierarchical system used by the SOC, the same occupational code is assigned to a Civil Engineer with a bachelor's degree employed by a civil engineering services firm, as is assigned to a Civil Engineer with a master's degree employed by a similar civil engineering services firm, and further, to a Civil Engineer with a bachelor's degree in a nonresidential building construction firm. Under a faceted system with three facets (work performed, educational level, and industry) each of these three workers would have a different code.

Hierarchical systems can be either polyhierarchical or mono-hierarchical, depending on whether or not the classified items appear in multiple locations. In a polyhierarchical system, content is reused, therefore an occupation can be found in multiple places. For example, an occupation requiring expertise in both business and sales (such as fundraising) can be found in two places in the structure, under both sales and business. Further, if an individual's occupation was "fundraising manager," that

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[1] *Dictionary of Occupational Titles, Revised 4th edition*, Vol. 1, p. xvii, (U.S. Department of Labor, Employment and Training Administration, 1991).
[2] *Federal Register*, Vol. 71, No. 94, p. 28538, (Office of Management and Budget, May 16, 2006).
[3] *Federal Register*, Vol. 74, No. 12, p. 3921, (Office of Management and Budget, January 21, 2009).
[4] See Pavel Babikov, Oleg Gontcharov, and Maria Babikova, "Polyhierarchical Classifications Induced by Criteria Polyhierarchies and Taxonomy Algebra," QNT Software Development, Inc., on the Internet at http://arxiv.org/ftp/cs/papers/0312/0312059.pdf (visited Jan. 4, 2010).

category could be found in three locations: sales, business, and management. The SOC is a mono-hierarchical system, under which each occupation is found in only one place. In addition, the categories in the SOC are exclusive, exhaustive, and the higher levels are completely described by the lower levels of aggregation.

The classification principles determine the fundamental characteristics of the SOC. As shown in Figure 1, the exclusivity of the SOC occupations is explained in the first classification principle, "Each occupation is assigned to only one occupational category at the lowest level of the classification." The principle of exhaustivity is demonstrated by the fourth coding guideline, "Workers who perform activities not described in any distinct detailed occupation in the SOC structure should be coded in an appropriate 'All Other' or residual occupation." The inclusion of residual occupations ensures that all jobs can be captured by the SOC structure. (See Appendix A for the full list of SOC Classification Principles and Coding Guidelines.)

Figure 1: Exclusivity and Exhaustivity

SOC Classification Principle 1
The SOC covers all occupations in which work is performed for pay or profit, including work performed in family-operated enterprises by family members who are not directly compensated. It excludes occupations unique to volunteers. Each occupation is assigned to only one occupational category at the lowest level of the classification.

SOC Coding Guideline 4
Workers who perform activities not described in any distinct detailed occupation in the SOC structure should be coded in an appropriate "All Other" or residual occupation. These residual occupational categories appear as the last occupation in a group with a code ending in "9" and are identified by having the words "All Other" appear at the end of the title.

Yet even mono-hierarchical systems can have a plethora of occupations. The fourth edition of the Dictionary of Occupational Titles (DOT) listed 12,099 occupations. The vast level of detail in the DOT made it difficult to provide reliable information for DOT occupations on a recurring, timely, and consistent basis. The ninth classification principle, new to the 2010 SOC, requires that "for a detailed occupation to be included in the SOC, either the Bureau of Labor Statistics or the Census Bureau must be able to collect and report data on that occupation."[5] This objective is not met if the categories created are too narrow, as in the DOT, where separate classifications were created for Tree Surgeon (408.181-010), Tree Trimmer (408.664-010), and Tree Pruner (408.684-018). Although there are slight differences in the work performed in each of these detailed occupations, there are also many similarities. All workers classified in these occupations "Cut away dead or excess branches from trees or shrubs to maintain right-of-way for roads, sidewalks, or utilities, or to improve appearance, health, and value of tree."[6] Therefore, following the principles and guidelines of the SOC, all of these types of workers are included in the SOC occupation, Tree Trimmers and Pruners (37-3013).

Overview of the SOC Hierarchy

In the 2010 SOC, as with the 2000 SOC, there are four levels of aggregation: major group, minor group, broad occupation, and detailed occupation. All occupations are clustered into 23 major groups (listed in Table 1), such as Business and Financial Operations Occupations (13-0000) or Healthcare Practitioner and Technical Occupations (29-0000). These major groups are broken down into occupationally-specific minor groups, such as Financial Specialists (13-2000) in Business and Financial Operations Occupations, or Health Diagnosing and Treating Practitioners (29-1000) in the Healthcare Practitioners and Technical Occupations major group. Minor groups, in turn, are divided into broad occupations, such as Credit Counselors and Loan Officers (13-2070) or Therapists (29-1120), which are further divided into detailed occupations, such as Credit Counselors (13-2071), or Exercise Physiologists (29-1128).

