New and Emerging (N&E) Occupations

Methodology Development Report

Prepared for

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Employment and Training Administration
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Executive Summary

In order to make O*NET information more responsive to the needs of its users, a process is described for identifying, evaluating, and incorporating New and Emerging (N & E) occupations which are not adequately covered in the O*NET-SOC classification system. The focus is on high growth industries and the new occupations these industries are creating. Key participants in the process include the National Center for O*NET Development, DOL/ETA, North Carolina State University, ETA Industry Partners, Human Resources Research Organization (HumRRO), and Research Triangle Institute (RTI).

The O*NET system is designed to have the capacity to reflect on-going developments in workforce needs. This adaptability makes the O*NET system unique. It can be responsive to current developments in technology, social organization, business practices and government regulations. Incorporating N & E occupations into the O*NET system in a timely manner has the potential to benefit many users in both the public and private sector.

This document is composed of three sections:

Background Information

The primary purpose of this section is to define and establish criteria for incorporating N & E occupations into the O*NET-SOC system. Criteria for identifying N & E occupations include:

- The occupation involves significantly different work than performed by job incumbents of other occupations, as determined by NC State and O*NET research consultants;
- The occupation is not adequately reflected by the existing O*NET-SOC structure;

These two criteria are considered together. Proposed occupations that do not perform work that is significantly different from the work of existing O*NET occupations will not be considered N & E occupations.

Additional information will also be used to identify N & E occupations:

- The occupation has significant employment;
- The occupation has a positive projected growth rate;
- The occupation has developed due to changes in technology, society, law or business practices;
- The occupation has licensure or certification requirements;
- The occupation offers education or credentials to its employees;
- The occupation has related professional associations;
- The occupation has related journals or professional publications;
- The occupation is at the appropriate occupation level;
- The occupation has a supporting O*NET-SOC structure or has supporting existing O*NET-SOC occupations.

Proposed N & E occupations not meeting these criteria may not be good candidates for O*NET data collection. Most N & E occupations have developed relatively recently, but this may not always be the case. Some occupations classified as N & E may have existed for some time, but have evolved and changed significantly and/or only recently have reached employment numbers to make them practical for inclusion in the O*NET taxonomy. Information such as employment, projected growth, and professional association membership are considered to determine whether employment exists in sufficient numbers to support O*NET data collection.

In addition, this section includes a description of the O*NET occupational taxonomy, a discussion of occupational level of analysis, identification of criteria for high growth occupations, and a brief overview of the high growth industry sector identified by the President's High Growth Job Training Initiative and administered by the Department of Labor's Employment Training Administration (DOL/ETA) http://www.doleta.gov/BRG/JobTrainInitiative/.

Proposed N & E Process

This section describes a 7-step process by which N & E occupations can be identified, evaluated and incorporated into the O*NET system:

Step 1: Develop List of Potential N & E occupations in High Growth Industries.
Step 2: DOL/ETA Review and Approval of Proposed N & E Occupations.
Step 3: Develop Task Lists for Approved N & E Occupations.
Step 4: Finalize Occupation Profiles.
Step 5: Create Occupation Profiles and Submit to DOL/ETA for Approval.
Step 6: Initiate Data Collection.
Step 7: Refine Criteria and Methodology (Continuous).

N & E Process Tryout

A pilot study was conducted by the O*NET Center to try out the proposed N & E process. An abbreviated investigation of three high growth industries (Healthcare, Biotechnology, and Geospatial Technology) was conducted. The tryout demonstrated that sufficient information is available to generate support information/documentation for recommending N & E occupations for inclusion within the O*NET-SOC system.

Five potential N & E occupations were identified during the tryout:

- Advanced Practice Nurses (Healthcare)
- Bioinformatics Scientists (Biotechnology)
- Bioinformatics Technicians (Biotechnology)
- Geospatial Information Systems Scientists and Technologists (Geospatial Technology)
- Geospatial Information Systems Technicians (Geospatial Technology)

Information supporting the inclusion of these five N & E occupations, along with a complete profile for each occupation is included in appendices of this paper.

Background

The effort to identify New and Emerging (N & E) occupations is driven by the evolving nature of workforce requirements. New technologies, business practices, and social settings prompt new occupational fields.

The O*NET system is designed to have the capacity to reflect on-going developments in workforce needs. This adaptability makes the O*NET system unique. It can be responsive to current developments in technology, social organization, business practices and government regulations. Incorporating N & E occupations into the O*NET system in a timely manner has the potential to benefit many users in both the public and private sector.

Individuals seeking new careers or new pathways within existing careers will benefit from this effort. Educational institutions developing training programs to meet workforce demands, and companies writing job descriptions for workers in a changing environment will also benefit. In addition, as N & E occupations are incorporated into the O*NET taxonomy, other systems, such as the Standard Occupational Classification (SOC), will benefit from this resource.

O*NET Occupational Taxonomy

The occupational taxonomy of the O*NET system (O*NET-SOC) is based on the Standard Occupational Classification (SOC) system (Office of Management and Budget, 2000). These taxonomies are very similar and classify occupations in the same way (Taxonomy Implementation Report, 2005). N & E occupations will be included in the O*NET-SOC taxonomy. By adding these occupations, the taxonomy will more accurately reflect the world of work. In addition to N & E occupations, the O*NET taxonomy differs from the SOC system in that the O*NET taxonomy classifies occupations at a more detailed level than does the SOC taxonomy.

The SOC taxonomy was last updated in 1998, and the SOC committee reports the next round of revisions will occur prior to the 2008 American Community Survey. The O*NET-SOC system was designed to augment the original SOC system. As the world of work changes, the O*NET system can capture and report such changes in a timely manner by including N & E occupations.

N & E Occupations

One of the first challenges in identifying N & E occupations is defining criteria used to select the occupations. Several organizations have looked at these issues. In 1998, the Bureau of Labor Statistics (BLS) defined N & E occupations as occupations that are "becoming numerically important or emerging due to technological change and are specific to the new or emerging industries they are born to" (Monthly Labor Review, 1998).

More recently, BLS describes new occupations as those "…created by changes in technology, society, markets or regulations." In addition, BLS describes emerging occupations as those that "…may also be created by existing occupations that have been substantially modified by the same changes, and are increasing in employment" (OES BLS, 1998).

Several state agencies have focused on this topic recently. One such agency is the Minnesota Department of Economic Security. In 1998 it conducted a survey for the state of Minnesota identifying "New and Evolving Occupations" (Research & Statistics Office, Minnesota Department of Economic Security, August, 1999). The following definitions were applied within the study:

- New Occupations -- "those where skill sets (knowledge, skills, abilities, and work activities) that are so new they are not captured by present occupational classifications."
- Evolving Occupations—"established occupations that have seen a rapid change in their skill sets in recent years and, as a result, require updated information."

Work conducted by the Texas Workforce Commission utilizes similar definitions in their work to identify Emerging and Evolving occupations within the state.

Building on previous efforts, the O*NET Project will determine which N & E occupations to include within the O*NET-SOC taxonomy using the following criteria:

- The occupation involves significantly different work than that performed by job incumbents of other occupations, as determined by NC State and O*NET research consultants;
- The occupation is not adequately reflected by the existing O*NET-SOC structure;

N & E occupations will meet both of these criteria, which are considered together. Proposed occupations that do not perform work that is significantly different from the work of existing O*NET occupations will not be considered N & E occupations.

