
O*NET® Center Tools and Technology Quality Control Processes

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I. Overview

The purpose of this report is to describe the Tools and Technology (T2) quality control (QC) processes conducted by the National Center for O*NET Development (O*NET Center or Center). Center staff review and produce publications and applications from the T2 data deliverables. As explained by Dierdorff, Drewes, and Norton (2006), T2 objects are specific tools or technologies essential to occupational incumbents for performing their work roles. T2 objects are termed “examples” in the O*NET OnLine system. Tools are, in general, machines, equipment, and tools. Technologies are, in general, software and information technology. A commodity is a product or service at the lowest level of the United Nations Standard Products and Services (UNSPSC) taxonomy. UNSPSC commodities are termed “categories” within O*NET OnLine. Dierdorff, Drewes, and Norton (2006) provide more explanation of T2 terminology within the report titled, *A Synopsis of Data Development Procedures*.

The O*NET Center’s T2 QC processes are designed to meet two primary purposes:

1. Provide a process for incorporating the different sources of T2 objects (tools or technology examples) into one file with a consistent presentation and file structure.
2. Provide a review process to ensure that O*NET customers receive quality, accurate, and face valid lists of T2 objects and commodities for each occupation.

To meet the first purpose, the Center uses a standard file structure (see Appendix 1) and the T2 Style Guide (see Appendix 2) for all T2 deliverables. The standard file structure ensures that all deliverables can be easily combined into one file and then checked with automated computerized routines to quickly examine many different quality issues. For example, the Center examines spelling and code deviations from the United Nations Standard Products and Services Code (UNSPSC) system (<http://www.unspsc.org/>) and the O*NET-SOC taxonomy (<http://www.onetcenter.org/taxonomy.html>) using automated computer routines on the formatted files. The standard file structure also allows the Center to quickly identify and delete object duplicates both within and across the different deliverables. Identifying the source for each object and assigning a unique identifier for each unique object-occupation combination are additional benefits of a standard file structure. The standardized structure and automated routines also allow the Center to quickly transfer revisions made to an object in one deliverable to the same objects in other deliverables. Finally, the standardized file structure provides a standardized input file for the creation of T2 publications (<http://www.onetcenter.org/supplemental.html>) and applications (<http://online.onetcenter.org/search/t2/>).

Use of the style guidelines brings a more consistent presentation for T2 objects. The guidelines eliminate much of the noise from the many different ways that workers describe the same tools or technologies in the world of work. For example, Microsoft Excel is a common software technology. Yet, workers refer to and write this object in many different formats, such as MS Excel, excel, Microsoft Excel, and ms excel. Reviewing the collected objects for agreement with the style guidelines brings order to the different ways workers describe tools and technologies.

Within the T2 quality control process, the Center also examines the accuracy, quality, and face validity of the T2 objects for each occupation. The Center examines accuracy by reviewing the object-UNSPSC commodity links and the occupation-object links. For the NC State deliverables, we review a small sample of links. For customer suggestions, we examine each link or designate these links ourselves.

While the Center examines the face validity of T2 objects throughout all phases, the online review is the phase where we place the most focus. First, the Center IT contractor implements automated routines based on commodity and object frequencies to select the categories and examples displayed within the O*NET OnLine summary and detail reports. Then, Center analysts review the displayed commodities and examples and make selections to enhance face validity.

To enhance the quality and usability of T2 data, the Center conducts many different reviews including the low frequency and not elsewhere classified (NEC) reviews. The low frequency review flags occupations with less than three unique objects for both tools and technologies. Then, we conduct additional research on these flagged occupations to ensure that O*NET customers see a minimum number of both tools and technologies. When NC State is unable to classify objects within the UNSPSC taxonomy, they assign the object to NEC. The Center's review of these NEC classified objects is designed to find suitable commodity links, thereby increasing the number of objects published for each occupation. More details on the other QC reviews conducted by Center staff are described in the following pages.

II. Five Phases of Tools and Technology (T2) Quality Control

The O*NET Center QC processes are composed of five phases:

- Phase 1: Review of T2 File Deliverables
- Phase 2: Current Year Review
- Phase 3: All Years' Review
- Phase 4: Online Review
- Phase 5: Publication of T2 Files

QC work proceeds in a straight progression from Phases 1 to 5. The earlier phase has to end before the next phase begins. Phase 1 is the longest phase covering 9 months and usually ends in September. Phases 2 and 3 each last approximately one month. The last 2 phases each last approximately 2 weeks with Phase 5 ending in December.

The first phase, the individual file reviews, verifies the quality and occupational coverage of the T2 data received from North Carolina State University (NC State), O*NET OnLine, ACINet, and the other sources. The current year and all years' reviews check for consistency in taxonomy linkages and style presentation across the different sources of T2 data. The online review

examines the face validity of the categories and examples appearing in the O*NET OnLine reports. After the online review is complete, the Center's IT contractor prepares the T2 files for publication.

NC State collects the vast majority of T2 data (National Center for O*NET Development, 2010) using their general collection procedures (Dierdorff, Drewes, & Norton, 2006). NC State begins work on at least 100 new occupations each January. They deliver their work in six batches, beginning in February and then delivering a batch each subsequent month with the last batch arriving in July. Each NC State batch deliverable contains a group of occupations and the T2 objects and commodities that NC State has linked to those occupations.

The Center T2 processes begin in January with the Center delivering to NC State the list of occupations for the year and ends at the end of the year, usually December with the publication of T2 data. For T2 customer submissions, the collection period runs from July 1st of the previous year to June 31st of the current publication year. The December T2 publication for the year, usually released in December, contains data from both the NC State batches and the other sources of T2 data.