Each item in the hierarchy is designated by a six-digit code. The first two digits of the 2000 SOC code represent the major group; the third digit represents the minor group; the fourth and fifth digits represent the broad occupation; and the sixth digit represents the detailed occupation. Major group codes end with 0000 (e.g., 29-0000, Healthcare Practitioners and Technical Occupations), minor groups generally end with 000 (e.g., 29-1000, Health Diagnosing and Treating Practitioners), broad occupations end with 0 (e.g., 29-1120, Therapists), and detailed occupations end with a nonzero digit (e.g., 29-1123, Physical Therapists). The hyphen between the second and third digit is used only for presentation clarity.[7]

[5] *Federal Register*, January 21, 2009, p. 3924.
[6] *Standard Occupational Classification Manual 2000*, p. 116, (Office of Management and Budget, October 2000).
[7] *Federal Register*, Vol. 64, No. 180, p. 53138, (Office of Management and Budget, September 30, 1999).

Table 1: 2010 SOC Major Groups

Code	Title	Code	Title
11-0000	Management Occupations	33-0000	Protective Service Occupations
13-0000	Business and Financial Operations Occupations	35-0000	Food Preparation and Serving Related Occupations
15-0000	Computer and Mathematical Occupations	37-0000	Building and Grounds Cleaning and Maintenance Occupations
17-0000	Architecture and Engineering Occupations	39-0000	Personal Care and Service Occupations
19-0000	Life, Physical, and Social Science Occupations	41-0000	Sales and Related Occupations
21-0000	Community and Social Service Occupations	43-0000	Office and Administrative Support Occupations
23-0000	Legal Occupations	45-0000	Farming, Fishing, and Forestry Occupations
25-0000	Education, Training, and Library Occupations	47-0000	Construction and Extraction Occupations
27-0000	Arts, Design, Entertainment, Sports, and Media Occupations	49-0000	Installation, Maintenance, and Repair Occupations
29-0000	Healthcare Practitioners and Technical Occupations	51-0000	Production Occupations
31-0000	Healthcare Support Occupations	53-0000	Transportation and Material Moving Occupations
		55-0000	Military Specific Occupations

Background on the SOC and the 2010 SOC Revision

Prior to the development of the 2000 SOC, government statistical agencies that collected and reported occupational information did not all use a common classification system. In response to a need for such a system, in 1994 the Office of Management and Budget (OMB) chartered the Standard Occupational Classification Revision Policy Committee (SOCRPC), which was tasked with devising a uniform classification system. In carrying out this charge, OMB and the Committee issued several Federal Register notices. Based on comments in response to these notices, and four years of research by the SOCRPC and workgroups composed of members from more than fifteen government agencies, the SOCRPC and OMB developed and published the *2000 Standard Occupational Classification Manual.*

In 2005, the Office of Management and Budget first met with a newly-formed Standard Occupational Classification Policy Committee (SOCPC) to initiate the formal 2010 SOC revision process. The first question the Committee addressed was the scope of the revision. The Committee determined to keep a major organizing principle used in the 2000 SOC, and classify occupations based on the type of work performed. As Levine, Salmon, and Weinberg noted for the 2000 revision, the SOCRPC considered four basic organizing principles for constructing the 2000 SOC. The first option, used in the 1980 SOC, was the type of work performed. The second option, used in the International Standard Classification of Occupations (ISCO), was education-based. The third option was to devise a skills-based system, and the fourth option was to use an economic-based system.[8]

Task-Based System

The SOCPC decided that the underlying organizational concept, as presented in the classification principles for the 2010 SOC system, should continue to be work performed. Therefore, workers with varying levels of skills, education, or experience performing the same tasks are classified in the same occupation in the SOC. The 2010 SOC system specifies both

[8]See Chester Levine, Laurie Salmon, and Daniel H. Weinberg, "Revising the Standard Occupational Classification system," *Monthly Labor Review*, May 1999, p. 37, on the Internet at http://www.bls.gov/opub/mlr/1999/05/art4full.pdf (visited Jan. 4 2010).

classification principles and coding guidelines, whereas the 2000 SOC only identified classification principles. Both were determined to be necessary because they serve different purposes. The classification principles form the basis on which the SOC system is structured and describe "how" and "why" occupations are classified in the 2010 SOC structure. The coding guidelines assist users in consistently assigning SOC codes to survey responses. The first coding guideline states "A worker should be assigned to an SOC occupation code based on work performed."[9]

The SOCPC also considered, but ultimately rejected, other alternatives to the task-based system, such as skills or credentials. If a classification scheme is based on skill level, which of the multiple skill levels within an occupation should be used to classify the occupation? The difficulty in answering this question exemplifies the problematic nature of a classification scheme that is based upon determining a single skill level for an occupation. Classification principle 2 and coding guideline 2 mention skills, but in the context of work performed as the primary determinant of classification. In its official response to the comment suggesting increased emphasis on credentials in the classification, the SOCPC stated that:

