Hot Technologies and In Demand Technology Skills within the O*NET System

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Prepared for

U.S. Department of Labor
Employment and Training Administration
Office of Workforce Investment
Division of National Programs, Tools, & Technical Assistance
Washington, DC

Submitted by

The National Center for O*NET Development
November, 2022

onetcenter.org

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Overview

This paper describes an updated approach to identifying "Hot Technologies" and introduces the concept of "In Demand" technology skills.

- Hot Technologies are *software and technology requirements most frequently included across all employer job postings.*
- In Demand technology skills are *software and technology requirements frequently included in the employer job postings for a particular occupation*.

The new approach is implemented within the newly released O*NET 27.1 Database.

Within the previous database release (O*NET 27.0), over 8,750 technology skills were identified across the 923 data-level occupations included within O*NET-SOC 2019 Taxonomy (Gregory et al., 2019). The purpose of the two skill designations described in this paper is to enable a wide variety of customers – students, job seekers, curriculum developers, employment and training providers, researchers, and policy makers – to learn which of these technology skills employers in the United States economy are presently emphasizing and searching for while recruiting employees. This awareness can help better prepare and match the workforce with the needs of employers, facilitating the career exploration, education, training and development, and job search processes.

The designations will be updated twice annually. Both are included within the occupation and career reports of the primary O*NET websites (onetonline.org; mynextmove.org; mynextmove.org/vets; miproximopaso.org). O*NET OnLine also features an application to help customers find occupations based on Hot Technologies (https://www.onetonline.org/search/hot_tech/). Within the web sites, the designations will have associated graphical icons (See Figure 1 and Figure 2). For developers and researchers, the Hot Technology and In Demand designations are included in the O*NET Technology Skills database available for download within the O*NET Resource Center (https://www.onetcenter.org/dictionary/27.1/excel/technology_skills.html) and within O*NET Web Services (services.onetcenter.org).

Background

Technology Skills were introduced within the O*NET System starting in 2006 as part of the Tools and Technology (T2s) database (Dierdorff et al., 2006). T2s were defined as the *machines, equipment, tools, information technology, and software that are important to occupational performance.* The initial database was populated by occupational analysts using a standardized search, review, and processing of information discovered on web-based resources. An important aspect of the development of this database was the use of a standardized taxonomy structure entitled the *United Nations Standard Products and Services Code* (UNSPSC: for more details see www.unspsc.org). The specific examples found via the web-based resources were linked to the generic classifications of the taxonomy, facilitating standardization and a common language. Importantly, the structure allowed for more cross-occupational comparisons. Within the current database (O*NET 27.1), specific technology skill "objects" continue to be classified into the UNSPSC hierarchy (i.e., from most specific to least: Commodity, Class, Family, and Segment).

Additional sources of populating the T2 data were added, including transactional data, customer additions, and employer job postings (National Center for O*NET Development, 2011; Lewis and Norton, 2016). Currently, employer job postings and customer additions (https://www.onetcenter.org/t2_feedback.html) serve as the primary sources for identifying and updating technology skills.

The "Hot Technologies" designation was introduced within the O*NET System starting in 2016 (Lewis and Norton, 2016). Millions of employer job postings across occupations were analyzed using data-mining software and applications developed by *Burning Glass Technologies* (Burning Glass Technologies: Labor Insight, 2016)[1] in order to discover the top 200 frequently mentioned technology terms (e.g., software and programming languages). Occupational analysts then performed the following procedural steps:

- Converted and combined the top 200 data-mined technology terms into technology skill objects with a similar level of specificity, uniqueness, style, and format;
- Designated the processed technology skill objects as hot technologies;
- Classified the technology skill objects within the UNSPSC classification;
- Linked the technology skill objects to O*NET-SOC occupations by rationally reviewing summary statistics and results of employer job postings mined by a specific technology term and occupation. Occupation linkages based on earlier web-resource research and customer additions were also included.
- Determined the presentation order of the occupations linked to each hot technology skill by examining the percentage of job postings mentioning the hot technology. Occupations without employer job postings data were assigned to the bottom of the rank.

