



Cybersecurity
Workforce
Data Initiative

Federal Data Evaluation Report

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Final Report

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NCSES Cybersecurity Workforce Data Initiative:

Federal Data Evaluation Report

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Abstract

The Cybersecurity Workforce Data Initiative (CWDI) reviewed existing federal survey data sources that are of potential use in analyzing and measuring the U.S. cybersecurity workforce. These sources were evaluated for their ability to describe the educational attainment, employment outcomes, and demographics of the cybersecurity workforce; their ability to link to existing labor market and educational taxonomies; and the extent to which they cover the entire cybersecurity workforce. Analysis showed that there is currently no single federal survey data source that can describe the entire cybersecurity workforce with sufficient granularity. This analysis supports the development of a new survey questionnaire and pilot study aimed at producing national estimates for the cybersecurity workforce.

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Executive Summary

The Cybersecurity Workforce Data Initiative (CWDI) is supported by the National Center for Science and Engineering Statistics (NCSES), the federal statistical agency within the U.S. National Science Foundation, to determine the feasibility of producing national estimates and statistics on the U.S. cybersecurity workforce. As part of that work, the CWDI evaluated existing federal survey data sources to determine the extent to which the needed statistical information for the U.S. cybersecurity workforce can already be obtained from current sources.

RTI International (RTI), under contract from NCSES, examined federal survey data from 13 sources using three domains of the Federal Committee for Statistical Methodology (FCSM) data quality framework. Our evaluation found that all the sources met the standards for objectivity and integrity because federal data sources are required to follow federal guidelines for survey development, data collection, data distribution, data security, and confidentiality and meet standards for scientific integrity and credibility. In the FCSM data quality framework, the utility of a federal data source is determined by its relevance, accessibility, timeliness, punctuality, and granularity. All data sources were determined to be timely, punctual, and accessible because they all have reference periods within the last 5 years and public-use files for current and past data collections are available.

However, none of the 13 data sources examined for this report were found to have sufficient relevance and granularity for measuring and describing the U.S. cybersecurity workforce. First, each data source was found to have some gaps in coverage. Some businesses, occupations, or individuals are excluded from each sample such that no data source would cover the entirety of the cybersecurity workforce. Additionally, although many of the data sources examined contain information about educational attainment, no data source collects comprehensive information about all certifications or professional licenses held by sample members. Therefore, the data sources examined for this paper are not sufficient to learn about the diverse educational pathways into the cybersecurity workforce. Similarly, while a variety of employment information is available across the 13 surveys—including employment status, occupation, primary work activities or job duties, wages, hours, job satisfaction, working in field of highest earned degree, industry, health insurance, knowledge, skills, hazards, and environmental conditions—no survey alone contains all these variables of interest. Some data sources allow analysis of various demographic variables, but not all do. However, the data sources that do allow such analysis had shortcomings in other areas, such as coverage or variables of interest. Finally, many of the data sources are aligned to existing taxonomies, including the Classification of Instructional Programs (CIP), the Standard Occupational Classification (SOC), or the North American Industry Classification System (NAICS). Although this alignment does help researchers to understand the data in the context of existing labor market and educational taxonomies, RTI determined in its definitions report that cybersecurity crosses numerous CIP, SOC, and NAICS codes. These codes alone are not sufficient to understand the cybersecurity workforce.

In conclusion, because all the data needed to measure and describe the U.S. cybersecurity workforce cannot be obtained from any existing federal survey data source, the development of a new survey questionnaire and pilot study aimed at producing national estimates for the cybersecurity workforce is supported.

Introduction

In fall 2023, the National Center for Science and Engineering Statistics (NCSES), a principal federal statistical agency within the U.S. National Science Foundation (NSF) began work on the Cybersecurity Workforce Data Initiative (CWDI) in response to a mandate in the CHIPS and Science Act of 2022. The purpose of the CWDI is to determine the feasibility of producing national estimates and statistics on the U.S. cybersecurity workforce. As part of that effort, RTI International (RTI), under contract to NCSES, reviewed existing federal survey data sources that are of potential use in analyzing and measuring the U.S. cybersecurity workforce. This review follows an analysis of the definitions, knowledge gaps, and data on supply and demand in the cybersecurity workforce and accompanies those analyses.