In addition to information specific to the above criteria, background information for each occupation, such as the history of the development of the occupation, employment, education, licensure, and associations the occupation supports will be considered. This additional information will help to identify and support the existence of N & E occupations:

- The occupation has a significant number of employees working in the occupation;
- The occupation has a positive growth rate. (See the "High Growth Occupations" Section of this paper below for more detail);
- The occupation has developed due to changes in technology, society, law or business practices;
- The occupation has licensure or certification requirements;
- The occupation offers education or credentials to its employees;
- The occupation has related professional associations;
- The occupation has related journals or professional publications;
- The occupation has a supporting O*NET-SOC structure or has supporting existing O*NET-SOC occupations.

Proposed N & E occupations not meeting these criteria may not be good candidates for O*NET data collection. Most N & E occupations have developed relatively recently, but this may not always be the case. Some occupations classified as N & E may have existed for some time, but have evolved and changed significantly and/or only recently have reached employment numbers to make them practical for

inclusion in the O*NET taxonomy. Information such as employment, projected growth, and professional association membership are considered to determine whether employment exists in sufficient numbers to support O*NET data collection.

Occupational Level of Analysis

An additional consideration for identifying N & E occupations is the level at which occupations should be studied and incorporated into the O*NET taxonomy. As mentioned previously, for some occupations, the O*NET taxonomy is more detailed than is the SOC taxonomy.

As N & E occupations are identified, the goal is to identify occupations at a similar level of specificity. O*NET research consultants will be key to achieving this goal. Briefly, N & E occupations should perform significantly different work than other occupations. It is likely that an N & E occupation will require different levels or types of education, training and experience. It is also likely that incumbents of N & E occupations will work with different or new technologies to produce a unique type of information, create a new type of product, or achieve a unique set of outcomes.

All N & E occupations will initially be classified in the SOC residual (i.e., All Other) occupations.

High Growth Occupations

Various organizations have made efforts to identify N & E occupations. Career Voyages (http://www.careervoyages.gov) has developed four categories to describe occupation projected growth levels between 2002 and 2012:

- 0% to 9% growth – slower than average;
- 10% to 20% growth – average;
- 21% to 35% growth – faster than average;
- 36% or higher growth – much faster than average.

N & E occupations that are projected to approach a faster than average growth rate will be assigned a high priority for study and data collection by the O*NET program.

High Growth Industries

The President's High Growth Job Training Initiative (http://www.doleta.gov/BRG/JobTrainInitiative/) has identified industries that are economically critical, projected to add substantial numbers of new jobs, and are being transformed by technology and innovations. The in-demand industries identified by this initiative (see Table 1 below) will serve as the primary focus of the search for N & E occupations. Detailed research conducted on these industries will ensure that additional critical, in-demand occupations are included within the O*NET system.

Table 1. DOL/ETA High Growth Industries

- Advanced Manufacturing
- Automotive
- Biotechnology
- Construction
- Energy
- Financial Services
- Geospatial Technology
- Health Care
- Hospitality
- Information Technology
- Retail Trade
- Transportation

Proposed N & E Process

This section describes the proposed process of identifying, evaluating and incorporating N & E occupations into the O*NET system (See Figure 1 for an illustration of the detailed process flow). The focus will be on high growth industries and the new occupations these industries are creating. Key participants in the process include the National Center for O*NET Development, DOL/ETA, North Carolina State University, Human Resources Research Organization (HumRRO) and Research Triangle Institute (RTI). The National Center for O*NET Development will work closely with DOL/ETA to prioritize the investigation of the 12 high growth industries.

Step 1: Develop List of Potential N & E Occupations in High Growth Industries.

Starting with the first industry(s) from the prioritized list of high growth industries, discover the growth and change occurring within each industry, focusing on new technologies, business practices, laws and other significant changes that could lead to changes in the way work is performed. Identify and document the potential N & E occupations that meet the criteria for inclusion within the O*NET-SOC taxonomy. In addition, document the unique titles of specialties discovered while investigating each industry.

1) Use Web search methodology to investigate the high growth industry:

   - Conduct extensive Web searches covering a wide net of Web sites including: industry association, organization, and educational Web sites, in addition to job posting Web sites, such as Monster (http://www.monster.com), Career Builder (www.careerbuilder.com) and America's Job Bank (www.ajb.org).

   - Identify associations and educational programs as sources for information on N & E occupations and SMEs for each industry and occupation.

2) Follow leads from DOL/ETA to study specific N & E occupations:

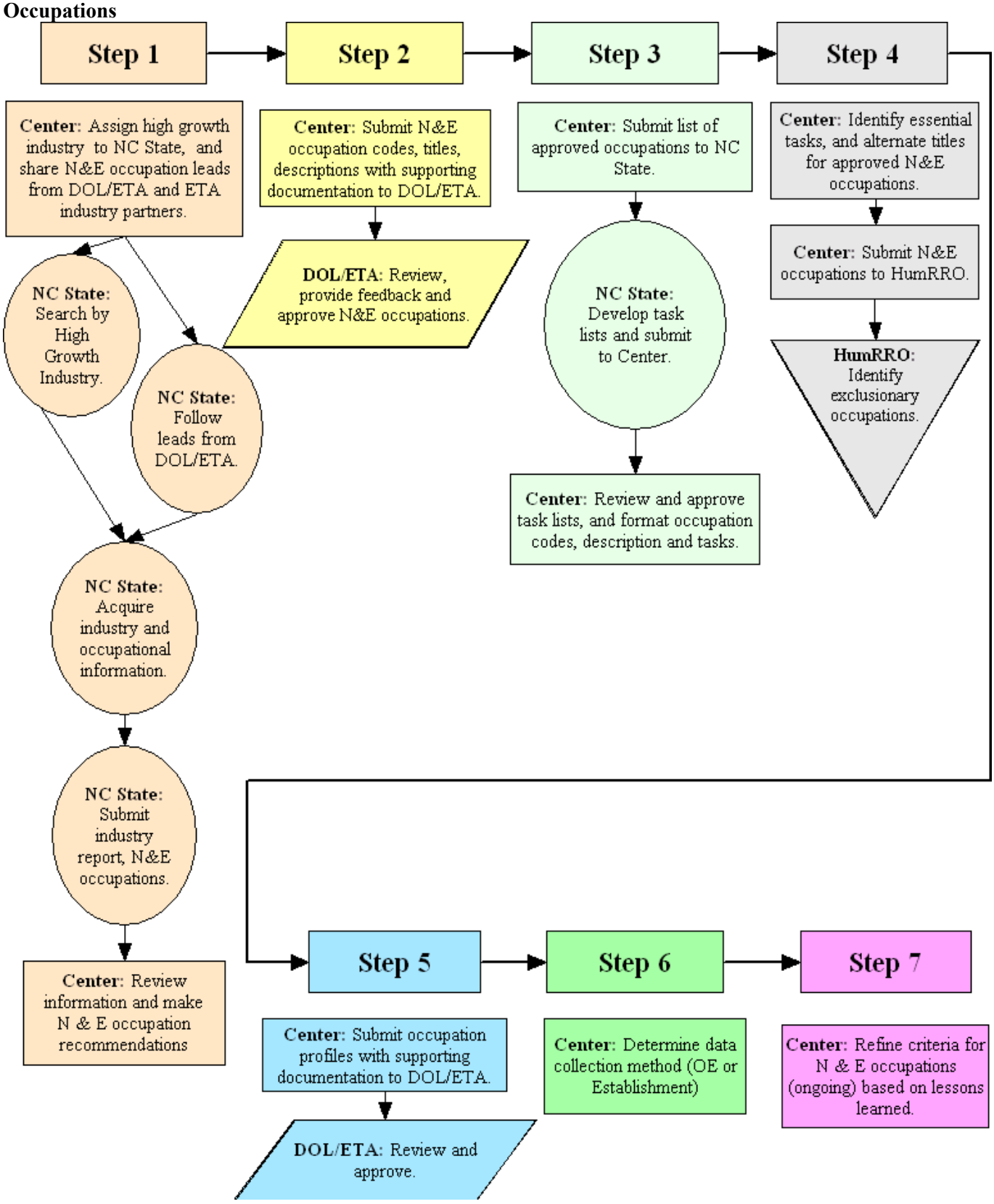
   - Investigate leads from DOL/ETA Business Relations Group and ETA industry partners to acquire information on potential N & E occupations, changes within industries, industry specialties, as well as additional resources available for discovering information related to a particular industry.