> *The SOC classifies occupations based on work performed, therefore unless a specific credential is required in order to work in a position (as in the case of licensed occupations), possessing a credential may enhance an individual's skills or employability but is not always a requirement for employment in the occupation. Persons employed in most occupations include both those who do not possess certain credentials, as well as those who do, with significant variation by locality and employer. No good information exists on the number or share of people in occupations who possess credentials. Further, many credentials are for specific skill sets, not for occupations, and would not be germane in any case.*[10]

The SOCPC removed ''credentials'' from the criteria listed in the second classification principle used in the 2000 SOC due to the complexity, variability, and frequency of change in credential requirements. In particular:

(1) There are many different types of credentials that apply to occupations–State occupational licensing, Federal occupational licensing, private sector occupational certifications, as well as certifications of particular skill sets that may apply to multiple occupations, such as certification in facility with a certain type of software, equipment, or safety or regulatory procedures.
(2) Credentialing requirements vary not only from State to State, but may also vary by locality, by industry size class, or by firm.
(3) There is no current data collection mechanism to obtain comprehensive information on occupational credentialing and keep it updated; therefore, it is not feasible to adequately factor in credentialing requirements when classifying or defining an occupation.
(4) As technology and other requirements change, credentials change over time more rapidly than other variables and these changes could not be reflected in a classification that is to remain stable over a 5- to 10-year period–as attested to by the hundreds of Information Technology certifications that have come into existence during the last 5 to 10 years–the period during which the 2000 SOC was developed and put into use.[11]

The Review Process

OMB and the SOCPC first requested public comment on the SOC revision for 2010 in the May 16, 2006 Federal Register. In this notice, the Committee welcomed comments related to all aspects of occupational classification but specifically requested comments on the revised classification principles, the intention to retain the major group structure, and proposals on corrections or changes to existing occupations and for new detailed occupations. To carry out the bulk of the revision effort, the committee created six work groups to review the comments received in response to the Federal Register notice. The review of the recommendations was guided by the classification principles, and all decisions were made by consensus. A second Federal Register notice soliciting comments on recommended changes to the occupational structure, classification principles, and coding guidelines was published on May 22, 2008.

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[9] *Federal Register,* Vol. 73, No. 100, p. 29932, (Office of Management and Budget, May 22, 2008).
[10] See Standard Occupational Classification Policy Committee, "*Responses to comments on 2010 SOC*," on the Internet at http://www.bls.gov/soc/2010_responses/response_08-0897.htm (visited Jan. 4, 2010).
[11] *Federal Register*, May 16, 2006, p. 28537.

The SOCPC responded to the hundreds of comments received by creating new occupations, revising occupational titles, and changing the placement of individual occupations within the revised structure. An important question raised in one of these comments asked whether users could conclude that changes to the 2010 SOC structure stemmed from changes to the 2000 SOC classification principles. However, because the changes made by the SOCPC were intended to clarify the existing principles, the substantive structural changes incorporated throughout the revised 2010 SOC can be attributed to technological advancements and actual changes in the nature or organization of work activities performed in the economy.[12]

What changed in the 2010 SOC

In comparison to the 2000 SOC, the 2010 SOC realized a net gain of 19 detailed occupations, 12 broad occupations, and 1 minor group. The 2010 SOC system contains 840 detailed occupations, aggregated into 461 broad occupations. In turn, the SOC combines these 461 broad occupations into 97 minor groups and 23 major groups. Of the 840 detailed occupations in the 2010 SOC, 359 remained the same as in 2000, 452 had definition changes, 21 had a title change only, and 9 had a code change without a change in the definition. Most of the definition changes (392) were editorial revisions that did not change occupational content. Therefore, no substantive change occurred in occupational coverage for more than 9 out of 10 detailed occupations in the 2010 SOC.

As noted, the codes, titles, and definitions for many existing SOC occupations were changed. Sometimes occupational titles were changed to clarify occupational coverage or mitigate confusion. For example, Architectural Managers in the 2000 SOC were included in "Engineering Managers" (11-9041 in the 2000 SOC), but not specified in the SOC title. In the 2010 structure, the title was changed to Architectural and Engineering Managers and the code 11-9041 was retained.

There were 60 instances of a code change. In some cases, a code changed because a broad occupation was split. For example, Training and Development Specialists (13-1073) were formerly classified in the broad occupational group, Human Resources, Training, and Labor Relations Specialists (13-1070). However, in the 2010 SOC this detailed occupation appears under its own broad occupation group Training and Development Specialists (13-1150). In this case, the content of the occupation did not change, just its location in the structure. In other cases, the code changed because the content changed. For example, the 2010 code for Registered Nurses (29-1141) was modified to draw attention to a change in occupational content. The 2010 SOC was expanded to include three new detailed nursing occupations that were previously included with Registered Nurses: Nurse Anesthetists (29-1151), Nurse Midwives (29-1161), and Nurse Practitioners (29-1171).