The initial effort led to the identification of 156 hot technologies. The designations and/or occupation rankings were updated quarterly. The O*NET 27.0 database (the last release before the updates described below) included 175 technology skills with the Hot Technology designation (See Appendix A). The updated approach led to 157 technology skills with the Hot Technology designation within the O*NET 27.1 database (see Appendix B).

An Updated Approach

The availability of more robust, detailed employer postings information along with improved data mining applications and APIs initiated a review of the procedures related to the O*NET Technology Skills database and designations.

In 2022, the National Center for O*NET Development migrated to the use of Lightcast, the replacement tool for the deprecated Burning Glass Technologies: Labor Insight (Lightcast, 2022). A critical aspect of this decision was the incorporation of the O*NET-SOC 2019

[1] In 2022, *EMSI Burning Glass* became *Lightcast*. To learn about the current system, see: https://lightcast.io/

Taxonomy within the Lightcast system. In addition, Lightcast makes use of an internal skills taxonomy to better organize and detail information gleaned from employer job postings. Lastly, Lightcast offers a number of APIs that allow for more customized and automated searches and extractions of the employee job postings data (e.g., Job Posting API; Skills API).

Hot Technologies

The purpose of the Hot Technologies designation is to help O*NET customers discover the top technology skills employers from across the U.S. economy are presently emphasizing or searching for while recruiting employees. Within the updated approach, the definition of hot technologies remains unchanged.

- Hot Technologies are *software and technology requirements most frequently included across all employer job postings.*

New procedural steps, however, are now performed. First, to collect the most frequently mentioned technology terms and relevant occupations, the Lightcast system is queried with the following criteria:

- Search unique US nationwide employer job postings within a designated 12-month period (to minimize seasonal variations).
- Filter and collate postings using the Lightcast skills category "software skills" to obtain the number of unique postings which mention each Lightcast-classified technology term.
- Rank the results by the ratio of postings mentioning the Lightcast skills term to all unique postings. Select the 300 Lightcast skills terms with the highest ratio.
- For each selected skills term, identify data-level O*NET-SOC occupations (as linked to postings by Lightcast) with at least 50 unique postings mentioning the term during the designated period.

After the above data is collected, the following analysis steps are performed:

- Occupational analysts review the top 200 terms. First, terms that are direct links to existing Technology Skills objects are identified. Remaining terms are converted into new technology skill objects if they are at the targeted level of specificity and uniqueness. Terms are then styled and formatted following standardized guidelines (See Appendix C). Terms that are not technology skills are removed (e.g., company name or too broad).
- Designate any new processed technology skills as hot technologies, if they match a specific product or suite. Skills which are generic software categories (e.g., "photo editing software") are excluded from designation.
- Remove the designation of any existing hot technologies which no longer link to any of the top 300 Lightcast skills terms. This avoids repeated addition and removal of technologies near the top-200 cutoff, while allowing removal of skills which are truly no longer frequently mentioned.
- Occupational analysts classify the newly identified technology skill objects within the UNSPSC classification.

- Occupation linkages for each technology skill object with Hot Technologies designation, as collected earlier from Lightcast, are added to the O*NET Technology Skills database if they are not already present, if they pass a face validity analyst review, and if they meet either of the following criteria:
    - At least 5% of the postings mentioning the skill term are linked to the occupation (i.e., the occupation accounts for a significant portion of the skill's postings), or
    - Within the occupation's unique postings, at least 5% mention the skill term (i.e., the skill is frequently mentioned within the occupation's postings).
- All occupation linkages within the Technology Skills database linked to a hot technology skill are designated as Hot Technologies, whether they were added based on Lightcast statistics or were previously present in the Technology Skills database (from earlier web-resource research, customer additions, or previous Lightcast or Burning Glass processes).
- For display within O*NET OnLine, hot technology occupation linkages are ordered based on the percentage of postings that mention the related Lightcast skill term, relative to all unique postings linked to the O*NET-SOC occupation. Individual percentages are also displayed to users. Occupation linkages that do not have employer job postings information for this period are added to the bottom of the rank (percentage "not available").