   - Use Web search methodology to further investigate each lead.

Step 2: DOL/ETA Review and Approval of Proposed N & E Occupations

Results of Step 1 will be quality checked, formatted and then provided to DOL/ETA for consideration and approval. The O*NET Center will provide information detailing recommendations for the inclusion of N & E occupations within the O*NET-SOC classification.

Figure 1. Process for Identifying, Evaluating and Incorporating N&E Occupations



Specifically, each submission will include:

- General information, background, and trends within each industry;
- Listing of N & E occupation titles and draft definitions;
- Table comparing each potential occupation to the N & E occupation criteria. (See Table 2 for a sample of the proposed table).

DOL/ETA will provide feedback on the proposed N & E occupations indicating its decision on whether to include each proposed N & E occupation within the O*NET-SOC classification. It may also suggest modifications to proposed occupation titles, definitions, levels of specificity, and other relevant occupational classification information.

Step 3: Develop Task Lists for Approved N & E Occupations.

Task lists for each of the approved N & E occupations will be developed using existing task development procedures. These procedures involve researching relevant Web sites as well as reviewing available task lists provided by industry/occupation experts. The information discovered during Steps 1 and 2 described above will serve as a strong foundation for the development of the task lists.

Step 4: Finalize Occupation Profiles

The title, definition and newly developed task lists will be used to develop the remaining parts of the Identification Profile (ID Profile) used in the data collection process. The parts include identification of essential tasks, alternate titles, and exclusionary occupations.

Step 5: Create Occupation Profiles and Submit to DOL/ETA for Approval.

The O*NET Center will gather and format all of the information collected for each N & E occupation. This information will be sent to DOL/ETA for final review and approval. This information will include:

- O*NET-SOC code, title and description;
- Occupation task list with essential tasks identified;
- Alternate titles and exclusionary occupations.

Table 2. N&E Health Care Occupations

Y = Yes; N = No

Candidate NEO	Description	SOC Differentiation		Well Reflected?	Employment > 5000 by 2012?		Positive Projected Growth?	
Allergists and Immunologists	Diagnose and treat diseases or conditions with allergic or immunologic causes.	Y	Completeness and consistency of O*NET-SOC classification.	N	Y	The American Academy of Allergy, Asthma, and Immunology has more than 6000 members.	Y	American Academy of Allergy, Asthma, and Immunology predicts an increase in demand for services because of increases in rates of asthma and allergies.
Dermatologists	Diagnose and treat diseases of the human skin.	Y	Completeness and consistency of O*NET-SOC classification.	N	Y	The U.S. Census Bureau reported that there were 8,000 Dermatologists in 2000.	Y	US. Census Bureau's figure of 8,000 Dermatologists in 2000 represents an 82% increase since 1990. Shortages in Dermatologists workforce are predicted.

Candidate NEO	Stems from Identifiable Industry Trend		Licensure or Certification Requirements?		Education or Credentials Offered?		Professional Associations?		Journals or Professional Publications?		Appropriate Level?	Supporting Structure/Occs?
Allergists and Immunologists	Y	Increased rates of allergies and asthma in recent years.	Y	Board certified by American Board of Allergy and Immunology. Medical license required for certification.	Y	Two-year residency/fellowship programs in allergy and immunology offered by major medical schools.	Y	American Academy of Allergy, Asthma, and Immunology.	Y	Journal of Allergy and Clinical Immunology	Y	N
Dermatologists	Y	Dermatologist workforce has increased considerably since 1990 and shortages are predicted.	Y	Board-certified by American Board of Dermatology.	Y	Three-year residency programs in Dermatology are offered at major medical schools.	Y	American Academy of Dermatology: American Society for Dermatologic Surgery	Y	Journal of American Academy of Dermatology	Y	N

Step 6: Initiate Data Collection

Occupations will be assigned to Establishment or Occupation Expert (OE) methodology for data collection. Decisions regarding which data collection method to pursue for each occupation will be made by a collaborative decision among the O*NET Center, RTI, and DOL/ETA.

As occupations are put into primary data collection, supplemental occupational information [such as Tools and Technology (T2) or Detailed Work Activities (DWAs)] for each occupation will also be developed.

Step 7: Refine Methodology and Criteria

The O*NET Center will thoroughly document Steps 1 through 6, with particular attention to the technical lessons learned. This information will be used to refine:

- The criteria for identifying N & E occupations;
- The methodology for creating occupational descriptions, task lists, supplemental information, O*NET-SOC code, title and description.

Additional sources of information on N & E occupations will be also be considered, including information gathered from the O*NET Occupational Code Assignment (OCA) process, papers written on emerging technologies or occupations, O*NET data collection business liaison comments, records of O*NET customer service inquiries, and existing O*NET data.

In the attempt to generate long-term criteria and methodology, multiple sources of information on N & E occupations will be evaluated, and it will be determined which methods best meet the needs and restraints of the O*NET project. A preliminary list of potential internal sources of information is presented below.

- Customer Service Inquiries
- Business Liaison Comments
- Job Titles, or Unmatched Lay Titles (possible use of keyword searches)
- Deviance Analysis of O*NET Surveys (O*NET task data)
- Occupational Diffraction
    - Task data
    - Detailed Work Activities (DWAs)
- Tools and Technology project profiles.

In addition, working with data available from the Bureau of Labor Statistics (BLS), the O*NET Center may evaluate the numbers of employees working in SOC Residual, or "All Other" occupations to identify where N & E occupations with relatively high employment numbers may be found.

N & E Process Tryout

A pilot study was conducted by the O*NET Center to try out the proposed N & E process. An abbreviated investigation of three high growth industries (Healthcare, Biotechnology, and Geospatial Technology) was conducted[1].

Two O*NET research consultants were assigned to each industry and tasked with conducting a shortened version of the Web search methodology described in Step 1. The tryout demonstrated that sufficient information is available to generate the supporting information and documentation for recommending N & E occupations for inclusion within the O*NET-SOC classification.

Five potential N & E occupations were identified during the tryout:

- Advanced Practice Nurses (Healthcare)
- Bioinformatics Scientists (Biotechnology)
- Bioinformatics Technicians (Biotechnology)
- Geospatial Information Systems Scientists and Technologists (Geospatial Technology)
- Geospatial Information Systems Technicians (Geospatial Technology)

Appendix A includes the information described in Step 2 of the process that would be submitted to DOL/ETA as support for including these five N & E occupations within the O*NET-SOC classification. Appendix B includes the occupational profile that would be created for each N & E occupation after DOL/ETA approval during Step 5 of the process.

[1] Note the pilot study implemented an abbreviated investigation of the three industries to serve as a quick test of the proposed process. The investigation focused on identifying an initial set of N & E occupations for tryout purposes. Upon approval of the N & E process, a more extensive web search, along with input from industry partners, and experts is recommended to identify a more exhaustive list of the N & E occupations likely existing within each of the three identified industries.