III. Phase 1: Review of T2 File Deliverables

As soon as the list of occupations for the current year's T2 work is approved by the United States (US) Department of Labor (DOL) Education and Training Administration (ETA), the O*NET Center T2 lead sends this list to our IT contractor. The contractor will check the occupations on the list for duplicates and notify the T2 lead if any are found. Within Phase 1 of the T2 QC processes, the O*NET Center reviews the T2 deliverables, which include the six NC State batches, the low frequency searches, the customer additions, and any special T2 collection requests. NC State collects and delivers both the six batches and the low frequency search. The Center collects customer additions from the Career One Stop Job Description Writer (<http://www.careerinfonet.org/jobwriter/default.aspx>) at America's Career InfoNet (ACINet) Web site (<http://www.acinet.org/>) and the O*NET Web sites (<http://online.onetcenter.org> and <http://www.onetcenter.org/t2/>). The Center or NC State may conduct T2 special collection requests.

A. Phase 1 - North Carolina State University (NC State) Batches

The primary source of T2 data are the NC State batch deliverables. Over 96% of the T2 objects within the 2010 T2 publication were provided by NC State (National Center for O*NET Development, 2010). The Center sends each NC State batch through 10 review steps. More details on each of the 10 steps are presented below.

Center Ten Step Review Process

Step 1: O*NET Center Conducts Initial Review

- Step 2: IT Contractor Conducts Automated Checks
- Step 3: Center Reviews Results of Automated Checks
- Step 4: Center Conducts Style and Level Review
- Step 5: Center Conducts Web Searches
- Step 6: Center Reviews NEC Classified Objects
- Step 7: IT Expert Reviews Difficult Technology Cases
- Step 8: Center Reviews T2 Objects for Consistent Presentation
- Step 9: Center Project Managers Review Proposed Changes
- Step 10: NC State Reviews Proposed Changes

Step 1 (Phase 1, NC State Batches): O*NET Center Conducts Initial Review

The Center initiates Phase 1 of the quality control processes by conducting three checks.

Initial Three Checks

1. Review O*NET-SOC codes and titles to ensure they are consistent with the latest O*NET taxonomy (<http://www.onetcenter.org/taxonomy.html>).
2. Identify requested occupations not included within the deliverable.
3. Review file to ensure it follows the T2 file transfer structure (see Appendix 1).

If occupations are missing or O*NET-SOC codes and titles are not consistent with the latest O*NET taxonomy, the Center T2 team lead will make a recommendation to the project managers. If no concerns are identified in the first three checks, the T2 lead assigns occupations to Center analysts. The T2 lead then sends the deliverable onto the IT contractor for automated checks.

Step 2 (Phase 1, NC State Batches): IT Contractor Conducts Automated Checks

The Center IT contractor runs the 9 automated checks below on the NC State deliverable, maintaining the not elsewhere classified (NEC) cases within the file. The contractor then splits the file into separate review files for Center analysts.

Nine Automated Checks

1. Verify that O*NET-SOC codes and titles are consistent with the latest O*NET taxonomy (<http://www.onetcenter.org/taxonomy.html>).
2. Verify that requested occupations are included within the deliverable.
3. Produce a list of objects with the first letter of the first word not capitalized.
4. Produce a list of objects linked to more than one commodity across multiple occupations.
5. Verify that there are no duplicate objects linked to one occupation.
6. Verify that the UNSPSC (<http://www.unspsc.org/>) commodity and class codes and titles are consistent with the UNSPSC version in use.
7. Produce, for all revised T2 objects, a list of all corresponding unrevised or unchanged objects across the current file.
8. Flag not published objects indicating NEC (not elsewhere classified) and deleted objects.

9. Produce a worksheet showing the number of T2 objects and commodities per occupation after suppression. The Center's focus for this review is the number of unique objects that will be displayed after suppression. (Within O*NET OnLine (<http://online.onetcenter.org/>), we suppress the display of those objects that exactly match their commodities because they are redundant with the commodities which are also displayed.) While these redundant objects are suppressed within O*NET OnLine, they are maintained within the T2 publication file and Center internal files. The worksheet that is produced highlights those occupations with fewer than 3 unique (not matching the linked commodity), tool or technology objects. The goal is to have 3 or more unique T2 objects for each occupation for both tool and technology categories displayed in O*NET OnLine.

Step 3 (Phase 1, NC State Batches): Center Reviews Results of Automated Checks

The Center analysts review 5 of the 9 automated checks in Step 3

1. Review O*NET-SOC codes and titles not consistent with the latest O*NET taxonomy (<http://www.onetcenter.org/taxonomy.html>).
2. Review objects with the first letter of the first word not capitalized.
3. Review objects linked to multiple commodities across multiple occupations. Verify rationale supporting the linking of one object to multiple commodities.
4. Review duplicate objects linked to one occupation.
5. Review UNSPSC (<http://www.unspsc.org/>) commodity and class codes and titles not consistent with the UNSPSC version in use.

When recommending a change to a commodity link for an NC State submitted case, the Center provides a rationale and documentation of research and Web sites supporting the change. When Wikipedia or similar Web sites are used to support changes, the Center also provides other quality Web sites or sources and rationales to support the changes. The Center does not support changes by referencing solely Wikipedia or similar Web sites.

Step 4 (Phase 1, NC State Batches): Center Conducts Style and Level Review

In the style and level review, the Center examines the Style Guide (see Appendix) and the level relationship between the objects and commodities. The style and level review is composed of two parts:

Part 1: Center checks all objects for consistency with style guidelines.

Part 2: Center checks all objects to ensure that objects are presented at the same level or a more specific level than the commodity. The Center flags those objects more general than the commodity for NC State revision

Step 5 (Phase 1, NC State Batches): Center Conducts Web Searches

In a continuous improvement effort, the Center conducts a more extensive review of one or two occupations within each NC State batch deliverable. The Center team conducts Web searches to research and develop a better understanding of the objects and their commodity classifications. Analysts go to company Web sites to find the latest presentation of software objects and to see if the software is developed by a government agency and/or distributed as freeware or shareware. The Center believes this closer examination of a sample of cases keeps the review team closer to and more knowledgeable of NC State’s T2 data collection processes and their commodity classifications.