Our analysis showed that there is currently no single federal data source that provides all the needed and relevant information about the cybersecurity workforce with sufficient granularity to understand the entirety of the workforce. That is, no single source provides detailed information on credential attainment (including degrees, certificates, certifications, and licenses) combined with information on a variety of employment outcomes (including wages, hours, occupation, and work activities) that can be disaggregated by demographic characteristics at the employee level. This analysis supports the development of a new federal data collection to produce national estimates on the cybersecurity workforce.

This report presents a review of the existing federal data that are of potential use in analyzing and measuring the U.S. cybersecurity workforce. The goal of this review is to provide a comprehensive compilation of the existing federal survey data collections related to the cybersecurity workforce as of July 2024.¹

Methodology

RTI reviewed 13 federal survey data sources. Each data source was examined for the purpose of the data collection, the population covered, the sample size, the frequency of survey administration, the available data, and the types of information collected, including demographic information. RTI employed the three domains of the Federal Committee for Statistical Methodology (FCSM) data quality framework: utility, objectivity, and integrity.² We determined that all the data sets met the FCSM standards of objectivity and integrity because federal data sources are required to follow federal guidelines for survey development, data collection, data distribution, data security, and confidentiality. Federal data are accurate and hold up to tests of scientific integrity, credibility, security, and confidentiality. We analyzed data sets for their utility based on their relevance, accessibility, timeliness, punctuality, and granularity related to the cybersecurity workforce. All the data discussed in this analysis have reference periods within the last 5 years, and public-use data files are available for current and past data collections. Therefore, the data are timely and accessible. However, we identified that relevance and granularity are challenges to using the federal sources to better understand the cybersecurity workforce.

RTI identified several criteria to determine whether a data source has high utility and relevance for describing the U.S. cybersecurity workforce. These criteria, and our rationale for selecting them, are described as follows:

- Ability to map to existing taxonomies and frameworks, including the Standard Occupational Classification (SOC) and the National Initiative for Cybersecurity Education Workforce Framework for Cybersecurity (NICE Framework). This alignment helps researchers understand the data sources in the context of current labor market and education taxonomies.

- Granularity of demographic information at the employee level. More information is needed about the gender, racial, ethnic, and age makeup of the cybersecurity workforce to target recruitment and retention efforts toward underrepresented populations and ensure the robustness and diversity of the cybersecurity workforce.
- Ability to provide information about credential attainment, including degrees and certificates of all levels, certifications, and licenses. This information is needed to provide a complete picture of the diverse pathways that individuals follow into the cybersecurity workforce.
- Ability to provide information about employment, including wages, hours, occupations, and work activities. This information is needed to understand working conditions for cybersecurity workers as well as provide a complete picture of the knowledge and skills that cybersecurity workers use to perform their daily tasks and the amount of time spent on different tasks.
- Coverage of individuals from diverse educational and work experience backgrounds. This is necessary to ensure coverage of the entire cybersecurity workforce, not just one subpopulation of it (e.g., those with college degrees).

RTI reviewed data from the following federal sources and surveys outlined in Table 1. In the accompanying *Cybersecurity Workforce Supply and Demand Report*, RTI conducted an in-depth analysis of data from these sources, exploring their potential to quantify the workforce and the gaps in the existing data. Surveys in this report are presented in alphabetical order.