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Appendix A: High Growth Industry Information Gathered

To develop preliminary cases for the N & E Occupations project, three High Growth Industries were selected to demonstrate the proposed methodology:

- Healthcare
- Biotechnology
- Geospatial Technology

The following information is presented, when applicable, for each of the three industries:

- Industry Trends
- Potential N & E Occupations
- Web Site Sources

Healthcare

Industry Trends

Introduction:

Research into new and emerging health care occupations as well as employment trends for existing occupations closely mirrors the findings of the Bureau of Labor Statistics:

> "Demand for physicians' services is highly sensitive to changes in consumer preferences, healthcare reimbursement policies, and legislation. Demand for physician services may also be tempered by patients relying more on other healthcare providers—such as physician assistants, nurse practitioners, optometrists, and nurse anesthetists—for some healthcare services. Opportunities for individuals interested in becoming physicians and surgeons are expected to be favorable. Reports of shortages in some specialties or geographic areas should attract new entrants, encouraging schools to expand programs and hospitals to expand available residency slots." (http://www.bls.gov/oco/ocos074.htm)."

Summary of Industry Trends:

Shortages of physicians, surgeons, radiologists, anesthesiologists, dental hygienists, nurses, and radiological technologists and technicians have been reported for the past 5 years and are predicted to continue for the next decade. Factors contributing to the shortages include:

- Increased demand for services due to the aging general population.
- Increased technological developments fractioning practitioner time.
- Retirement or impending retirement of existing practitioners.
- Caps on programs for medical students and residents.
- Concerns with managed health care.
- Shortages of faculty available in medical and graduate schools.

Broad Occupation Changes Resulting from Industry Trends

To cope with the shortages as well the move away from hospital-based to community-based health care, practitioners are employing 'physician extenders.' These employees' tasks and responsibilities fall in between the technologists or technicians and the practitioner (e.g. physician, radiologist) with whom they work. For example, some of these occupations include:

- Nurse Practitioners
- Physician Assistants
- Radiologist Assistants
- Radiology Practitioner Assistants
- Advanced Dental Hygiene Practitioners.

Thus, these employees relieve practitioner shortages, but create shortages in technologists and technicians, as realized by the BLS:

> "Job opportunities [for radiological technologists and technicians] are expected to be favorable; some employers report difficulty hiring sufficient numbers of radiological technologists and technicians. Imbalances between the demand for, and supply of, qualified workers should spur efforts to attract and retain qualified radiological technologists and technicians. As an example of such efforts, employers may provide more flexible training programs or improve compensation and working conditions. However, a greater number of new jobs will be found in offices of physicians and diagnostic imaging centers. Health facilities such as these are expected to grow rapidly through 2012,

> due to the strong shift toward outpatient care, encouraged by third-party payers and made possible by technological advances that permit more procedures to be performed outside the hospital." (http://www.bls.gov/oco/ocos105.htm).

Technological advancements, predicted employment shortages, and unique tasks (e.g. use of radioisotopes) for Radiologists may also warrant an independent O*NET-SOC classification.

Nursing has been hit particularly hard by employment shortages:

- Thirty states were estimated to have shortages of registered nurses (RNs) in the year 2000 (Health Resources and Services Administration, July 2002).
- By 2020, 44 states plus the District of Columbia are expected to have RN shortages.
- More than one million new and replacement nurses will be needed by 2012. (*Monthly Labor Review*, BLS, February, 2004).
- DOL identified Registered Nursing as the top occupation, in terms of job growth, through the year 2012.

Shortages in all areas of nursing, especially critical care nursing, are being caused by:

- Increased demand for services.
- Inadequate supply of new graduates.
- Slowest increase in the population of RNs in 20 years.

One way of compensating for the shortages is to create new jobs through specialized and accelerated training. While helping to aid the shortage, the American Nurses Association has made the following criticisms:

> "An unwarranted proliferation of providers serves to confuse the consumers of health care who must be able to discern the roles and responsibilities of the various providers if they are to evaluate the care that they receive. The confusion that results from role blurring among providers greatly concerns the professional and regulatory communities in that such confusion may diminish professional accountability and regulatory enforcement of legal standards... Specifically, the American Nurses Association, the National Federation of Licensed Practical Nurses, Inc., and the National Council of State Boards of Nursing join to oppose: the delivery of nursing care by non-nursing personnel who are not under the supervision of a licensed nurse; the substitution of licensed nurses with unlicensed personnel; *the unnecessary creation of a new categories of health care personnel as well as other efforts that serve to fragment care*; the lowering of established legal standards designed to prohibit the licensure of persons who have not demonstrated competence to practice nursing; and the lowering of professional nursing standards that exist to ensure accountability of nurses for safe and effective nursing practice." (http://www.nursingworld.org)

Due to increasing health costs, alternative forms of treatment have also become more popular. For instance, the following new occupations are on the rise:

- Dance Therapists (recently acknowledged by AMA).
- Naturopathic Physicians or Naturopathic Doctors (considered for licensure by state legislatures).

There are other alternative forms of treatment, not listed here, that are gaining recognition. Currently, such are classified under the O*NET SOC 29-1199.99, Health Diagnosing and Treating Practitioners, All Other.

Potential N & E Occupations

Some potential N & E occupations identified in the course of conducting this research include:

- Advanced Practice Nurses
- Radiologists, Radiologist Assistants and/or Radiology Practitioner Assistants
- Advanced Dental Hygiene Practitioners
- Naturopathic Physicians
- Advanced Practice Psychiatric Nurses
- Acute Care Nurses
- Critical Care Nurses
- Dance Therapists

- Certified Nurse Midwives

At the present time, it is suggested that Advanced Practice Nurses be considered for inclusion in the O*NET-SOC taxonomy.

Comparison of Potential N & E Occupation to Criteria

Industry: Healthcare
OccupationTitle: Advanced Practice Nurses
Occupation Code: 29-1199.01

Occupation Definition: Administer advanced, specialized nursing care to diagnose and treat disease, injury and disability in a highly autonomous setting. Integrate patient care in collaboration with other healthcare professionals across the healthcare continuum.

Criterion	Met? (Y/N)	Findings and Conclusions
1. The occupation has developed due to changes in technology, society, law or business practices.	Y	This occupation has developed due to an increased demand for healthcare services due to the aging general population, increased technological developments (leaving MDs less time to interact with patients), concerns with managed healthcare, and a move away from hospital-based to community-based healthcare. APNs often serve as 'physician extenders' (employees whose tasks and responsibilities fall in between the technologists or technicians and medical doctors), providing cost-effective alternatives to traditional healthcare.
2. The work performed is significantly different than the work performed by members of other occupations.	Y	APNs meet educational, training and clinical requirements beyond those required of traditional Registered Nurses. APNs often work independently, and are able to diagnose and treat medical conditions, without the supervision of a medical doctor (MD). Some APNs can prescribe medication without the supervision of an MD.
3. The occupation is not adequately reflected in the O*NET taxonomy.	Y	While APNs are currently described as part of the SOC level definition for Registered Nurses 29111.00, the difference in skill level and work performed (see criteria #2) indicates that in the O*NET-SOC classification, this occupation would be classified at the more detailed O*NET-SOC level (.01, .02 etc.) to distinguish it from other registered nurses.
4. At least 5,000 working in the occupation	Y	According to the American Nurses Association, approximately 140,000 nurses are working as APNs.
5. High projected growth rate for the occupation.	Y	The American Nurses Association indicates that the number of APNs is growing. The U.S. Department of Labor has identified Registered Nursing as the top occupation in terms of job growth through the year 2012. It can be inferred from this information that the rate of growth for APNs is growing at a rate equal to or greater than that of other Registered Nurses.