In Demand Technology Skills

The described updated approach introduces a new concept, In Demand technology skills.

- In Demand technology skills are *software and technology requirements frequently included in the employer job postings for a particular occupation*.

The purpose of this new designation is to help O*NET customers discover the top technology skills which employers from within a particular target occupation are presently emphasizing or searching for while recruiting employees. This awareness can help better prepare and match the workforce with the needs of employers from within a particular industry or profession…facilitating the career exploration, education, training and development, and job search processes. In Demand technology skills may or may not have the Hot Technologies designation.

The procedural steps for identifying In Demand technologies are described below:

- Query Lightcast for each data-level O*NET-SOC occupation, using unique US nationwide employer job postings within a designated 12-month period, for the following statistics:
    - The total number of unique postings for the occupation. If the occupation has fewer than 50 unique postings, the following steps are skipped.
    - The list of Lightcast "software skills" which are present in postings linked to the occupation, along with the total number of matching unique postings. Skills are discarded if fewer than 50 unique postings match, or if the number of matching postings is less than 5% of the total number of unique postings for the occupation.

- Each distinct Lightcast skill term collected above is linked to a Technology Skills object, using the same process described for Hot Technologies. Occupational analysts review and process any new Lightcast skills terms.
- The collected Lightcast occupation linkages which include a technology skill are added to the O*NET Technology Skills database if they are not already present, and if they pass an analyst face validity review.
- Occupation linkages within the Technology Skills database are designated as In Demand only if they match a corresponding skill-occupation combination for the current time period. Previous In Demand designations are reset and re-evaluated for each release.
- For display within O*NET OnLine, In Demand linkages for an occupation are ordered by the percentage of postings that mention the related Lightcast skill term, relative to all unique postings linked to the O*NET-SOC occupation. Individual percentages are also displayed to users.

Conclusions

The O*NET 27.1 Database features the results of this updated approach. 157 technology skills include the hot technology designation, 43 of which are newly designated in this release. Over 10,700 linkages are identified connecting these skills to O*NET-SOC occupations. In addition, over 2,500 linkages are designated as In Demand, highlighting frequently mentioned skills for 478 occupations.

This evolution of the original Hot Technology procedure brings a tighter connection between our technology skill designations and real-world job postings, by leveraging the granular data available through the Lightcast APIs. We also bring greater clarity to job seekers by distinguishing between technologies popular across all occupations (Hot Technologies), and technology skills popular within a single target occupation (In Demand). The latter is particularly helpful for choosing education and training options within a specific profession.

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United Nations Standard Products and Services Code (UNSPSC), version 23.0701. United Nations Development Programme. https://www.unspsc.org/

Appendix A: O*NET 27.0 Hot Technologies

Adobe Systems Adobe Acrobat
Adobe Systems Adobe After Effects
Adobe Systems Adobe Creative Cloud
Adobe Systems Adobe Illustrator
Adobe Systems Adobe InDesign
Adobe Systems Adobe Photoshop
ADP Workforce Now
Advanced business application programming ABAP
AJAX
Amazon DynamoDB
Amazon Elastic Compute Cloud EC2
Amazon Redshift
Amazon Simple Storage Service S3
Amazon Web Services AWS CloudFormation
Amazon Web Services AWS software
Ansible software
Apache Ant
Apache Cassandra
Apache Groovy
Apache Hadoop
Apache Hive
Apache HTTP Server
Apache Kafka
Apache Pig
Apache Solr
Apache Spark
Apache Struts
Apache Subversion SVN
Apache Tomcat
Apple macOS
Atlassian Bamboo
Atlassian JIRA
Autodesk AutoCAD
Autodesk AutoCAD Civil 3D
Autodesk Revit
Backbone.js
Bash
Bentley MicroStation
C#
C++
Cascading style sheets CSS
Citrix
Common business oriented language COBOL
Computer aided design CAD software
Confluence
Dassault Systemes SolidWorks
Database software
Django
Docker
Drupal
Eclipse IDE
Elasticsearch
Enterprise resource planning ERP software
Epic Systems
ESRI ArcGIS software
Extensible markup language XML
Facebook
Geographic information system GIS software
Git
GitHub
Go
Google AdWords
Google Analytics
Google AngularJS
Google Docs
Google Drive
Healthcare common procedure coding system HCPCS
Henry Schein Dentrix
HubSpot software
Hypertext markup language HTML
IBM Cognos Impromptu
IBM Notes
IBM SPSS Statistics
IBM WebSphere
Integrated development environment IDE software
Intuit QuickBooks
JavaScript
JavaScript Object Notation JSON
jQuery
JUnit
LinkedIn
Linux
Marketo Marketing Automation
Medical condition coding software
MEDITECH software
Microsoft .NET Framework
Microsoft Access
Microsoft Active Server Pages ASP
Microsoft ASP.NET
Microsoft ASP.NET Core MVC
Microsoft Azure
Microsoft Dynamics
Microsoft Dynamics GP
Microsoft Excel