Table 1
Federal surveys reviewed for analysis
(Survey name, acronym, and agency)

Survey name	Survey acronym	Agency
American Community Survey	ACS	Census Bureau, Department of Commerce
Annual Business Survey ^a	ABS	National Center for Science and Engineering Statistics, National Science Foundation
Current Population Survey ^b	CPS	Bureau of Labor Statistics, Department of Labor
Integrated Postsecondary Education Data System	IPEDS	National Center for Education Statistics, Department of Education
Longitudinal Employer-Household Dynamics	LEHD	Census Bureau, Department of Commerce
National Postsecondary Student Aid Study	NPSAS	National Center for Education Statistics, Department of Education
National Survey of College Graduates ^a	NSCG	National Center for Science and Engineering Statistics, National Science Foundation
Occupational Employment and Wage Statistics	OEWS	Bureau of Labor Statistics, Department of Labor
Occupational Information Network	O*NET	Employment and Training Administration, Department of Labor
Occupational Requirements Survey	ORS	Bureau of Labor Statistics, Department of Labor
Quarterly Census of Employment and Wages	QCEW	Bureau of Labor Statistics, Department of Labor
Survey of Doctorate Recipients	SDR	National Center for Science and Engineering Statistics, National Science Foundation
Survey of Graduate Students and Postdoctorates in Science and Engineering	GSS	National Center for Science and Engineering Statistics, National Science Foundation
Survey of Income and Program Participation	SIPP	Census Bureau, Department of Commerce

^a Conducted by the Census Bureau on behalf of the sponsoring agency.

^b The Bureau of Labor Statistics CPS Web page identifies the CPS as "conducted by the Bureau of Census for the Bureau of Labor Statistics," <https://www.bls.gov/cps/home.htm>, while the Census CPS Web page says the CPS is "sponsored jointly by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics," <https://www.census.gov/programs-surveys/cps.html>.

Source(s):
National Center for Science and Engineering Statistics, Cybersecurity Workforce Data Initiative (CWDI).

Additionally, RTI reviewed data sources that it did not include in the analysis because of lack of relevance to the cybersecurity workforce. Those include the Census Bureau's Economic Census, the NCSES Survey of Earned Doctorates, and data from the Bureau of Economic Analysis.

Analysis of Data Sources

This section contains overall analysis and conclusions about the utility and relevance of the 13 federal survey data sources examined for this report based on the criteria outlined in the methods section: ability to map to existing taxonomies and frameworks, availability of demographic data, information about credential attainment, information about employment, and coverage of the cybersecurity workforce. In the following sections, specific characteristics of each survey is discussed in more detail. See Table A-1 in Appendix for a summary table of each survey by evaluation criteria.

Ability to Map to Existing Taxonomies and Frameworks

Although many of the data sources analyzed in this report are aligned to the Classification of Instructional Programs (CIP), SOC, or the North American Industry Classification System (NAICS), there are not singular CIP, SOC, or NAICS codes that have the granularity to understand the entire cybersecurity workforce. For example, cybersecurity professionals may hold degrees from many different fields; they are not necessarily confined to computer-related degrees classified under the CIP. Cybersecurity roles also cut across numerous industries classified under NAICS. Cybersecurity professionals are needed in utilities,³ finance,⁴ health,⁵ education,⁶ and more. Interviewees noted that SOC code 15-1212, Information Security Analysts, captures some core cybersecurity occupations, and there are related occupations in the Occupational Information Network (O*NET) where cybersecurity knowledge, skills, and abilities appear.⁷ However, many of the SOC codes in O*NET are from the 2018 revision, and new occupation titles in cybersecurity fall under “Computer Occupations, All Others.” O*NET is not yet aligned to the knowledge, skills, and abilities outlined in the NICE Framework, the premier framework for understanding the cybersecurity workforce. Nonetheless, current sources of labor market data use the SOC to provide data about occupations. Therefore, data that can be mapped to SOC codes or the Census Bureau’s occupational codes are needed for researchers to understand employment outcomes for cybersecurity workers in the context of the data currently available.