Summary: Advanced Practice Nurses

The team determined that the work done by "Advanced Practice Nurses" is unique. Unlike other Registered Nurses, APNs often work independently, without the supervision of medical doctors. There is high demand for APNs, there are many people working in the occupation, the expected growth rate for the occupation is high, there are existing education and training programs available for this occupation and APNs are recognized by the American Nurses Association.

In addition, this occupation incorporates several of the other nursing occupations considered (Critical Care Nurse, Certified Nurse Midwife, Acute Care Nurse, and Advanced Practice Psychiatric Nurse). APN is at the appropriate O*NET SOC level, while the other occupations considered are job titles within the APN occupation. The addition of APNs to the O*NET taxonomy would reflect the basic changes taking place in the organization of the healthcare industry.

Occupational Specialties:

For Advanced Practice Nurses, several occupational specialties were identified during the Web site searching. These are:

- Critical Care Nurses
- Nurse Practitioners
- Clinical Nurse Specialists
- Certified Registered Nurse Anesthetists
- Advanced Practice Psychiatric Nurses
- Acute Care Nurses

Web Site Resources:

www.doleta.gov/BRG/IndProf/Health.cfm
http://www.bls.gov/oco/ocos074.htm
http://www.aamc.org/
http://www.asrt.org/
http://www.jrcert.org/
http://www.arrt.org/
http://www.acr.org/departments/pub_rel/press_releases/ra_functions.html
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Biotechnology

Industry Trends

Introduction:

A Web search was conducted for new and emerging occupations in the biotechnology industry. Three search terms and two general Web search modes were used in the search. Terms included "biotechnologist," "biotech," "genetic counselor" "genomic" and "bioinformatics." Search modes included a general Web search (Google) and a job listings search (Monster.com and America's Job Bank [AJB]). Listed below are the results of searches on each of the search terms. An independent Web search for occupations relating to bioinformatics was also undertaken.

Summary of Industry Trends:

A review of the biotechnology industry yielded several general trends, including:

- Educational programs in biotechnology are well-established.
- New technologies are yielding massive amounts of biodata, requiring experts in analyzing, managing and studying those data.
- New applications of biological data are leading to new occupations in biotechnology.
- Many new occupations in biotechnology cross over industry lines.

Broad Occupation Changes Resulting from Industry Trends

Although graduate programs in genetic counseling have existed for 30 years, the demand for genetic counselors is anticipated to increase as the findings of the Human Genome Project are applied. The following excerpt from the Brandeis University Genetic Counseling program Web page explains this trend, as well as the role of the genetic counselor, in detail.

> "The advent of recombinant DNA research, and more recently advances of the Human Genome Project, has produced a revolution in human genetics. This recent progress... has led to a dramatic increase in the number of individuals using genetic services. This number will continue to grow as new tests are developed for carrier detection, and the diagnosis of genetic conditions and genetic susceptibility to disease. Increased information will result in a broader spectrum of choices, responsibilities and decisions. It is predicted that genetic counselors, medical professionals with special training in genetics and counseling, will be needed in growing numbers to help families and society cope with the information and psychological implications of this genetic revolution: in hospitals and clinics to counsel families who are affected by or may be at risk for a genetic disorder; in diagnostic laboratories as resource people for physicians and their patients; and in government agencies to design genetic education programs, shape public health policy and develop more effective ways of communicating the many new findings to employers, insurers and the public at large." (http://squirrel.bio.brandeis.edu/gc01/index.html)

According to this source, Genetic Counselors may expect to perform the following tasks:

- Consult with clients regarding risk evaluations, benefits, and limitations of studies, samples needed to optimize utility, and significance of results.
- Verbally report results to clients and referrals to geneticists when appropriate.
- Collect or review medical information required for interpretations.
- Coordinate with supervisory technologists to monitor and prioritize tests.
- Assist with the design of test requisitions and report forms.

The National Society of Genetic Counselors states that there are currently 1,500 practicing genetic counselors in the United States. Job listing searches on Monster.com and AJB produced a total of 9 listings under the title "genetic counselor." Job descriptions for these listings overlapped with the Brandeis description of work in this field.

The National Center for Biotechnology Information (http://www.ncbi.nlm.nih.gov/) provides this information on bioinformatics:

> "Bioinformatics is the field of science in which biology, computer science, and information technology merge into a single discipline. There are three important sub-disciplines within bioinformatics: the development of new algorithms and statistics with which to assess relationships among members of large data sets; the analysis and interpretation of various types of data including nucleotide and amino acid sequences, protein domains, and protein structures; and the development and implementation of tools that enable efficient access and management of different types of information.
>
> - 1972 - The first biological database - Protein Identification Resource was established by Margaret Dayhoff
> - 1980 - The first complete gene sequence for an organism (FX174) is published. The gene consists of 5,386 base pairs which code nine proteins.
> - 1986 - The term "Genomics" appeared for the first time to describe the scientific discipline of mapping, sequencing, and analyzing genes. The term was coined by Thomas Roderick as a name for the new journal.
> - 1988 - The Human Genome Initiative is started (Commission on Life Sciences, National Research Council. *Mapping and Sequencing the Human Genome*, National Academy Press: Washington, D.C.), 1988."

Bioinformatics is being applied to diverse subfields, including:

- Pharmaceuticals
- Medical technology
- Biotechnology
- Computational Biology
- Proteomics
- Computer and Information Science
- Biology
- Medical Information

Potential N & E Occupations

Potential N & E Occupations identified in the Biotechnology Industry:

- Bioinformatics Scientists
- Bioinformatics Technicians
- Genetic Counselors
- Genomic Technicians
- Genetic Technologists
- Biotechnologists

It is recommended that Bioinformatics Scientists and Bioinformatics Technicians be considered for inclusion in the O*NET-SOC taxonomy.

Comparison of Potential N & E Occupation to Criteria

Industry: Biotechnology
OccupationTitle : Bioinformatics Scientists
Occupation Code: 15-2099.01

Occupation Definition: Conduct research in bioinformatics, using computational methods and scientific reasoning to predict the structure and function of newly discovered protein sequences. Design databases and develop algorithms for processing and analyzing huge amounts of genomic information.

Criterion	Met? (Y/N)	Findings and Conclusions
1. The occupation has developed due to changes in technology, society, law or business practices.	Y	Changes in technology have led to the Biotechnology disciplines. Most notable are the creation of biological databases in the early 1970's, the development of the field of genomics in the mid 1980's and the Human Genome Initiative. These changes in technology have led to the need for individuals with training in statistics, genomics, and information technology.
2. The work performed is significantly different than the work performed by members of other occupations.	Y	Bioinformatics integrates three existing fields: information science, statistics and genomics. There are several subdisciplines within this field, and the work of bioinformaticians is applied to many other disciplines, such as pharmaceuticals, medical technology, biotechnology, computational biology, proteomics, computer and information science, biology and medical informatics. There are several sub-disciplines within bioinformatics: the development of new algorithms and statistics with which to assess relationships; the analysis and interpretation of various types of data including nucleotide and amino acid sequences, protein domains, and protein structures; and the development and implementation of tools that enable efficient access and management of different types of information.
3. The occupation is not adequately reflected in the O*NET taxonomy.	Y	This occupation does not exist in the current O*NET-SOC classification. The work performed (see criteria #2) is significantly different from other O*NET-SOC occupations such as 15-20412.00 Statisticians and 19.1020.01Biologists. It is also at a different skill level than other bioinformatics occupations such as the proposed Bioinformatics Technicians (15-2099.02)
4. At least 5,000 working in the occupation	Y	No estimate of the number of employees working as Bioinformatics Scientists has been found. However, there are many educational programs, both undergraduate and graduate, in bioinformatics, and there are several organizations devoted to bioinformatics. One organization, Bioinformatics Organization, Inc, claims to have over 13,800 members.
5. High projected growth rate for the occupation.	Y	No formal estimates of the growth rates for Bioinformatics Scientists have been found, however, the increase in new education programs for the field of Bioinformatics support this conclusion. Forty-eight universities and colleges in the United States currently offer or are preparing to offer bachelors, masters, and/or doctorate degrees in Bioinformatics.