The vast majority of the changes, however, were editing changes. Some editing changes were relatively minor–correcting punctuation or changing a single word, for example. Other editing changes were more extensive and resulted in a complete re-writing of the definition. There were also 60 instances of revisions to definitions that affected occupational coverage. These 60 detailed occupations, which include the 24 new occupations denoted by an asterisk (*), can be found in Appendix B. Appendix B encompasses collapsed occupations, as well as 2010 occupations that resulted from a split. A table describing the types of changes made to all detailed occupations will be available on the SOC homepage at www.bls.gov/soc, along with other supporting materials.

While it is not practical to discuss all of the changes incorporated in the 2010 SOC, this paper will highlight the two new renewable energy occupations and the consideration given to new "green" economic activities. There will be a further discussion of changes in the information technology occupations in the section that relates to the International Standard Classification of Occupations (ISCO).

"Green" Occupations in the 2010 SOC

The 2010 SOC contains two new detailed occupations related to renewable energy; Solar Photovoltaic Installers (47-2231) and Wind Turbine Service Technicians (49-9081). Solar Photovoltaic Installers assemble, install, or maintain solar photovoltaic (PV) systems that generate solar electricity. Wind Turbine Service Technicians inspect, diagnose, and repair wind turbines. Their maintenance work may include resolving electrical, mechanical, or hydraulic malfunctions. The SOCPC carefully analyzed over 80 unique suggestions regarding "green" occupations and considered these recommendations from the perspective of the SOC classification principles. The three classification principles most commonly cited in the rationales provided for the SOCPC's decisions were: classification principle 1 which states that occupations are assigned to

[12]See Standard Occupational Classification Policy Committee, "*Responses to comments on 2010 SOC*," on the Internet at http://www.bls.gov/soc/2010_responses/response_08-0012.htm (visited Jan. 4, 2010).

only one occupational category, classification principle 2 which states that occupations are classified based on work performed, and classification principle 9 which relates to collectability.[13]

More specifically, classification principle 1 states "Each occupation is assigned to only one occupational category at the lowest level of the classification." The SOCPC frequently found that the work performed by a proposed "green" job was already covered by the description of an existing SOC occupation. For example, a "Cellulose Insulation Installer" would be coded in 47-2131 "Insulation Workers, Floor Ceiling and Walls" because although the materials used may differ, the work performed is the same as the work performed by other Insulation Workers, who "line and cover structures with insulating materials." The Occupational Information Network (O*NET) described some of these proposed green jobs as "Green Increased Demand Occupations" where the work context may change but the tasks themselves do not, or "Green Enhanced Skills Occupations" where the essential purposes of the occupation remained the same, but the skills, knowledge, or credentials have been altered.[14] For examples of "green" job titles the SOCPC felt were already covered in the existing SOC structure, see Table 2.

Table 2: Examples of "Green" Job Titles and where they are included in the SOC

"Green" Job Title	SOC Code	SOC Title
Hybrid Vehicle Mechanic	49-3023	Automotive Service Technicians and Mechanics
Solar Photovoltaic Electrician	47-2111	Electricians
Solar Photovoltaic Installation Supervisor	47-1011	First-Line Supervisors of Constructions Trades and Extraction Workers
Solar Thermal Installer	47-2152	Plumbers, Pipefitters, and Steamfitters
Sustainable Landscape Architect	17-1012	Landscape Architects
Water Retrofitter	47-2152	Plumbers, Pipefitters, and Steamfitters
Wind Turbine Erector	47-2221	Structural Iron and Steel Workers

After extensive research, the SOCPC determined that the work performed by Solar Photovoltaic Installers and Wind Turbine Service Technicians was sufficiently distinct from the work performed in other occupations and would satisfy the collectability requirements of classification principle 9. According to a U.S. Energy Information Administration (EIA) report, "Strong growth in the U.S. photovoltaic (PV) industry continued in 2008. Total shipments of PV cells and modules increased more than 90 percent to nearly 1 million peak kilowatts."[15] In their *2009 International Energy Outlook*, the EIA noted that solar power is one of the fastest-growing sources of renewable energy and its use is likely to increase in the future, and further, the U.S. Department of Energy indicated that "up to $87 million will be made available to support the development of new solar energy technologies and the rapid deployment of available carbon-free solar energy systems."[16] The American Wind Energy Association (AWEA) noted in their 2008 Annual Report that "in 2008, the U.S. wind energy industry brought online over 8,500 megawatts (MW) of new wind power capacity, increasing the nation's cumulative total by 50% to over 25,300 MW and pushing the U.S. above Germany as the country with the largest amount of wind power capacity installed."[17]

Currently there are 24 States (plus the District of Columbia) with a renewable portfolio standard (RPS), which is a State policy requiring electricity providers to obtain a minimum percentage of their power from renewable energy sources. Five other States have nonbinding goals for adoption of renewable energy instead of an RPS. "Together these States account for more than half of the electricity sales in the United States."[18] The U.S. Department of Energy formed a Solar Energy Technologies Program (SETP) to focus on research, development, and deployment projects for renewable energy. The SETP Multi Year Program Plan released in April 2008 highlighted an expected increase in the global and domestic growth rate of the photovoltaic market. This report noted "the most optimistic of these forecasts calls for a 51% compound annual growth rate in worldwide solar installations through 2011. This evidence points to the emergence of a worldwide industry at a