Step 6 (Phase 1, NC State Batches): Center Conducts NEC Review

T2 object classifications are made to the United Nations Standard Products and Services Code (UNSPSC) classification system (<http://www.unspsc.org/>). The UNSPSC system is a global, multi-sector standard for the classification of products and services. NC State identified and recommended the adoption of the UNSPSC system as the taxonomic structure for collected T2 objects (Dierdorff, Drewes, & Norton, 2006). While it has served the purpose of classifying T2 objects extremely well, a small number of T2 objects are very difficult to classify.

To address those instances where the UNSPSC does not provide a suitable classification for collected objects, NC State created a NEC (not elsewhere classified) classification and linked these unable-to-classify objects to NEC. The Center maintains these T2s within internal files but does not publish the NEC classified objects.

The Center review of NEC classified objects grew out of the QC reviews the Center conducts on all NC State deliverables. Within the 2008 QC reviews, the Center identified a few T2 objects classified to NEC that could be classified to a UNSPSC commodity. The Center decided to expand this review to include all NEC classified objects. Following from the Center’s objective to publish as many objects as possible, more objects are made available for customer use by identifying an appropriate UNSPSC commodity.

Within the first four years of T2 data collection (2005-2008), NC State classified 267 objects to the NEC classification. In the Center’s review of these 267 objects, we struck a balance between the desire to publish as many objects as possible and the concern of inappropriate classifications. Two Center analysts reviewed the 267 objects and recommended keeping the NEC classification for 123 objects, changing the NEC classification to a UNSPSC commodity for 122 objects, and deleting 22 objects. Center project managers and NC State also reviewed and approved the new UNSPSC classifications. This review of the NEC classified objects resulted in the publication of 122 objects that were previously unpublished.

Table 1
Examples of T2 Objects Classified to a UNSPSC Commodity from NEC

O*NET-SOC Code	O*NET-SOC Title	T2 Object	Commodity
17-2031.00	Biomedical Engineers	Bacteria-based environmental toxicity testing devices	Bacteria transformation kits

O*NET-SOC Code	O*NET-SOC Title	T2 Object	Commodity
19-1023.00	Zoologists and Wildlife Biologists	Dart guns	Air rifles or air handguns
29-1125.00	Recreational Therapists	Digital drumsticks	Percussion instrument accessory
29-1111.00	Registered Nurses	DrugGuide medical information reference software	Information retrieval or search software
17-1022.00	Surveyors	Elevator tripods	Instrument tripods
51-8011.00	Nuclear Power Reactor Operators	Fuel handling systems	Nuclear fuel rod
29-1024.00	Prosthodontists	Intraoral still cameras	Videoscopes
19-1021.00	Biochemists and Biophysicists	Laser tweezers	Lasers
29-1071.00	Physician Assistants	Life support for trauma and transport LSTAT intensive care units	Emergency response litters or stretchers or accessories
13-1061.00	Emergency Management Specialists	National Notification Network 3n InstaCom Enterprise	Automatic call distributor ACD
29-2033.00	Nuclear Medicine Technologists	Radiation protection eyewear	Eye shields
17-1022.00	Surveyors	Robotic tripods	Instrument tripods
27-4012.00	Broadcast Technicians	Satellite trucks	Minivans or vans
47-2051.00	Cement Masons and Concrete Finishers	Sidewalk forms	Cement retainers

The Center also requested that the UNSPSC add these NEC classified objects as new commodities. The UNSPSC is a member-funded organization that allows members to request changes to its classification system or code set. If, at some point, the UNSPSC adds these commodities to the classification system, the Center could then reclassify these same objects and any similar future T2 data to the new UNSPSC commodities. This process began by identifying 160 objects from the pool of 245 (122 plus 123) that were suitable for submission as new

commodities. Due to duplication in the list of 160 objects across occupations, the final list submitted to the UNSPSC included only 131 commodity additions.

Out of the 160 objects identified, the Center recommended keeping the NEC classification for 123 of the objects and revising the NEC classification to a UNSPSC commodity for the remaining 37 objects. Changing the classification to a UNSPSC commodity for these 37 objects allowed the Center to both publish and submit them to the UNSPSC for commodity additions. If the UNSPSC adds these commodities at a future point, the Center can revise the classifications within the T2 database.

Many of the commodities submitted to the UNSPSC, such as biomimetic robots and digital drumsticks, can be considered new tools and technology. Yet, not all of the submissions are new. Some of the commodities, such as pepper spray and safety blocks, have been in use for many years.

Table 2

Examples of T2 Objects Submitted as Commodity Additions to the UNSPSC

T2 Objects	Class Code	Class Title
Autonomous underwater vehicles AUV	25111500	Commercial marine craft
Bacteria-based environmental toxicity testing devices	41106200	Microorganism propagation and transformation media and kits and equipment
Biomimetic robots	23153200	Robotics
Dart guns	46101500	Firearms
Digital drumsticks	60131500	Musical instrument parts and accessories
Driving simulators	42183000	Ophthalmic diagnostic exam products
Dry tape banjos	30161500	Wall finishing materials
Graston instruments	42251600	Rehabilitation exercise devices and equipment
Gunshot residue kits	41113300	Liquid and solid and elemental analyzers
Low-velocity explosive actuated fastening tools	27112400	Fastener setting tools
Pepper spray	46151600	Security and control equipment
Personal computer PC transcription foot pedals	43211700	Computer data input devices
Remotely operated vehicles ROV	25111500	Commercial marine craft
Safety blocks	23171600	Machine tools

T2 Objects	Class Code	Class Title
Stun guns	46151600	Security and control equipment
Submersible vehicles	25111500	Commercial marine craft
Trace evidence vacuums	46151700	Forensic equipment and supplies and accessories
Transfer carriages	26142100	Nuclear reactor equipment

After the 2008 NEC review, the Center added an NEC review of each NC State batch deliverable to its QC processes. In 2009, NC State classified 19 objects to NEC. Two analysts at the Center reviewed these 19 NEC objects and recommended revising 10 of the NECs to UNSPSC commodities and keeping the NEC classification for the other 9 objects. A total of 38,186 T2 objects were published within the 2009 cumulative T2 database. One hundred sixteen (116) objects were classified to the NEC commodity and not published in 2009. In 2010, the Center published 43,848 T2 objects with another 121 objects classified to NEC and not published. NC State classified 16 NEC cases in 2010. The Center changed the NEC classification to a UNSPSC commodity for 10 of the 16 cases from 2010.