Microsoft Exchange
Microsoft Office
Microsoft Outlook
Microsoft PowerPoint
Microsoft PowerShell
Microsoft Project
Microsoft SharePoint
Microsoft SQL Server
Microsoft SQL Server Integration Services SSIS
Microsoft SQL Server Reporting Services
Microsoft Visio
Microsoft Visual Basic
Microsoft Visual Basic for Applications VBA
Microsoft Visual Basic Scripting Edition VBScript
Microsoft Visual Studio
Microsoft Windows
Microsoft Windows Server
Microsoft Word
MicroStrategy
Minitab
MongoDB
MySQL
Nagios
National Instruments LabVIEW
NetSuite ERP
Node.js
NoSQL
Objective C
Oracle Business Intelligence Enterprise Edition
Oracle Fusion Middleware
Oracle Hyperion
Oracle Java
Oracle JavaServer Pages JSP
Oracle JD Edwards EnterpriseOne
Oracle JDBC
Oracle PeopleSoft
Oracle PL/SQL
Oracle Primavera Enterprise Project Portfolio Management
Oracle software
Oracle Solaris
Oracle Taleo
Oracle WebLogic Server
Palm OS
Perl
PHP
PostgreSQL
Puppet
Python
Qlik Tech QlikView
R
React
Red Hat Enterprise Linux
Red Hat OpenShift
Red Hat WildFly
Relational database management software
Ruby
Ruby on Rails
Salesforce software
Salesforce Visualforce
SAP
SAP Crystal Reports
SAS
Scala
Selenium
Shell script
SmugMug Flickr
Social media sites
Splunk Enterprise
Spring Boot
Spring Framework
Structured query language SQL
Supervisory control and data acquisition SCADA software
Swift
Symantec
Tableau
Teradata Database
The MathWorks MATLAB
Transact-SQL
Trimble SketchUp Pro
Unified modeling language UML
UNIX
UNIX Shell
Virtual private networking VPN software
VMware
Voice over internet protocol VoIP system software
Wireshark
Yardi software
YouTube

Appendix B: O*NET 27.1 Hot Technologies

Technology skills marked with an asterisk (*) are newly added or designated in the 27.1 release.