[13]See Standard Occupational Classification Policy Committee, "*Responses to comment on 2010 SOC*," on the Internet at http://www.bls.gov/soc/2010_responses/response_08-0492_08-0762_08-1157.htm (visited Jan. 4, 2010).
[14]See Erich C. Dierdorff, Jennifer J. Norton, Donald W. Drewes, Christina M. Kroustalis, David Rivkin and Phil Lewis, "Greening of the World of Work: Implications for O*NET®-SOC and New and Emerging Occupations," on the Internet at http://www.onetcenter.org/dl_files/Green.pdf (visited Jan. 4, 2010).
[15]U.S. Department of Energy, Energy Information Administration, "Solar Photovoltaic Cell/Module Manufacturing Activities 2008," on the Internet at http://www.eia.doe.gov/cneaf/solar.renewables/page/solarreport/solarpv.pdf (visited Jan. 4, 2010).
[16]U.S. Department of Energy, Oct. 8, 2009 press release, "DOE Announces $87 Million in Funding to Support Solar Energy Technologies," on the Internet at http://www.energy.gov/news2009/8115.htm (visited Jan. 4, 2010).
[17]American Wind Energy Association, "Annual Wind Industry Report, Year Ending 2008," on the Internet at http://www.awea.org/publications/reports/AWEA-Annual-Wind-Report-2009.pdf (visited Jan. 4, 2010).
[18]U.S. Department of Energy "States with Renewable Portfolio Standards, May 2009" on the Internet at http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm (visited Jan. 4, 2010).

'jumping off' point."[19] The American Wind Energy Association reported on October 20, 2009 that the U.S. wind energy industry installed 1,649 megawatts (MW) of new power generating capacity in the third quarter, an amount higher than either the 2nd quarter of 2009 or the 3rd quarter of 2008.[20] According to the Occupational Outlook Quarterly "electricity generated from renewable sources is one of the fastest growing segments of the electric power industry."[21]

Classification principle 9 indicates that "For a detailed occupation to be included in the SOC, either the Bureau of Labor Statistics or the Census Bureau must be able to collect data on that occupation."[22] Collectability was frequently a concern in evaluating proposals for new occupations. In some instances, the quantity of workers performing "green" tasks as their primary activity was not substantial enough to support a new detailed occupation. For other recommendations, the recommended occupations were so dispersed throughout the economy that it would be difficult to reliably collect and report data.[23] If a job title was not accepted as a separate SOC occupation, the SOCPC then considered whether to include it in the Direct Match Title File, which is limited to titles that can be coded to only one SOC occupation. The job title "Sustainability Specialist" could belong in multiple SOC occupations, such as Environmental Engineers (17-2081), Environmental Engineering Technicians (17-3025), Zoologists and Wildlife Biologists (19-1023), Conservation Scientists (19-1031), or Forestry and Conservation Workers (45-4011). Therefore, the title "Sustainability Specialist" would not be included in the Direct Match Title File. In contrast, a title such as "Environmental Law Professor" can only be classified under Law Teachers, Postsecondary (25-1112) and would be a Direct Match Title. The SOCPC agreed to add various "green" job titles to the Direct Match Title File, including Environmental Economists, Hybrid Vehicle Mechanics, Environmental Communications Specialists, Wind Turbine Erectors, and Wind Turbine Mechanics.[24]

Overview of ISCO

Work on the 2010 SOC coincided with the International Labor Organization's revision of its 1988 International Standard Classification of Occupations (ISCO) for the year 2008. Like the SOC, the ISCO is a hierarchal system with major groups, sub-major groups, minor groups, and unit groups. Although the ISCO classification scheme is task based, eight of the ten major groups are also linked to one of the four ISCO skill levels, a divergence from the SOC organizing principle. These skill levels relate to the International Standard Classification of Education (ISCED) and roughly correspond to (1) primary, (2) secondary, (3) university or tertiary, and (4) graduate levels of education.[25] Table 3 lists the ISCO major groups and the skill level for each group. The concept of skill level was not applied in the case of major group 1, Managers, and major group 0, Armed forces occupations.

Table 3: ISCO Major Groups with skill levels

	Major Groups	ISCO Skill Level
1	Managers	
2	Professionals	4
3	Technicians and associate professionals	3
4	Clerical support workers	2
5	Service and sales workers	2
6	Skilled agricultural, forestry, and fishery workers	2
7	Craft and related trades workers	2
8	Plant and machine operators, and assemblers	2
9	Elementary occupations	1
0	Armed forces occupations	

Another significant difference between the two classification systems is that ISCO places some emphasis on classifying workers in the informal economy, including work done by family members around the house. Both ISCO-88 and ISCO-08 included categories for workers who perform subsistence agriculture and fishery workers. For example, ISCO-08 includes