Step 7 (Phase 1, NC State Batches): IT Expert Reviews Difficult Technology Cases

As the Center team reviews a sample of the object-commodity linkages within each NC State deliverable, they identify cases where they question commodity links and then conduct more research on these cases. In some cases, the Center analysts realize they need help from someone with expertise in the IT field. These cases are sent to an IT expert with over 20 years of experience. He reviews the identified computer software and hardware objects and provides research and rationale to support his judgments for the best commodity links. The Center team then incorporates the IT expert reviews within the overall review of the batch. Examples of the reviews conducted by the IT expert are presented in Table 3.

Table 3

Examples of IT Expert Reviews for T2 Objects

Occupation	T2 Object	UNSPSC Commodity	IT Expert Review
Graphic Designers	Adobe ActionScript	Development environment software	Adobe Actionscript is the scripting language used in Adobe Flash. I researched Flash (http://www.adobe.com/products/flashplayer/) and see that it can be used on "operating systems, browsers, mobile phones and devices". Based on these varied platforms the more generic object "Development environment software" is more appropriate than "Web platform development software" since the tool can also be implemented on platforms other than web browsers.

Occupation	T2 Object	UNSPSC Commodity	IT Expert Review
Remote Sensing Scientists and Technologists	BAE Systems SOCET GXP	Map creation software	This object is similar to the Gamma Remote Sensing software. I don't see any additional functionality with this product... it essentially creates maps and geographically correct images. Both of these products should have the same commodity - either Map Creation Software or Analytical or Scientific Software. I believe Map Creation Software is the more accurate commodity.
Computer Operators	BMC CONTROL-M software	Operating Environment Software	I would classify this as 43233004 Operating Environment Software. It is used to schedule programs to run in various operating system and application system environments.
Property, Real Estate, and Community Association Managers	Bostonpost Technology Property Manager	Data base user interface and query software	This is not an ERP software package. I would classify it as 43232306 Data base user interface and query software. This is based upon several findings on the website but the most conclusive was "To accomplish this design goal, Bostonpost Property Manager combines a single, intuitive, Windows interface with a powerful SQL Server database. This unified design is the key to making the system easy to use and allowing users to access information used throughout the company regardless of property type or where employees and properties are located." I found this at http://www.bostonpost.com/product_description.htm
Computer Security Specialists	Hewlett-Packard HP OpenView	Network monitoring software	This is not HelpDesk or Call center software; it is used to monitor and manage computer networks and systems. The classification should not depend upon the occupation because the object essentially provides the same functions regardless of the occupation using it. The generic "OpenView" product provides network, system, storage and application monitoring and management functions within the suite and should be listed as Network Monitoring Software. More specific product names (e.g. OpenView Service Center) provide insight into what system component it is used to manage and can be classified as one of the more specific codes in Network Management Software or Operating Environment Software. This object classification is correct in my opinion.
Statisticians	IBM DB2	Data base user interface and query software	In most cases, any non-IT SOC will be using a product such as DB2 to manipulate and analyze the data. They will rarely be using the full spectrum of capabilities available within the DBMS software commodity that an IT professional would. While there are exceptions I believe that in most cases the non-IT occupations uses a product such as DB2 as a data base user interface and query tool.
Mechanical Engineers	Life cycle cost software	Analytical or scientific software	This is not CAD software or accounting software. It appears that this type of product allows an engineer to specify different materials and design options used in a product and then calculate the life cycle cost. Since this is an engineering analytical tool I would classify it as Analytical or scientific software. Here is a link that describes engineering life cycle cost... http://www.springerlink.com/content/1773np11732w4m25/

Occupation	T2 Object	UNSPSC Commodity	IT Expert Review
Rehabilitation Counselors	Microsoft ActiveSync	Mobile operator specific application software	This should be coded as Mobile operator specific application software (43233508) because it is an optional software interface that synchs calendars, notes, emails, photos, music, etc... more than just a calendar. It is also only applicable to cell phones.
Paralegals and Legal Assistants	Saga Practice Manager	Data base user interface and query software	This is more than a document management software since it also handles calendars, expenses, generates reports, etc. I would assign it to the commodity Data base user interface and query software since the information entered is saved in a database for retrieval.
Rehabilitation Counselors	Windows Mobile Explorer	Internet browser software	The correct product name is Microsoft Mobile Explorer (MME) and it is an internet browser installed on cell phones that run the Windows Mobile operating system. I think it should be coded as (43232705)

Step 8 (Phase 1, NC State Batches): Review T2 Objects for Consistent Presentation

If deemed necessary, the Center will review object titles to ensure consistency in presentation. This consistency review will only be conducted when some concern arises. Two common sorts used to conduct this review are 1) Sort objects alphabetically looking for consistency in presentation across occupations, and 2) Sort file first by commodity and then by object to identify like objects that may appear in multiple forms. Before conducting this review, the Center analysts discuss and agree on the best sorts and file formatting to address the concern(s) identified.

Step 9 (Phase 1, NC State Batches): Center Project Manager Reviews

Center project managers review the proposed changes and note concerns or questions. After the concerns and questions are addressed, the Center T2 lead prepares the batches for delivery back to NC State.

Step 10 (Phase 1, NC State Batches): NC State Reviews Proposed Changes

NC State reviews the Center proposed changes and notes their agreement or disagreement. The Center and NC State then resolve any differences. As reviews are completed on the individual files, the Center T2 lead saves the six completed NC State batches to later combine them into one NC State file for the year.