Data sets that use SOC codes or the Census Bureau’s occupational codes are of higher utility than those that do not. They are of higher utility because researchers can analyze employment outcomes for those occupations where cybersecurity workers are likely to be located although, as explained above, SOC codes alone cannot describe the entire cybersecurity workforce. Data sources that do use SOC codes or the Census Bureau’s occupational codes include the American Community Survey (ACS), Current Population Survey (CPS), Occupational Employment and Wage Statistics (OEWS), Occupational Requirements Survey (ORS), and National Survey of College Graduates (NSCG). The Longitudinal Employer-Household Dynamics (LEHD) data program provides high-level labor force information, but the data are unable to be disaggregated by occupation. Other sources, such as the Annual Business Survey (ABS) and the Quarterly Census of Employment and Wages (QCEW), can only be disaggregated by NAICS code at the industry level.

Granularity of Demographic Data

Data sets that contain demographic data are of higher utility for describing the cybersecurity workforce than data sets that provide only occupation-level, industry-level, or area-level data. Data sets that allow disaggregation on a variety of demographic variables—such as age, race, ethnicity, sex, gender, disability status, or citizenship status—include the NSCG, Survey of Doctorate Recipients (SDR), Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS), Integrated Postsecondary Education Data System (IPEDS), National Postsecondary Student Aid Survey (NPSAS), ACS, CPS, and Survey of Income and Program Participation (SIPP). The ABS collects demographic information for the business owner but does not do so at the employee level. The ORS and O*NET data programs provide occupation-level information (identified by SOC code) on job requirements, knowledge, skills, and

abilities. However, the data are for occupations only; worker-level data are not available from these sources. The QCEW and LEHD provide geographic area-level data, but worker-level data are not available from those sources either.

Information about Credential Attainment

Educational attainment data are collected in several of the federal surveys discussed in this report. However, the amount and type of these data vary. To be of high utility in answering questions about the U.S. cybersecurity workforce, a data source would ideally collect postsecondary degrees and certificates of all levels, as well as certifications and licenses. To not collect all those data would be to not cover the variety of educational backgrounds and pathways in the cybersecurity workforce pipeline. Several of the surveys discussed in this report contain highest postsecondary degree completion data, but only the NSCG, SIPP, and the Annual Social and Economic Supplement (ASEC) of the CPS ask about professional certifications or licenses, and the information collected in those three surveys is not comprehensive. The NSCG contains the most detailed questions about certifications or licenses but only asks about the most recently earned or renewed. Therefore, no existing federal survey would provide a comprehensive picture of educational pathways for the cybersecurity workforce.

Information about Employment and Employment Status

Employment data are collected in many of the federal surveys discussed in this report. Again, the amount and type of these data vary. Variables collected across all the surveys examined here include employment status, occupation, primary work activities or job duties, wages, hours, job satisfaction, working in field of highest earned degree, industry, and health insurance. These sources can help us understand the workforce (those who are currently employed) and the labor force (including those who are currently unemployed, defined as those who are not working but actively looking for work). Occupation-level sources such as O*NET and ORS contain information about the knowledge and skills required for an occupation as well as hazards or environmental conditions associated with the occupation. O*NET and ORS capture those who are in the workforce but do not contain information on those who are currently unemployed or out of the labor force. No single source contains all employment variables that are of interest to studying the cybersecurity workforce.

As noted in the accompanying *2024 Cybersecurity Workforce Supply and Demand Report*, the number of individuals in the workforce and their employment status varies depending on the survey and methodology. While the ACS estimates nearly 3.5 million people employed in the workforce from a household survey, the Bureau of Labor Statistics (BLS) estimates that value to be 2.4 million from an establishment survey.⁸ This variation in values is due to several factors, including differences in survey methodology, and makes it difficult to accurately estimate employment levels.