[19][19]U.S. Department of Energy, Solar Energy Technologies Program, "Multi Year Program Plan, 2008-2012," on the Internet at http://www1.eere.energy.gov/solar/pdfs/solar_program_mypp_2008-2012.pdf (visited Jan. 4, 2010).
[20]American Wind Energy Association, Oct. 20, 2009 press release, "U.S. Wind Energy Industry Installs over 1,600 MW in Third Quarter," on the Internet at http://www.awea.org/newsroom/releases/10-20-09_AWEA_Q3_market_report.html (visited Jan. 4, 2010).
[21]See Phillip Bastian, "On the grid: Careers in Energy," on the Internet at http://www.bls.gov/ooq/2008/fall/art02.pdf (visited Jan. 4, 2010).
[22]*Federal Register*, May 16, 2006, p. 28537.
[23]See Standard Occupational Classification Policy Committee, "*Responses to comment on 2010 SOC*," on the Internet at http://www.bls.gov/soc/2010_responses/response_08-0492_08-0762_08-1157.htm (visited Jan. 4, 2010).
[24]See Standard Occupational Classification Policy Committee, "*Responses to comment on 2010 SOC*," on the Internet at http://www.bls.gov/soc/2010_responses/response_08-0492_08-0762_08-1157.htm (visited Jan. 4, 2010).
[25]International Labour Organization, Technical Expert Group for Updating ISCO, Annex 1, "International Standard Classification of Occupations (ISCO-08) – Conceptual Framework," pp. 5-6, on the Internet at http://www.ilo.org/public/english/bureau/stat/isco/docs/annex1.doc (visited Jan. 4, 2010).

Subsistence crop farmers (6310), Subsistence livestock farmers (6320), Subsistence mixed crop and livestock farmers (6330), and Subsistence fishers, hunters, trappers and gatherers (6340). A new unit occupation was added to ISCO-08 for Water and firewood collectors (9624), which includes work performed for subsistence, or for economic profit.[26] Conversely, the first classification principle of the SOC limits coverage to work that is performed for pay or profit.[27]

Updating ISCO

While both the ISCO and SOC revision committees indicated their intention to keep the underlying organizing principles and structure of the respective classification systems, significant changes were made in some areas in response to changes in technology. For example, both the ISCO-08 and 2010 SOC revisions aimed to accurately capture rapid changes to the occupational structure of the information technology sector, resulting in an increase in the number of detailed occupations, updated descriptions, and structural changes to this sector. Not only do these revisions more accurately describe the current world of work, but they also improve comparability between the two classification systems. The number of detailed computer occupations in the 1988 ISCO and the 2000 SOC were 4 and 10, respectively. In the revised versions of both classification systems, the number of computer occupations increased to 13. See appendix C for a list of the computer occupations included in ISCO-88, 2000 SOC, ISCO-08, and 2010 SOC.

The robustness of the information technology sector, in terms of both industry and occupational classification, was recognized by Scopp, who noted that for Census, "the major occupation group with the largest percent increase from 1990 to 2000 was the one for 'Computer specialists,' which more than doubled from 1990 to 2000 (122.2 percent increase). Within this group several detailed categories showed huge increases, some over 1000 percent: 'Database administrators' (1773.4 percent increase); 'Computer support specialists' (1174.9 percent); 'Network systems and data communications analysts' (1022.6 percent); 'Network and computer systems administrators' (514.8 percent); and 'Computer software engineers' (194.5 percent), among others."[28] Therefore, it was to be expected that the revision committees for both the ISCO and the SOC would carefully review the computer occupations and consider expanding the number of detailed computer occupations to better describe the work performed in this critical sector–with the added benefit of greatly enhancing comparability between the ISCO-08 and the 2010 SOC.

Supervisors

Another noteworthy change made to ISCO-88 relates to the treatment of supervisors within the classification structure. The previous version, ISCO-68, had separate categories for supervisors, but ISCO-88 did not retain these, since supervisors often carry out the tasks and duties of the jobs they supervise, in addition to controlling the professional or technical quality of the work done by others. The intention was to have supervisors classified with the workers that they supervise, however since in many countries supervisors have the authority to hire and fire workers, some countries did not wish to include supervisors with the specific workers they hire and fire. Therefore, the lack of supervisors as a separate category had the potential to overstate the number of managers. This concern was remedied in ISCO-08. The new categories for supervisors in ISCO-08 are: Mining supervisors (3121), Manufacturing supervisors (3122), Construction supervisors (3123), Office supervisors (3341), Building and housekeeping supervisors (515), and Shop supervisors (5222).[29]

The 2000 and the 2010 SOC both have separate categories for "Managers" and "First-line supervisors." The language used in the SOC definitions for managers and in classification principle 3 specifies that these workers are engaged in planning and directing activities, whereas workers whose "primary duty is supervising are classified in the appropriate first-line supervisor category because their work activities are distinct from those of the workers they supervise."[30] Some of the most substantial differences between ISCO-88 and the 2000 SOC related to the treatment of supervisors. These changes to ISCO-08 will not only allow ISCO to better reflect the workforce, they will also increase comparability between ISCO and the SOC.