B. Phase 1 - Low Frequency Searches

Each year, after all NC State deliverables have been reviewed, the Center IT contractor runs frequency counts to identify the number of unique tools and technologies for every occupation. For those occupations not meeting the Center's coverage goal, the T2 lead requests a more

targeted search from NC State. The low frequency searches are in-depth searches to address coverage needs when there is a disparity between the lists of tools and technology objects, with one category having few or no unique objects. For those occupations with low representation, one category, tools or technologies, displays many objects or examples, and the other category displays no or very few examples.

The Center first asked NC State to conduct this targeted search in 2006, the second year of T2 collection. It was successful in achieving some representation of both tools and technologies for most, but not all, occupations. Starting mid-2007, the Center refined its goal to aim for the collection of three or more unique objects for both tools and technology. The Center defines unique as an object that does not exactly match the commodity. If the object is a synonym of the commodity, but not exactly the same, the Center treats this object as a unique object. Within the O*NET OnLine reports, the Center suppresses examples that exactly match the UNSPSC (<http://www.unspsc.org/>) commodity.

The Center conducts the same 10 step review process on the low frequency deliverable as it does on the other T2 deliverables. The Center reviews the objects, proposes revisions or accepts the additions as is, and then asks NC State to approve the final recommendations. The Center T2 lead incorporates any additional changes from NC State within the low frequency file for later inclusion within the Current Year (CY) review.

C. Phase 1 - Customer Additions File

The O*NET Center provides customers the ability to interact with the T2 database and suggest additions or revisions. Customer input helps to keep the database fresh and representative of the broad range of tools and technology used in the workplace. The Center invites employers, workforce development professionals, occupational incumbents, experts, and other interested parties to review T2 data, either online or in the T2 downloadable database (<http://www.onetcenter.org/supplemental.html#tools>). Feedback to the O*NET Center can be provided through O*NET OnLine Details reports (<http://online.onetcenter.org>) and the T2 page of the Developer's Corner on the O*NET Resource Center Web site (<http://www.onetcenter.org/t2/>). America's Career InfoNet (ACINet) also collects customer T2 submissions through the Career One Stop Job Description Writer (<http://www.careerinfonet.org/jobwriter/default.aspx>). This Web application assists employers in writing meaningful descriptions of current or future positions in their organization.

Before the customer additions are sent through the automated checks, the T2 customer additions lead ensures that all UNSPSC (<http://www.unspsc.org/>) commodity links are assigned and the customer submissions file is converted to the T2 file transfer structure. The Center maintains the original submissions, the revised submissions, and a rationale for revision. Within the file transfer structure, the Center uses the T2 object column for original customer submissions and the revised T2 object column for revised submissions. For those T2 objects submitted by customers that cannot be classified to a UNSPSC commodity, the customer additions lead labels the object NEC and assigns a UNSPSC Class code (the broader level above UNSPSC Commodity).

Upon receipt of the file, the IT contractor verifies that the occupations included within the file are current T2 occupations, auto-fills any blank Class columns, and checks for duplicates. When duplicates are identified, the Center reviewers remove the redundant customer additions, not the NC State submissions or the already published T2s.

The customer additions file undergoes the same ten-step review process as other deliverables. In the final step, the Center asks NC State to review and approve or reject final recommendations. The Center T2 lead incorporates the approved changes within the final customer additions file for inclusion in the T2 current year (CY) review.

D. Phase 1 – Summary

In Phase 1, the Center reviews and combines the T2 deliverables from the different sources, including NC State, O*NET customer submissions, and ACINet customer submissions. The Center coordinates and manages the T2 file deliverables through a series of QC reviews. At the end of Phase 1, each deliverable has been through several reviews including the initial Center analyst reviews, the IT expert reviews, the Center project manager reviews, and, finally, reviews of the Center’s proposed changes by NC State. The Center T2 lead incorporates the decisions made with each review and then stores the final versions of the individual file deliverables. After all deliverables have been reviewed and approved, the Center T2 lead combines the individual files to form the input file for the current year (CY) review. Before starting the CY review, the Center T2 lead reviews a random sample of cases to ensure the revisions have been correctly incorporated into the combined CY file.

IV. Phase 2: Current Year (CY) Review

The current year (CY) review looks for consistency in presentation and object-commodity classifications across the T2 files received in the current year. The review of style guidelines and the object-commodity level relationship are not included within this review. The CY review does not begin until the reviews of all NC State batches, the customer additions files, and all other individual file deliverables are complete.

Throughout the next three phases of the QC process, the current year, all years’ and online reviews, the IT contractor includes all columns of the T2 file structure and maintains the notes and comments provided within the columns. For example, the IT contractor maintains the notes, comments, and entries included within the revised T2 object, action, and explanation columns of the T2 file structure.

The CY review is composed of 6 steps:

- Step 1: IT Contractor Conducts Automated Checks
- Step 2: Center Reviews Results of Automated Checks

- Step 3: IT Expert Reviews Difficult Technology Cases
- Step 4: Center Assigns Identification Numbers (IDs)
- Step 5: Center Project Managers Review Proposed Changes
- Step 6: IT Contractor Produces Deliverable

Step 1 (Phase 2): IT Contractor Conducts Automated Checks

The same eleven automated checks that the IT contractor conducts in Phase 1 are also conducted within Phase 2.

Step 2 (Phase 2): Center Reviews Results of Automated Checks

The Center focuses on five of the nine automated checks during the current year review. Other reviews may be conducted as deemed necessary. The T2 lead sorts the file by occupation code and then by commodity code before splitting the file by the number of reviewers. To facilitate the review of similar cases across occupations, the T2 lead also provides the complete CY file to the reviewers.