Coverage

Surveys that cover the entire working age population in a nationally representative sample are of higher utility for measuring the cybersecurity workforce than surveys that are restricted to populations with higher-level postsecondary degrees. Not all cybersecurity workers hold a bachelor's degree or higher; some may hold associate's degrees or have undergone professional training in a different capacity. Surveys covering a nationally representative sample regardless of education level include the ACS, CPS, and SIPP. The NSCG samples only those with bachelor's degrees or higher, the SDR samples only those with research doctoral degrees, and NPSAS samples only those who are attending a postsecondary institution at the undergraduate or graduate level. Some of the surveys examined for this report are institution or establishment surveys, and, like the sample surveys, some have more comprehensive coverage than others. For example, IPEDS surveys all postsecondary institutions that participate in federal student aid programs, whereas the GSS only surveys institutions granting research-based master's

or doctoral degrees. The ABS only surveys employer businesses, that is, businesses with paid employment or payroll, so it does not cover all businesses. The QCEW collects data reported by employers covered by unemployment insurance, and the OEWS and ORS model data from a subset of establishments to represent the U.S. workforce. However, some workers are excluded from one or more of those establishment surveys, such as those in the military, in agricultural or farming jobs, and in the federal government or those who are self-employed. They also do not capture those who are unemployed or out of the labor force. Therefore, each federal survey has some gaps in coverage when it comes to measuring the entire cybersecurity workforce.

Conclusions

Of all the sources, the NSCG came the closest to meeting the relevance and granularity needed to describe the cybersecurity workforce. In addition to containing some, although not all, relevant information on both credential attainment and employment outcomes, the NSCG has a high level of granularity, allowing disaggregation of individuals by race, ethnicity, sex, and disability status. However, the NSCG only includes individuals with bachelor’s degrees or higher, so it would provide an incomplete picture of the cybersecurity workforce because it excludes individuals with associate’s degrees or other occupational training or certificates.

In conclusion, there are gaps in the federal data with respect to the cybersecurity workforce. No existing source contains all the variables of interest and can be disaggregated by detailed occupation and demographic characteristics. In addition, no existing source is aligned to the NICE Framework, and other existing taxonomies (e.g., CIP, SOC, and NAICS) are not sufficient to identify the cybersecurity workforce. Therefore, the need for a new federal effort to analyze and measure the cybersecurity workforce is supported.

Summary of Data Reviewed

Table 2 outlines the cybersecurity workforce relevance and the gaps of each of the data sources reviewed.

Table 2
Summary of surveys reviewed for analysis
 (Survey name, acronym, relevance, and gaps)

Survey name	Survey acronym	Cybersecurity workforce relevance (strengths)	Cybersecurity workforce gaps (limitations)
American Community Survey	ACS	The ACS is a nationally representative sample survey of the working age population ages 16 and over in the workforce and the labor force. It collects a variety of data on demographics, employment, and education. The ACS can be mapped to Standard Occupational Classification (SOC) occupation codes that could be considered part of the cybersecurity workforce.	The ACS occupation codes and SOC codes lack granularity on occupations and cannot separate cybersecurity workers from non-cybersecurity workers within an occupation code, particularly broad codes like "computer occupations, all other." Therefore, the ACS likely overestimates the size of the cybersecurity workforce. The ACS also lacks information on professional certifications and licenses.
Annual Business Survey	ABS	The ABS is a nationally representative sample of businesses, collecting data on research and development activity, innovation, technology, intellectual property, and business owner characteristics, with additional rotating content that changes from year to year. Future ABS surveys could potentially include a cybersecurity question or questions in the rotating content in an upcoming year.	Demographic and educational attainment information is limited to business owners only. Employment information is at the business level, not the individual level. The ABS maps to North American Industry Classification System (NAICS) codes, which cannot be reliably mapped to cybersecurity.
Current Population Survey	CPS	The CPS provides a strong variety of data on the labor force, employment, unemployment, people not in the labor force, hours of work, earnings, and other labor force characteristics as well as worker level demographic information. The CPS Annual Social and Economic Supplement (ASEC) can be mapped to SOC occupation codes that could be considered part of the cybersecurity workforce.	The basic monthly CPS survey does not publish detailed occupation data. The ASEC, collected annually in March and April, is the only sample that uses SOC codes. The ASEC's ability to estimate the cybersecurity workforce is limited by the same limitations of using SOC codes as the ACS is. The CPS also does not provide all the desired credential attainment information.