Adobe Systems Adobe Acrobat
Adobe Systems Adobe After Effects
Adobe Systems Adobe Creative Cloud software*
Adobe Systems Adobe Illustrator
Adobe Systems Adobe InDesign
Adobe Systems Adobe Photoshop
AJAX
Alteryx software*
Amazon DynamoDB
Amazon Elastic Compute Cloud EC2
Amazon Redshift
Amazon Simple Storage Service S3
Amazon Web Services AWS CloudFormation
Amazon Web Services AWS software
Ansible software
Apache Cassandra
Apache Hadoop
Apache Hive
Apache Kafka
Apache Maven*
Apache Spark
Apache Subversion SVN
Apache Tomcat
Apple iOS*
Apple macOS
Atlassian Bamboo
Atlassian Bitbucket*
Atlassian Confluence*
Atlassian JIRA
Autodesk AutoCAD
Autodesk AutoCAD Civil 3D
Autodesk Revit
Bash
Bentley MicroStation
Bootstrap*
C*
C#
C++
Cascading style sheets CSS
Chef*
Cisco Webex*
Dassault Systemes SolidWorks
Django
Docker
Drupal
eClinicalWorks EHR software*
Eclipse IDE
Elasticsearch
Epic Systems
ESRI ArcGIS software
Extensible markup language XML
Facebook
Figma*
Git
GitHub
GitLab*
Go
Google Angular*
Google Cloud software*
Google Docs
Google Sheets*
Google Workspace software*
GraphQL*
Hibernate ORM*
HubSpot software
Hypertext markup language HTML
IBM DB2*
IBM SPSS Statistics
IBM Terraform*
IBM WebSphere
Informatica software*
Intuit QuickBooks
JavaScript
JavaScript Object Notation JSON
Jenkins CI*
jQuery
JUnit
Kronos Workforce Timekeeper*
Kubernetes*
LinkedIn
Linux
Marketo Marketing Automation
Microsoft .NET Framework
Microsoft Access
Microsoft Active Directory*
Microsoft Active Server Pages ASP
Microsoft ASP.NET
Microsoft Azure software*
Microsoft Dynamics
Microsoft Excel
Microsoft Office software*
Microsoft Outlook
Microsoft PowerPoint
Microsoft PowerShell
Microsoft Project
Microsoft SharePoint

Microsoft SQL Server
Microsoft SQL Server Integration Services SSIS
Microsoft SQL Server Reporting Services SSRS*
Microsoft Team Foundation Server*
Microsoft Teams*
Microsoft Visio
Microsoft Visual Basic
Microsoft Visual Basic for Applications VBA
Microsoft Visual Studio
Microsoft Windows
Microsoft Windows Server
Microsoft Word
MicroStrategy
MongoDB
Node.js
NoSQL
Objective C
Oracle Database*
Oracle Java
Oracle Java 2 Platform Enterprise Edition J2EE*
Oracle JavaServer Pages JSP
Oracle PL/SQL
Oracle Primavera Enterprise Project Portfolio Management
Oracle SQL Developer*
Perl
PHP
PostgreSQL
Puppet
Python
Qlik Tech QlikView
R
React
Red Hat OpenShift
Redis*
Ruby
Ruby on Rails
SAP software*
SAS
Scala
Selenium
ServiceNow*
Shell script
Slack*
Splunk Enterprise
Spring Boot
Spring Framework
Structured query language SQL
Swift
Tableau
Teradata Database
The MathWorks MATLAB
Transact-SQL
Trimble SketchUp Pro
TypeScript*
UNIX
UNIX Shell
Vue.js*
WordPress*
Workday software*
Yardi software
Zoom*

Appendix C: Technology Skills and Tools Used Guidelines

A single technology title or can be presented in many forms on the web. These guidelines provide 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 ensure 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	**Non-preferred descriptive language**
Haga altimeters	Haga altimeters for measuring tree height
IFT-Pro	IFT-Pro map database software
Drafting triangles	Triangles for drafting
Fieldwork water quality monitors	Water quality monitors for fieldwork
Intravenous IV syringes	Syringe for use with IVs
Leica Geosystems	AeroPlan software Leica Aeroplan LiDAR flight planning software

<u>Acronyms and Abbreviations</u>

- 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.)

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.

Pluralizing Titles

- Use plural titles for generic objects (e.g., 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 pipettes	41121508	Electronic multichannel pipetters
RATHER:		
8 channel pipettes	41121508	Electronic multichannel 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. For example:

Wireless communication and satellite positioning tools	43233209	Location based messaging service platforms	43233200	Mobile messaging platforms

- 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 Technologies Skill or Tool Used.
- Convert non-ASCII characters to their ASCII equivalents.

Figure 1: Hot Technology Designation Graphic

Figure 2: In Demand Technology Designation Graphic