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[26]International Labour Organization, Tripartite Meeting of Experts on Labour Statistics on Updating the International Standard Classification of Occupations (ISCO), "Resolution Concerning Updating the International Standard Classification of Occupations," p. 34, on the Internet at http://www.ilo.org/public/english/bureau/stat/isco/docs/resol08.pdf (visited Jan. 4, 2010).

[27] *Federal Register*, p. 3924, January 21, 2009.

[28]See Thomas Scopp, "The Relationship Between the 1990 Census and Census 2000 Industry and Occupation Classification Systems, Technical Paper #65," pp. 16-17, on the Internet at http://www.census.gov/hhes/www/ioindex/pdfio/tech_0203.pdf (visited Jan. 4, 2010).

[29]International Labour Organization, Tripartite Meeting of Experts on Labour Statistics on Updating the International Standard Classification of Occupations (ISCO), "Resolution Concerning Updating the International Standard Classification of Occupations," on the Internet at http://www.ilo.org/public/english/bureau/stat/isco/docs/resol08.pdf (visited Jan. 4, 2010).

[30]*Federal Register*, p. 3924, January 21, 2009.

Summary

Classification systems must evolve in order to facilitate the collection of meaningful data and information. The unified classification structure produced by the 2010 SOC Revision process provides the foundation for future collection of the occupational statistics and information needed to accurately reflect the current workforce structure. The 2010 SOC reflects the desire of the SOCPC to retain time-series continuity, while also updating the classification to better reflect the current occupational structure in the U.S. economy, taking into account improvements in technology and changes to the world of work. Updating the occupational classification scheme will increase accuracy in collecting and reporting occupational data and clarifications of the definitions will ensure agreement among interpreters of the data. Only a flexible strategy for organizing knowledge, such as the one used to develop the SOC, can answer the challenge to maintain currency and adapt to unforeseen economic, social, and technological advancements.

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Appendix A: Complete list of SOC Classification Principles and Coding Guidelines

Classification Principles: *The SOC Classification Principles form the basis on which the SOC system is structured.*

1. The SOC covers all occupations in which work is performed for pay or profit, including work performed in family-operated enterprises by family members who are not directly compensated. It excludes occupations unique to volunteers. Each occupation is assigned to only one occupational category at the lowest level of the classification.
2. Occupations are classified based on work performed and, in some cases, on the skills, education, and/or training needed to perform the work at a competent level.
3. Workers primarily engaged in planning and directing are classified in management occupations in Major Group 11-0000. Duties of these workers may include supervision.
4. Supervisors of workers in Major Groups 13-0000 through 29-0000 usually have work experience and perform activities similar to those of the workers they supervise, and therefore are classified with the workers they supervise.
5. Workers in Major Group 31-0000 Healthcare Support Occupations assist and are usually supervised by workers in Major Group 29-0000 Healthcare Practitioners and Technical Occupations. Therefore, there are no first-line supervisor occupations in Major Group 31-0000.
6. Workers in Major Groups 33-0000 through 53-0000 whose primary duty is supervising are classified in the appropriate first-line supervisor category because their work activities are distinct from those of the workers they supervise.
7. Apprentices and trainees are classified with the occupations for which they are being trained, while helpers and aides are classified separately because they are not in training for the occupation they are helping.
8. If an occupation is not included as a distinct detailed occupation in the structure, it is classified in an appropriate "All Other," or residual, occupation. "All Other" occupations are placed in the structure when it is determined that the detailed occupations comprising a broad occupation group do not account for all of the workers in the group. These occupations appear as the last occupation in the group with a code ending in "9" and are identified in their title by having "All Other" appear at the end.
9. The U.S. Bureau of Labor Statistics and the U.S. Census Bureau are charged with collecting and reporting data on total U.S. employment across the full spectrum of SOC major groups. Thus, for a detailed occupation to be included in the SOC, either the Bureau of Labor Statistics or the Census Bureau must be able to collect and report data on that occupation.

Coding Guidelines: *The SOC Coding Guidelines are intended to assist users in consistently assigning SOC codes and titles to survey responses and in other coding activities.*

1. A worker should be assigned to an SOC occupation code based on work performed.
2. When workers in a single job could be coded in more than one occupation, they should be coded in the occupation that requires the highest level of skill. If there is no measurable difference in skill requirements, workers should be coded in the occupation in which they spend the most time. Workers whose job is to teach at different levels (e.g., elementary, middle, or secondary) should be coded in the occupation corresponding to the highest educational level they teach.
3. Data collection and reporting agencies should assign workers to the most detailed occupation possible. Different agencies may use different levels of aggregation, depending on their ability to collect data. For more information on data produced using the SOC, see the Frequently Asked Questions (FAQs) section.
4. Workers who perform activities not described in any distinct detailed occupation in the SOC structure should be coded in an appropriate "All Other" or residual occupation. These residual occupational categories appear as the last occupation in a group with a code ending in "9" and are identified by having the words "All Other" appear at the end of the title.
5. Workers in Major Groups 33-0000 through 53-0000 who spend 80 percent or more of their time performing supervisory activities are coded in the appropriate first-line supervisor category in the SOC. In these same Major Groups (33-0000 through 53-0000), persons with supervisory duties who spend less than 80 percent of their time supervising are coded with the workers they supervise.
6. Licensed and non-licensed workers performing the same work should be coded together in the same detailed occupation, except where specified otherwise in the SOC definition.