Summary: Bioinformatics Scientists

Individuals working as Bioinformatics Scientists will be trained in bioinformatics at a graduate level. This is consistent with the O*NET SOC classification structure for scientists. The phrase "Bioinformatics Scientist" was found to describe scientists working in the field, but such individuals were more commonly referred to as "Bioinformaticians."

Those occupations most similar to the proposed occupation do not reflect the broad cross-disciplinary training and specialized education required for technicians and scientists working in bioinformatics. In addition, there appears to be a significant presence of Bioinformatics, indicated by specialized degree programs and organizations, recognized by others in the Biotechnology disciplines.

Comparison of Potential N & E Occupation to Criteria

Industry: Biotechnology
OccupationTitle: Bioinformatics Technicians
Occupation Code: 15-2099.02

Occupation Definition: Build and maintain huge databases of genomic information. Apply methods for analyzing genomic information, including methods to predict the structure and function of newly discovered protein sequences.

Criterion	Met? (Y/N)	Findings and Conclusions
1. The occupation has developed due to changes in technology, society, law or business practices.	Y	Changes in technology have led to the Biotechnology disciplines. Most notable are the creation of biological databases in the early 1970's, the development of the field of genomics in the mid 1980's and the Human Genome Initiative. These changes in technology have led to the need for individuals with training in statistics, genomics, and information technology.
2. The work performed is significantly different than the work performed by members of other occupations.	Y	Bioinformatics integrates three existing fields: information science, statistics and genomics. There are several subdisciplines within this field, and the work of bioinformaticians is applied to many other disciplines, such as pharmaceuticals, medical technology, biotechnology, computational biology, proteomics, computer and information science, biology and medical informatics. Bioinformatics Technicians who have knowledge of biology, statistics and information science, and who support scientists in these diverse areas will perform work different than those in other occupations.
3. The occupation is not adequately reflected in the O*NET taxonomy.	Y	This occupations does not exist in the current O*NET-SOC classification. The work performed (see criteria #2) is significantly different from other O*NET-SOC occupations such as 43-9111.00 Statistical Assistants and 19-4021.00 Biological Technicians. It is also at a different skill level than other bioinformatics occupations such as the proposed Bioinformatics Scientists (15-2099.02).
4. At least 5,000 working in the occupation	Y	No estimate of the number of employees working as Bioinformatics Technicians has been found. However, there are many educational programs undergraduate and graduate programs in bioinformatics, and there are several organizations devoted to bioinformatics. One organization, Bioinformatics Organization, Inc, claims to have over 13,800 members
5. High projected growth rate for the occupation.	y	No formal estimates of the growth rates for Bioinformatics Technicians have been found, however, the increase in new education programs for the field of Bioinformatics support this conclusion. Forty-eight universities and colleges in the United States currently offer or are preparing to offer bachelors, masters, and/or doctorate degrees in Bioinformatics.

Summary: Bioinformatics Technicians

Individuals working as bioinformatics technicians will be trained in bioinformatics at an undergraduate level. This is consistent with the O*NET SOC classification structure for technicians. The term, Bioinformatics Technicians" was found on industry and job-related websites to describe technical positions.

Those occupations most similar to the proposed occupation do not reflect the broad training and specialized education required for technicians working in bioinformatics. In addition, there appears to be a significant presence of Bioinformatics, indicated by specialized degree programs and organizations, recognized by others in the Biotechnology disciplines.

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http://www.monster.com
http://www.hirehealth.com
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Geospatial Technology

Industry Trends

Introduction:

The President's High Growth Job Training Initiative administered by the Department of Labor's Employment Training Administration (DOL/ETA) http://www.doleta.gov/BRG/JobTrainInitiative/, indicates that there were 232,700 employees working in the Geospatial Technology Industry in 2001.

Summary of Industry Trends:

The major trends in the geospatial industry include:

- New geospatial technologies;
- Increases in the amount of geospatial data collected;
- The proliferation of applications of geospatial technologies and data across many disciplines resulting in new and emerging, cross-industry occupations.

Research indicates that geospatial technologies are being used by experts and scientists in diverse industries, such as:

- Computer Science
- Environmental Science
- Industrial Engineering
- Natural Resource Management
- Aerial Photography
- Photography
- Satellite Imagery
- Graphic Arts
- Forestry
- Engineering
- Community Planning
- Transportation
- Military Planning
- Biology
- Cartography
- Geodesy
- Geography
- Civil Engineering
- Architecture
- Archeology
- Meteorology
- Physics
- Urban Planning
- Agriculture
- Geology
- Medicine
- Geometry
- Economics
- Ecology
- Meteorology
- Sociology
- Hydrology
- Manufacturing

Broad Occupation Changes Resulting from Industry Trends

Four categories of geospatial technology competencies are identified that cover the knowledges, skills, and abilities to function in each of the twelve roles: (1) technical, (2) business, (3) analytical and (4) interpersonal. (http://gis.esri.com/library/userconf/proc02/pap0559/p0559.htm)

Environmental Systems Research Institute (ESRI) is a company that specializes in GIS research and provides consultation and software solutions for companies that wish to integrate GIS technology. Their paper *How to Recruit, Select, and Manage Geospatial Technology Professionals* presents human resource managers with a tool to use in the selection and recruitment of geospatial technology professionals. The paper also provides information on professional development plans for training across geospatial technology work roles. Twelve distinct roles are identified:

- Applications Development
- Data Acquisition
- Data Analysis and Interpretation
- Data Management
- Management
- Marketing
- Project Management
- Systems Analysis
- Systems Management
- Training
- Visualization
- Coordination

Potential N & E Occupations

Several N & E Occupations identified in the Geospatial Technology Industry:

- Geospatial Information Systems (GIS) Scientists and Technologists
- Geospatial Information Systems (GIS) Technicians
- Geospatial Specialists and Analysts
- Remote Sensing Specialists

It is recommended that Geospatial Information Systems (GIS) Scientists and Technologists and GIS Technicians be considered for inclusion in the O*NET-SOC taxonomy.

Comparison of Potential N & E Occupation to Criteria

Industry: Geospatial Technology
OccupationTitle: Geospatial Information Systems (GIS) Scientists and Technologists
Occupation Code: 15-1099.03

Occupation Definition: Design, implement and manage geospatial information systems programs, projects, applications, databases or analyses in fields such as ecology, urban planning, or military intelligence.