Survey name	Survey acronym	Cybersecurity workforce relevance (strengths)	Cybersecurity workforce gaps (limitations)
Integrated Postsecondary Education Data System	IPEDS	IPEDS covers more than 15 million students enrolled at 6,000 postsecondary institutions nationwide. IPEDS releases data on graduates with a high level of detail by degree or certificate field, level, race, ethnicity, gender, and other criteria.	There is no single code or classification within IPEDS for cybersecurity degrees, and cybersecurity workers frequently come from a mix of degree programs and educational backgrounds, so IPEDS is unable to isolate individuals that are definitely in the cybersecurity workforce pipeline. IPEDS does not report on employment outcomes after graduation.
Longitudinal Employer-Household Dynamics	LEHD	The LEHD program combines federal, state, and Census Bureau data on employers and employees to understand characteristics of home and work location, worker flows between states, and an experimental release of postsecondary employment and military veteran employment outcomes. Veteran Employment Outcomes do contain the three-digit Department of Defense Occupation Codes and could potentially track veteran employment in cybersecurity.	Limited alignment to other existing taxonomies; SOC and Classification of Instructional Programs (CIP) codes are not available in the LEHD program data products. Estimates are provided at the geographic area level, so no worker level data are available.
National Postsecondary Student Aid Study	NPSAS	NPSAS captures information about educational history, field of study, and grade point average as well as employment held while enrolled in postsecondary education. NPSAS also captures a variety of demographic information.	NPSAS collects data on current employment while enrolled but does not capture student outcomes after graduation or their relation to cybersecurity work. The sample is undergraduate and graduate students, so not primarily members of the workforce.
National Survey of College Graduates	NSCG	Collects employment outcomes, educational attainment, and demographic information on a nationally representative sample of individuals with at least a bachelor's degree. Data can be mapped to specific SOC and CIP codes related to cybersecurity.	The sample size is limited to individuals with at least a bachelor's degree and so does not cover the entire cybersecurity workforce.
Occupational Employment and Wage Statistics	OEWS	Provides national, state, and regional estimates of wages and number of people employed per SOC code. Survey has high coverage; covers most of the U.S. workforce.	Does not provide more detailed employment information, such as tasks or work roles. Also does not provide any information about credential attainment or worker level demographic information. Does not capture self-employed or unemployed individuals in the labor force.
Occupational Information Network	O*NET	Extensive detail on worker attributes and job characteristics for more than 1,000 occupations, including "new and emerging" occupations. Useful resource, including technology skills and knowledge required by occupation.	Knowledge and technology skills by occupation are not yet linked to cybersecurity workforce frameworks. Emerging occupations in cybersecurity lack detailed data.
Occupational Requirements Survey	ORS	Survey of more than 56,000 firms representing 148,000 jobs. Provides national data on job requirements and tasks, including work hazards, credentials, experience, and education.	Does not ask specific questions about the use of cybersecurity skills or related technology. Excludes farming industries, federal government, and private households.
Quarterly Census of Employment and Wages	QCEW	Reliable, time-series data on employment by industry available at a granular industry and geographic level over time (month, quarter, year). Full census of the workforce in jobs eligible for unemployment insurance (UI), representing more than 148 million workers and more than 11 million establishments.	QCEW's employment numbers are reported by NAICS industry code, not by occupation type. NAICS codes cannot be reliably mapped to cybersecurity. QCEW also lacks information on credential attainment and worker level demographic data.
Survey of Doctorate Recipients	SDR	Collects information about educational history and detailed employment outcomes information.	Occupations and degrees related to computer science are general and do not specify cybersecurity. The sample size is limited to doctoral degree holders and so does not cover the majority of the cybersecurity workforce.
Survey of Graduate Students and Postdoctorates in Science and Engineering	GSS	The GSS collects counts of enrolled master's and doctoral students, postdoctoral researchers, and doctorate-holding nonfaculty researchers at academic institutions by field of study, demographics, and other characteristics. Can obtain a count of students in the field of computer and information systems security.	The GSS has only reported data for computer and information systems security since 2020, and potential cybersecurity workers can come from a variety of undergraduate and graduate programs. The sample is limited to master's and doctoral students. The GSS does not track employment outcomes after graduation.
Survey of Income and Program Participation	SIPP	SIPP contains data on occupations by occupation codes that can be mapped to SOC codes. It collects a variety of worker-level demographic data and some employment and credential attainment information. It covers a nationally representative sample of people in and out of the workforce and labor force.	SIPP's ability to estimate the cybersecurity workforce is limited by the same limitations of using SOC codes as the ACS and CPS are. SIPP does not contain all the desired employment outcomes and credential attainment data elements. SIPP has a smaller sample size than some of the other surveys.