1. Verify that O*NET-SOC codes and titles are consistent with the latest O*NET taxonomy (<http://www.onetcenter.org/taxonomy.html>).
2. Review objects with the first letter of the first word not capitalized.
3. Review objects linked to multiple commodities across multiple occupations. Verify rationale supporting the linking of one object to multiple commodities.
4. Review duplicate objects linked to one occupation. When the Center identifies duplicate cases involving customer additions, the IT contractor designates the customer addition as the duplicate. The reviewers delete the customer addition, not the NC State submission.
5. Review UNSPSC (<http://www.unspsc.org/>) commodity and class codes and titles not consistent with the UNSPSC version in use.

Step 3 (Phase 2): IT Expert Reviews Difficult Technology Cases

The Center asks for help from an IT expert in reviewing difficult to classify computer software and hardware objects which show up as concerns within the automated check reviews. If no concerns arise, this step is skipped.

Step 4 (Phase 2): Center Assigns Identification Numbers (IDs)

The Center T2 team lead coordinates with NC State to ensure each T2 case within the current year file has a unique ID assignment. The IDs assigned in the current year follow the final ID assignments of the previous year.

Step 5 (Phase 2): Center Project Managers Review Proposed Changes

Center project managers review the proposed changes and note concerns or questions. After the concerns and questions are addressed, the Center T2 lead prepares the file for delivery to the IT contractor.

Step 6 (Phase 2): IT Contractor Produces CY File

To remove errors from the CY file before adding it to the previously published T2 file, the IT contractor runs the automated checks again. Several iterative checks between the IT contractor and the T2 lead are usually necessary to remove all errors. The Center T2 lead reviews a random sample of Center revisions to ensure they have been correctly incorporated into the final CY file. The IT contractor checks to ensure all cases have an ID assignment with no overlap. The output of the current year review is the CY file with all columns and maintaining the notes and comments made to support changes.

V. Phase 3: All Years' (AY) Review

The all years' (AY) review looks for consistency in T2 presentation across the multiple years of T2 publications. The AY review is composed of 6 steps:

- Step 1: IT Contractor Conducts Automated Checks
- Step 2: Center Reviews Results of Automated Checks
- Step 3: Center Reviews T2 Objects for Consistent Presentation
- Step 4: Center Project Manager Reviews
- Step 5: NC State Reviews Proposed Changes
- Step 6: IT Contractor Produces Final AY File

Step 1 (Phase 3): IT Contractor Conducts Automated Checks

The IT contractor initiates the AY review by combining the final file deliverable from the CY review and the previously published T2 file. The automated checks of the AY review are performed on this one combined file. Throughout the AY review, the IT contractor maintains the notes and comments. The same nine automated checks conducted in the CY review and the individual file reviews are performed in the AY review. Several iterative checks between the IT contractor and the T2 lead may be necessary to eliminate duplicate cases and other issues that may arise when combining the two files.

Step 2 (Phase 3): Center Reviews Results of Automated Checks

Only five of the nine automated checks are examined in the AY review. The review of unrevised objects is an important added focus for the AY review. For those objects changed within the CY review, the Center ensures those changes are carried through to the same objects included within the previously published T2 file.

1. Review O*NET-SOC codes and titles that are not consistent with the latest O*NET taxonomy (<http://www.onetcenter.org/taxonomy.html>).
2. Review objects linked to multiple commodities. The Center analysts examine those cases where the same objects are linked to multiple commodities and determine the need for commodity changes. When changing a commodity link for an NC State submitted case, Center analysts strive to provide needed documentation of research and Web sites supporting the change. It is not acceptable for Center analysts to simply provide a Web site or Web sites with no explanation or rationale supporting the changes. When Center analysts use Wikipedia to support changes, they must also provide another Web site or source and rationale to support the changes.

Rather than reviewing the object as a standalone object, Center analysts examine how the object may be used in different ways by different occupations. It is appropriate, in some cases, for the same object to link to different commodities. Before making software changes, Center analysts examine our IT experts' previous recommendations for the same or similar cases. When making changes within the AY review, Center analysts add their name in the reviewer column.

3. Review unrevised objects, where the same object title has been changed for a different T2 case. Determine if object changes should be applied to unrevised objects.
4. Review duplicate objects linked to one occupation. The reviewers delete the customer addition, not the NC State submission or the already published object.
5. Review UNSPSC (<http://www.unspsc.org/>) commodity and class codes and titles that are not consistent with the UNSPSC version in use.

Step 3 (Phase 3): Center Reviews T2 Objects for Consistent Presentation

Center analysts review object titles to ensure consistency in presentation within the AY file. In this review, Center analysts consider the importance of maintaining the unique language of the occupation to the extent possible and as judged appropriate. Center analysts conduct this review every other year. We are exploring other options for conducting this review in the intervening years.

Step 4 (Phase 3): Center Project Manager Reviews

Center project manager review the proposed changes and note concerns or questions. After concerns and questions are addressed, the Center T2 lead prepares the AY file for delivery to NC State.

Step 5 (Phase 3): NC State Reviews Proposed Changes

NC State reviews the proposed AY file changes and notes their agreement or disagreement. The Center and NC State then resolve any differences.

Step 6 (Phase 3): IT Contractor Produces Final AY File

At this last step of the AY review, the Center T2 lead and IT contractor work cooperatively to produce the final AY file. To eliminate errors, the T2 lead and IT contractor may send files back and forth for multiple iterations of automated checks and review. The Center T2 lead reviews a random sample of Center revisions identified both before and during the AY review to ensure the revisions have been correctly incorporated into the final AY file. The output of the AY review is an AY file maintaining the T2 file structure columns and the notes and comments needed to support changes.

VI. Phase 4: Online Review

The online review phase examines the face validity and occupational coverage of displayed objects and commodities. The online review is composed of 3 steps:

- Step 1: IT Contractor Builds Review File and Populates O*NET OnLine Staging Site
- Step 2: Center Review of Displayed Categories (commodities) and Examples (objects)
- Step 3: IT Contractor Produces Deliverable

Step 1 (Phase 4): IT Contractor Builds Review File and Populates O*NET OnLine Staging Site

The IT contractor initiates the work of this review phase by producing an OnLine review file and populating the O*NET OnLine staging site with T2 cases drawn from the final all years' (AY) review file.