Criterion	Met? (Y/N)	Findings and Conclusions
1. The occupation has developed due to changes in technology, society, law or business practices.	Y	Advances in satellite imagery, remote sensing and computerized mapping of geocoded data led to the development of occupations specializing in the use of geospatial technology.
2. The work performed is significantly different than the work performed by members of other occupations.	Y	Individuals trained in using geospatial technologies, or collecting or analyzing geospatial data, work in many industries. For instance, Geospatial Information Scientists and Technologists may work in diverse organizations and fields, such as urban planning, geology, meteorology, graphic arts, manufacturing or medicine. Common to those in GIS occupations are the specific types of spatial data or databases, tools, software, and types of algorithms used in maintaining, storing and analyzing geospatial information. This work requires some content knowledge (e.g., urban planning or forestry). However, the tools and techniques of geospatial information scientists and technicians require specific training and education, such as GIS, which is distinct from the content domain.
3. The occupation is not adequately reflected in the O*NET taxonomy.	Y	While the use of GIS technology is associated with 17-1021.00 Cartographers and Photogrammetrists, and potentially other occupations as well, this occupation as a technical specialization does not exist in the current O*NET-SOC classification. It is also at a different skill level from other GIS occupations such as the proposed Geospatial Information Systems Technicians (15-1099.04).
4. At least 5,000 working in the occupation	Y	No formal estimate for the number of employees working as GIS Scientists and Technologists was found. However, the President's High Growth Industry Profile reports 232,700 employees working in the Geospatial Technology Industry in 2001.
5. High projected growth rate for the occupation.	Y	Geospatial Information Systems (GIS) Scientists and Technologists is a key occupation in the President's High Growth Industry Geospatial Technology. The abundance of training programs, (more than 35 academic institutions are affiliated with the National Geospatial Intelligence Agency) further supports this conclusion.

Summary: Geospatial Information Systems Scientists and Technologists

Individuals are trained in geospatial technology and analysis at an undergraduate and at a graduate level, and special non-academic training courses and certifications are available in geospatial technology and information. The O*NET research consultants found that "GIS Analyst" is the most common job title in this industry. However, this title is used to describe entry-level positions, with relatively few education, training or experience requirements, and positions with extensive education, training and experience requirements. For this reason, the team decided that classifying GIS occupations in a manner consistent with other occupations in the O*NET-SOC taxonomy is more descriptive. So, the high-level occupation is titled, Geospatial Information Scientists and Technologists.

Comparison of Potential N & E Occupation to Criteria

Industry: Geospatial Technology
OccupationTitle: Geospatial Information Systems Technicians
Occupation Code: 15-1099.04

Occupation Definition: Assist scientists, technologists, and related professionals in building, maintaining, modifying and utilizing geospatial information systems databases.

Criterion	Met? (Y/N)	Findings and Conclusions
1. The occupation has developed due to changes in technology, society, law or business practices.	Y	Advances in satellite imagery, remote sensing and computerized mapping of geocoded data led to the development of occupations specializing in the use of geospatial technology.
2. The work performed is significantly different than the work performed by members of other occupations.	Y	Individuals trained in using geospatial technologies, or collecting or analyzing geospatial data, work in a wide variety of industries. For instance, Geospatial Information Scientists and Technologists may work in diverse organizations and fields, such as urban planning, geology, meteorology, graphic arts, manufacturing or medicine. Common to those in Geospatial Information occupations are the specific types of spatial data or databases, tools, software, and types of algorithms used in maintaining, storing and analyzing geospatial information. This work may require some content knowledge (e.g., urban planning or forestry). However, the tools and techniques of geospatial information scientists and technicians require specific training and education, such as the geospatial and information sciences, which is distinct from the content domain.
3. The occupation is not adequately reflected in the O*NET taxonomy.	Y	While the use of GIS technology is associated with 17-1021.00 Cartographers and Photogrammetrists, and potentially other occupations as well, this occupation as a technical specialization does not exist in the current O*NET-SOC classification. It is also at a different skill level from other GIS occupations such as the proposed Geospatial Information Systems Scientists and Technologists (15-1099.03).
4. At least 5,000 working in the occupation	Y	No formal estimate for the number of employees working as GIS Technicians was found, however, the President's High Growth Industry Profile reports 232,700 employees working in the Geospatial Technology Industry in 2001.
5. High projected growth rate for the occupation.	Y	Geospatial Information Systems Technicians is a key occupation in the President's High Growth Industry Geospatial Technology. The abundance of training programs, (more than 35 academic instituions are affiliated with the National Geospatial Intelligence Agency) further supports this conclusion.

Summary: Geospatial Information Systems Technicians

Individuals are trained in geospatial technology and analysis at an undergraduate and at a graduate level, and special non-academic training courses and certifications are available in geospatial technology and information.

The O*NET research consultants found that "GIS Analyst" is the most common job title in this industry. However, this title is used to describe entry-level positions, with relatively few education, training or experience requirements, and positions with extensive education, training and experience requirements. For this reason, the team decided that classifying these occupations in a manner consistent with other occupations in the O*NET-SOC taxonomy is more descriptive. So, the lower-level occupation is titled, Geospatial Information Technicians. This is consistent with the O*NET-SOC classification structure for technicians. Those occupations most similar to the proposed occupation do not reflect the specialized education required for technicians working with geospatial information.

Web Site Sources

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Appendix B: New & Emerging Occupations from High Growth Industries

From the information gathered through Web searches, five N & E occupations were selected for inclusion in the pilot study. Codes, titles, descriptions and tasks are presented for the following occupations:

- Advanced Practice Nurses
- Bioinformatics Scientists
- Bioinformatics Technicians
- Geospatial Information Systems Scientists and Technologists
- Geospatial Information Systems Technicians

Standard Occupation Code and Title:
29-1199.01
Advanced Practice Nurses

Description:
Administer advanced, specialized nursing care to diagnose and treat disease, injury and disability in a highly autonomous setting. Integrate patient care in collaboration with other healthcare professionals across the healthcare continuum.

These are some of the alternate titles for Advanced Practice Nurses:
Acute Care Nurse Practitioners
Advanced Dental Hygiene Practitioners
Advanced Practice Psychiatric Nurses
Certified Nurse Midwife (CNM)
Certified Registered Nurse Anesthetist (CRNA)
Clinical Nurse Specialist (CNS)
Critical Care Nurses
Nurse Practitioners (NP)

These occupations are NOT the same as Advanced Practice Nurses:
29-1070.00 Physical Therapists
29-1111.00 Registered Nurses
29-2061.00 Licensed Practical and Licensed Vocational Nurses
31-1012.00 Nursing Aides, Orderlies and Attendants
31-1013.00 Psychiatric Aids
31-9092.00 Medical Assistants

Task List:
(The order of the tasks in this list does not imply relative importance to the occupation.)

1. Provide advanced nursing care in healthcare specialties, such as obstetrics/gynecology, anesthesia, psychotherapy or dentistry.
2. Assess patient medical conditions to make medical diagnoses.
3. Prescribe medications in accordance with state law.
4. Consult with patients to take medical histories and implement treatment plans.
5. Provide expert consultation for nursing staffs.
6. Implement improvements in health care delivery systems.
7. Conduct physical exams and order and interpret lab tests and X-rays to diagnose and treat disease and injury.
8. Develop quality control methods to monitor and safeguard the quality of patient care.
9. Collaborate with health care professionals, family members, and patients to provide patient care.
10. Provide education and support to the patient or the patient's designated surrogate to assist in decision making.
11. Intercede for patients who cannot speak for themselves in situations that require immediate action.
12. Coordinate care in areas such as, emergency rooms and trauma, critical care, and intensive care units.

13. Demonstrate clinical expertise in providing care to acutely ill patients, including therapy provision, diagnostic reasoning, and complex monitoring.