Appendix B: Occupations with Content Changes

There were 60 instances of revisions to definitions that affected occupational coverage. These 60 detailed occupations are listed below and include the 24 new occupations denoted by an asterisk (*).

2010 Code	2010 SOC Title
11-9013	Farmers, Ranchers, and Other Agricultural Managers
11-9061	Funeral Service Managers
13-1041	Compliance Officers
13-1071	Human Resources Specialists
13-1075	Labor Relations Specialists
13-1121	Meeting, Convention, and Event Planners
13-1131	Fundraisers *
13-1161	Market Research Analysts and Marketing Specialists
13-1199	Business Operations Specialists, All Other
15-1121	Computer Systems Analysts
15-1122	Information Security Analysts *
15-1134	Web Developers*
15-1142	Network and Computer Systems Administrators
15-1143	Computer Network Architects *
15-1152	Computer Network Support Specialists *
21-1091	Health Educators
21-1094	Community Health Workers *
21-1099	Community and Social Service Specialists, All Other
23-1012	Judicial Law Clerks
23-2011	Paralegals and Legal Assistants
25-2051	Special Education Teachers, Preschool *
25-2052	Special Education Teachers, Kindergarten and Elementary School
25-2059	Special Education Teachers, All Other *
25-3099	Teachers and Instructors, All Other
29-1128	Exercise Physiologists *
29-1129	Therapists, All Other
29-1141	Registered Nurses
29-1151	Nurse Anesthetists*
29-1161	Nurse Midwives *
29-1171	Nurse Practitioners *

2010 Code	2010 SOC Title
29-2034	Radiologic Technologists
29-2035	Magnetic Resonance Imaging Technologists *
29-2057	Ophthalmic Medical Technicians *
29-2092	Hearing Aid Specialists *
29-2099	Health Technologists and Technicians, All Other
29-9092	Genetic Counselors *
29-9099	Healthcare Practitioners and Technical Workers, All Other
31-1014	Nursing Assistants
31-1015	Orderlies *
31-9097	Phlebotomists *
31-9099	Healthcare Support Workers, All Other
33-9032	Security Guards
33-9093	Transportation Security Screeners *
33-9099	Protective Service Workers, All Other
39-4031	Morticians, Undertakers, and Funeral Directors*
41-9099	Sales and Related Workers, All Other
43-3099	Financial Clerks, All Other *
43-9199	Office and Administrative Support Workers, All Other
47-2111	Electricians
47-2181	Roofers
47-2231	Solar Photovoltaic Installers*
47-4099	Construction and Related Workers, All Other
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers
49-9081	Wind Turbine Service Technicians*
49-9099	Installation, Maintenance, and Repair Workers, All Other
51-3099	Food Processing Workers, All Other *
51-5112	Printing Press Operators
51-5113	Print Binding and Finishing Workers
51-9151	Photographic Process Workers and Processing Machine Operators
51-9199	Production Workers, All Other

Appendix C: Computer Occupations (ISCO-88, SOC-2000, ISCO-08, SOC-2010)

ISCO-88

2131 Computer Systems Designers and Analysts
2132 Computer Programmers
2139 Computing Professionals Not Elsewhere Classified
3121 Computer Assistants

SOC- 2000

15-1011 Computer and Information Scientists, Research
15-1021 Computer Programmers
15-1031 Computer Software Engineers, Applications
15-1032 Computer Software Engineers, Systems Software
15-1041 Computer Support Specialists
15-1051 Computer Systems Analysts
15-1061 Database Administrators
15-1071 Network and Computer Systems Administrators
15-1081 Network Systems and Data Communications Analysts
15-1099 Computer Specialists, All Other

ISCO- 08

2511 Systems analysts
2512 Software developers
2513 Web and multimedia developers
2514 Applications programmers
2519 Software and applications developers and analysts not elsewhere classified
2521 Database designers and administrators
2522 Systems administrators
2523 Computer network professionals
2529 Database and network professionals not elsewhere classified
3511 Information and communications technology operations technicians
3512 Information and communications technology user support technicians
3513 Computer network and systems technicians
3514 Web technicians

SOC- 2010

15-1111 Computer and Information Research Scientists
15-1121 Computer Systems Analysts
15-1122 Information Security Analysts
15-1131 Computer Programmers
15-1132 Software Developers, Applications
15-1133 Software Developers, Systems Software
15-1134 Web Developers
15-1141 Database Administrators
15-1142 Network and Computer Systems Administrators
15-1143 Computer Network Architects
15-1151 Computer User Support Specialists
15-1152 Computer Network Support Specialists
15-1199 Computer Occupations, All Other