The online review file delivered to the Center shows, for each occupation, the objects and commodities displayed within the O*NET OnLine (<http://online.onetcenter.org/>) summary and detail reports. To ensure that none of the objects are suppressed on the public site, the IT contractor selects objects and commodities after object suppression has been implemented. The file provided by the IT contractor allows Center analysts to change the display of both objects and commodities.

Step 2 (Phase 4): Center Review of Displayed Categories and Examples

In this review, Center analysts examine the examples and categories displayed on the O*NET OnLine summary and detail reports.

- Part 1: Review of commodities: Within O*NET OnLine, T2 commodities are referred to as categories for ease of understanding. This review focuses on identifying alternate categories with more face validity. Center analysts determine if changes should be made to the T2 categories displayed within O*NET OnLine (<http://online.onetcenter.org/>). The display of categories is based on category

rankings. Categories are ranked based on the number of objects linked to the categories (commodities), with the most heavily-linked commodities ranking highest. Examples/objects suppressed are not counted towards the number of examples linked for a commodity. When the number of object links to commodities is equal, the digits of the commodity are reverse numbered and then sorted in ascending order. This review begins with the IT contractor applying the analyst changes from the previous year (aka overrides). Then, Center analysts only examine those occupations with category rankings that have changed, after applying the overrides from the previous year.

Part 2: Review of objects: Within O*NET OnLine, T2 objects are referred to as examples for ease of understanding. To begin the example review, the IT contractor creates an algorithm that selects two objects that are unique to the occupation and two objects that are common to all published occupations for display in O*NET OnLine (<http://online.onetcenter.org/>) summary and detail reports. Center analysts will only examine those occupations with changing objects/examples. The Center reviews the four examples selected by the algorithm and checks for alternate examples based on three issues.

- A. Face Validity – Center analysts replace less face valid examples with alternates.
- B. Specificity – Center analysts replace generic examples with more specific examples. For example, a specific type of database software such as SalesInSync software, which includes the company name, should replace the generic example of database software.
- C. Company duplicates for one commodity/category – Center analysts examine whether alternate examples can be identified when one company is featured within several examples for one category. For example, if both Westlaw and Westlaw Real Property Deed Images are displayed for the category, Information Retrieval or Search Software, the analyst determines if an alternate example should replace one of the Westlaw examples.

Step 3 (Phase 4): IT Contractor Produces T2 O*NET OnLine File

The IT contractor and Center review team work cooperatively until all changes are incorporated into the online file and no errors are detected on the staging site. The Center analysts review a random sample of occupations on the O*NET OnLine staging site to see if the changes have been incorporated.

VII. Phase 5: Publication of T2 Files

In this final phase, the IT contractor and the other members of the Center T2 team finalize:

1. T2 Publication Files – The IT contractor and the Center T2 team members update the O*NET OnLine files, T2 publication database, online database files, fact sheet, read me file, lists of occupations, What’s New, and downloadable files.
2. All Years’ (AY) File – The Center internal AY file incorporates the reviews of all T2 cases from the current year and from previous years. Center notes and comments provided within the columns of the CY T2 file are maintained.

VIII. Conclusion

Each year of T2 data collection, the Center works to improve the T2 QC processes. This policy of continuous improvement has been a collaborative process with the primary source and collector of T2 data, NC State. The O*NET Center regularly communicates with and solicits the help of NC State as we work to improve QC processes and to ensure that processes are followed.

The Center T2 QC processes include reviews by multiple experts, multiple automated computerized routines, and several phases of review to ensure that customers receive quality, accurate, and face valid lists of T2 objects and commodities. The multiple expert reviews begin with Center staff that have masters or doctoral level training in industrial/organizational psychology or career development/guidance, as well as several years of experience with occupational analysis. Whenever the Center staff encounters difficult technology cases where they recognize the need for help, they ask for a secondary review by an expert in the information technology (IT) field. IT expert help is requested by Center staff on most deliverables. All changes recommended by Center staff are then reviewed by Center project managers and the NC State team until consensus is reached.

Computer automated routines are run on all deliverables when they are received at the Center and then again at the beginning and end of each QC phase. At some points, several iterations of the routines are necessary to eliminate all errors before proceeding to the next phase. The creation and implementation of these routines has considerably reduced both the effort required and human error. The results of the automated checks guide Center staff by pinpointing issues to focus on in their reviews.

Collection of T2 data for occupations is ongoing and active today. For each of the past four years, the O*NET Center has published T2 data for at least 100 occupations. In addition, the Center publishes an average of 324 T2 objects each year from customers submissions received through America’s Career InfoNet (ACINet) and O*NET OnLine. Each year, the individual T2 deliverables proceed through the five QC phases, starting with the individual file reviews and ending with the publication of one combined T2 database. Each QC phase improves the quality of the published T2 data and supporting files for O*NET customers.

IX. References

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XI. Appendix 1: Tools and Technology (T2) Standard File Structure

Columns for Worksheet 1: Occupations

1. O*NET-SOC Code
2. O*NET-SOC Title
3. Current Year
4. Year
5. Missing from List
6. Tools Comms
7. Tools Object Count
8. Tech Comms
9. Tech Object Count
10. Low Tools or Tech Count

Columns for Worksheet 2: Rd#, Batch # T2 Data (N=#)

1. T2_ID
2. Source
3. SocCode
4. SocTitle
5. T2_Object
6. URL
7. Revised T2 Object
8. Action (Delete, Change, or Question)
9. Explanation
10. Reviewer
11. UNSPSC_CommodityCode
12. UNSPSC_CommodityTitle
13. Action (Delete, Change, or Question)
14. Revised Commodity Code
15. Revised Commodity Title
16. Explanation
17. UNSPSC_ClassCode
18. UNSPSC_ClassTitle
19. Action (Delete, Change, or Question)
20. Revised Class Code
21. Revised Class Title
22. Explanation
23. Alternate commodities for object

24. Lowercase object
25. Duplicate object
26. UNSPSC errors
27. O*NET-SOC errors
28. Object revisions
29. Not published
30. Any check flagged

XII. Appendix: Tools and Technology (T2) Style Guide



T2 STYLE GUIDE (TOOLS AND TECHNOLOGY)

A single tool or technology title can be presented in many forms on the web. This document provides a standard format for these titles – addressing such issues as how to present acronyms and abbreviations, how to use capitalization and pluralization, and other formatting issues.