Standard Occupation Code and Title:
15-2099.01
Bioinformatics Scientists

Description:
Conduct research in bioinformatics, using computational methods and scientific reasoning to predict the structure and function of newly discovered protein sequences. Design databases and develop algorithms for processing and analyzing huge amounts of genomic information.

These are some of the alternate titles for Bioinformatics Scientists:
Bioinformaticist
Bioinformatics Analyst
Bioinformatics Specialist

These occupations are NOT the same as Bioinformatics Scientists:
15-2041.00 Statisticians
19-1021.00 Biochemists and Biophysicists
19-1022.00 Microbiologists
19-1023.00 Zoological and Wildlife Biologists
19-4020.00 Biological Technicians

Core Task List:
(The order of the tasks in this list does not imply relative importance to the occupation.)
1. Design and create databases of biological information, mainly comprised of nucleic acid sequences, to support research in computational molecular biology.
2. Design genomic databases with interface capabilities such that researchers can both access existing information and submit new entries.
3. Develop methods to predict the structure and/or function of newly discovered proteins and structural RNA sequences.
4. Cluster protein sequences into families of related sequences to develop protein models.
5. Align similar proteins and generate phylogenetic trees to examine evolutionary relationships.
6. Develop programs and algorithms in advanced bioinformatics to assess relationships among members of large data sets.
7. Design microarray experiments to analyze gene expression.
8. Perform statistical analyses of biological data to aid the prediction of the biological function of genes and gene products.
9. Build computational models of biological systems to aid understanding of how and when genes are expressed.
10. Translate bioinformatics analyses to research on clinical diagnosis and treatment of disease.
11. Prepare documentation, reports and presentations of results to inform the research community of new discoveries.
12. Develop statistical approaches and computational algorithms for automated pathway discovery, proteomic data analysis, genome wide expression analysis, comparative genomics, homology search, and research on conserved features and multiple alignments.
13. Develop statistical methodologies for drawing inferences from genomic data.
14. Utilize automated techniques for sequence analysis and expression analysis tasks.

15. Integrate publicly or commercially available pathway data with novel experimental data to expand the scope of research.
16. Utilize data visualization software to present genomic sequence data and annotations in an intuitive, interactive format.

Standard Occupation Code and Title:
15-2099.02
Bioinformatics Technicians

Description:
Build and maintain very large databases of genomic information. Apply methods for analyzing genomic information, including methods to predict the structure and function of newly discovered protein sequences.

These are some of the alternate titles for Bioinformatics Technicians:
Bioinformatician

These occupations are NOT the same as Bioinformatics Technicians:
15-2099.02 Bioinformatics Scientists
19-4021.00 Biological Technicians
43-9111.00 Statistical Assistants

Task List:
(The order of the tasks in this list does not imply relative importance to the occupation.)
1. Build and maintain databases of biological information, mainly comprised of nucleic acid sequences, to support research in computational molecular biology.
2. Cluster protein sequences into families of related sequences to develop protein models.
3. Align similar proteins and generate phylogenetic trees to provide researchers with insight into evolutionary relationships.
4. Perform statistical data mining on genomic data to support microarray data analysis and genetic inference.
5. Perform text mining of biological data to build knowledge from unstructured information.
6. Perform “high throughput” screening for analysis of DNA components.
7. Utilize automated techniques for sequence analysis and expression analysis tasks.
8. Utilize data visualization software to aid research in the structure of genes.

Standard Occupation Code and Title:
15-1099.03
Geospatial Information Systems Scientists and Technologists

Description:
Design, implement and manage geospatial information systems programs, projects, applications, databases or analyses in fields such as ecology, urban planning, or military intelligence.

These are some of the alternate titles for Geospatial Information Systems Scientists and Technologists:
GIS Analyst
GIS Application Specialist
GIS Data Specialist
GIS Specialist

These occupations are NOT the same as Geospatial Information Systems Scientists and Technologists:
17-1021.00 Cartographers and Photogrammetrists
17-1022.00 Surveyors
17-3031.02 Mapping Technicians
19-3092.00 Geographers
25-1064.00 Geography Teachers, Postsecondary

Task List:
(The order of the tasks in this list does not imply relative importance to the occupation.)
1. Identify and develop geospatial tools, applications and instruments to satisfy customer specifications.
2. Design geospatial and related data acquisition processes to provide needed data.
3. Process geospatial data and extract information to create products, drive conclusions and inform decision-makers.
4. Catalog, retrieve, distribute and secure geospatial and related data to assure quality products in a timely manner.
5. Oversee geospatial and related project activities to produce desired outcomes on time and within budget.
6. Assess requirements including inputs, outputs, processes and timing and performance and recommend necessary additions and adaptations to develop effective systems.
7. Analyze, design, and develop instructional and non-instructional interventions to provide transfer of knowledge and evaluation for performance improvement.
8. Render geospatial and related data into visual presentations to produce products such as maps, charts, graphs, videos and Web applications.
9. Apply knowledge of geospatial information systems to design databases or data analyses for spatial and non-spatial information.
10. Designs analyses and presentation of this data, applying knowledge of geographic information systems.
11. Consult with organization decision-makers to determine geospatial information systems needs.
12. Integrate resources and develop additional resources to support spatial and temporal user requirements.

13. Meet with users to develop system or project requirements.
14. Recommend procedures to increase data accessibility and ease of use.
15. Write reports or make presentations to inform decision-makers.
16. Conduct meetings to facilitate inter-organizational communication.

Standard Occupation Code and Title:
15-1099.04
Geospatial Information Systems Technicians

Description:
Assist scientists, technologists, and related professionals in building, maintaining, modifying and utilizing geospatial information systems databases.

These are some of the alternate titles for Geospatial Information Systems Technicians:
Engineering Aide
Engineering Technician
GIS Analyst
GIS Mapping Assistant
GIS Mapping Technician
GIS Technician

These occupations are NOT the same as Geospatial Information Systems Technicians:
17-1021.00 Cartographers and Photogrammetrists
17-1022.00 Surveyors
17-3019.00 Drafters, All Other
17-3025.00 Environmental Engineering Technicians
17-3026.00 Industrial Engineering Technicians
17-3031.01 Surveying Technicians
17-3031.02 Mapping Technicians

Task List:
(The order of the tasks in this list does not imply relative importance to the occupation.)
1. Build, maintain and modify geospatial information system databases to store spatial and non-spatial data.
2. Meet with users to develop system or project requirements.
3. Discuss specific problems to be solved, such as development of transportation planning and modeling, marketing and demographic mapping, or assessment of geologic and environmental factors.
4. Use computers, software and related tools, such as plotters, to represent geospatial information.
5. Apply knowledge of spatial feature representations to create output, such as graphs or maps.
6. Enter data into geospatial information systems database, using techniques such as application of coordinate geometry, keyboard entry of tabular data, manual digitizing of maps, scanning and automatic conversion to vectors, or conversion of other sources of digital data.
7. Determine information to be queried, such as location, trend, pattern, routing, and modeling series of events.
8. Determine and apply analysis procedures to analyze spatial relationships, including adjacency, containment, and proximity.
9. Select cartographic elements, including two-dimensional or perspective view, map projection, scale, color, shading, symbols, and additional elements, such as images, graphs, tables, and overlays to develop effective presentation of information.
10. Check cartographic symbols to verify designation.

11. Review existing and incoming data for currency, accuracy, usefulness, quality, and completeness of documentation.
12. Recommend procedures to increase data accessibility and ease of use.