Before considering standardization and to insure accuracy and consistency,

- Proprietary software objects require the inclusion of the manufacturer’s name.
- For non-software objects, a generic object is preferred, without the use of a manufacturer’s name. For example, instead of “AutoXray EZ-Scan 6000”, the object should be “Automotive scanners,” and rather than “Bobcats” the object should be “Endloaders.”
- Avoid use of extra descriptive language. This often occurs when the words “with” or “for” are seen in the object title. (Exceptions are software objects such as CYMA IV Accounting for Windows, where the descriptive language is part of the product name.)

Preferred version

Haga altimeters
IFT-Pro
Drafting triangles
Fieldwork water quality monitors
Intravenous IV syringes
Leica Geosystems AeroPlan software

Non-preferred descriptive language

Haga altimeters for measuring tree height
IFT-Pro map database software
Triangles for drafting
Water quality monitors for fieldwork
Syringe for use with IVs
Leica Aeroplan LiDAR flight planning software

Acronyms and Abbreviations

- All abbreviated forms will be expanded, using the same format as used by the UNSPSC – full translation followed by acronym or abbreviation. For software objects, company names that are used primarily in abbreviated form (e.g., IBM, SAS, BEA) are not translated. In addition, if a proprietary software product name is itself an acronym, do not translate. (Check company web sites for correct representation.) Periods, trademark symbols, parentheses and Inc. are not included.

Examples:

Microsoft Visual Basic Scripting Edition VBScript

(The Microsoft home site reveals the software is referred to by both the expanded version and the acronym.)

Computer aided design CAD software

Four wheel drive 4WD vehicles

DATAS for SAS

Capitalization

- T2s follow UNSPSC format – for generic titles, the initial letter of the first word is capitalized; lower case is used for remaining words. Proper nouns are capitalized (each word in title) or follow the manufacturer’s style. All letters of abbreviations or acronyms are capitalized.

Examples:

Reliability centered maintenance RCM software

Common business oriented language COBOL

BEA WebLogic Server

(The word “server” in this case is part of the product name, so it should be capitalized and singular.)

Digital image printers

ALK Technologies FleetSuite software

(If the product contains many separately available components, “software” – using lower case – can be added to indicate the product. In this case, ALK Technologies FleetSuite includes ALK FleetSuite Tolls, ALK FleetSuite Directions and ALK FleetSuite Mapping.)

Abacus Tax Software

(In this case, the title, including “Software,” is part of the product name, and so all should be capitalized.)

Software-Specific Considerations

Inclusion of the generic term “software”

- The word “software” will be used when the object title provides a generic reference to multiple software products from a single manufacturer (e.g., SAS software). Use lower case “s.”
- The word “software” will be used when referring to a generic type of software -- when the object is not the name of a specific software program (e.g., Accounts receivable software). Use lower case “s.”
- The word “Software” will be used when it is part of a specific product or company name, as used by the manufacturer (e.g., Abacus Tax Software). Use upper case “S.”
- The word “software” will not be used when the object is one specific software product of a particular manufacturer (e.g., Microsoft Word) and the word “software” does not appear in the product name.

Version Indicators

- Version indicators such as Corel WordPerfect Office 12 and Microsoft Office XP will not be included.

Software Company Names

- Include company titles such as Microsoft Word, Adobe PageMaker. If the software is 1) freeware, 2) shareware or 3) government-developed software, an asterisk will be applied rather than a company name.

Software Products with Multiple Uses

- It may be difficult to link software products that perform several different functions to one commodity. To improve clarity for the user, if one occupation utilizes multiple product features, the product can be represented as in the following example:

Turtle Creek Software Goldenseal Architect (project management feature)
43231507 Project management software

Turtle Creek Software Goldenseal Architect (accounting feature)
43231601 Accounting software

Pluralizing Titles

- Use plural titles for generic objects.
Examples: Sledgehammers, Absorption equipment, Eye charts
- Proper names for software are singular (e.g., Microsoft Word)

Other considerations

- Remove commas from object titles.
For example, change “Adult blades, curved” to “Curved adult blades.”
- Avoid compound titles, splitting and rewording to form single objects.
For example, list two separate objects when more than one size or type of an object is described:

NOT:			
8 or 12 channel			Electronic multichannel
pipettes	41121508		pipetters
RATHER:			
8 channel pipettes			Electronic multichannel
	41121508		pipetters
AND:			
12 channel pipettes	41121508		Electronic multichannel
			pipetters

- However, when a compound object can be linked to one commodity and is commonly sold and used as an integrated system, it is appropriate to retain it in the compound form.

Example:

Wireless communication and satellite positioning tools	43223209	Location based messaging service platforms	43223200	Mobile messaging platforms
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- When there are multiple ways to spell a generic word (e.g., database or data base), rely on one dictionary source such as Merriam-Webster OnLine. (In this case, the preference is for database.) UNSPSC spelling that is different from preferred spelling will not be changed to agree with T2.
- Convert non-ASCII characters to their ASCII equivalents.
- When the T2 Style Document does not adequately address the presentation of a particular object, the O*NET Center contact person should be consulted. In addition, the Notes column in the file should briefly explain the issue and decision.