Source(s):
National Center for Science and Engineering Statistics, Cybersecurity Workforce Data Initiative (CWDI).

The following one-page summaries outline each of the data sources evaluated. The full detailed evaluation of data sources can be found in Table A-1.

American Community Survey; Census Bureau

The ACS is a household survey sponsored by the Census Bureau. The ACS collects and produces information on social, economic, housing, and demographic characteristics about the U.S. population every year. It helps local officials, community leaders, and businesses understand the changes taking place in their communities.

Coverage and Sample Size

The ACS is a nationally representative sample survey, with a sample of 3.5 million addresses each year. Information is collected on all household members of all ages.

Periodicity and Availability

The ACS is collected on a monthly, continually rolling basis. The information received within a calendar year is collected into a data file and processed for publication annually. Less-detailed estimates are released in September, detailed microdata are released in October, and pooled 5-year estimates are released in December and January. Estimates are published in tables and profiles and are available in application programming interfaces–generated estimates. Custom tables can be requested, and restricted-use microdata are available.

Demographic and Other Information

Information collected includes demographic info (age, sex, disability, Hispanic origin, race, marital status, citizenship, language), education (educational attainment and undergraduate field of degree), labor force participation, employment (employment status, employer, employer type, industry, occupation, job duties, income), housing information, and extensive geographical information. Note that the ACS is designed to provide estimates of the characteristics of a subpopulation, not counts of subgroups.

Cybersecurity Workforce Relevance and Gaps

The ACS provides estimates by occupation codes that map to SOC codes. New and emerging cybersecurity-related occupations fall under a catch-all code: SOC 15-1299, Computer Occupations, All Others, or ACS occupation code 1108. The sample size of the cybersecurity workforce population defined by a proposed set of seven SOC codes is large; for example, according to 2022 data, there were 31,224 people working in the seven relevant SOC codes out of 2,630,725 people aged 16 years or older (1.2% of the sample population), and 2,083 of those were Information Security Analysts (SOC: 15-1212, ACS 1007). See the *Cybersecurity Workforce Supply and Demand Report* for more details and analysis of data from the ACS.

Web Links

- General: <https://www.census.gov/programs-surveys/acs>
- Data release schedule (2022): <https://www.census.gov/programs-surveys/acs/news/data-releases/2022/release-schedule.html>
- ACS microdata: <https://www.census.gov/programs-surveys/acs/microdata.html>
- Code books and documentation: <https://www.census.gov/programs-surveys/acs/technical-documentation/code-lists.html>

Annual Business Survey; NCSES

The ABS is an establishment survey co-sponsored by NCSES and the Census Bureau. The ABS collects data on research and development (for businesses with one to nine employees), innovation, technology, intellectual property (IP), and business owner characteristics, with additional rotating content that changes from year to year.

Coverage and Sample Size

The ABS is a nationally representative establishment sample survey, with a sample of approximately 300,000 employer businesses from a population of approximately 4,900,000 employer businesses. These businesses have a U.S. presence in the mining, utilities, construction, manufacturing, wholesale trade, retail trade, or services industries. Farm businesses are not in scope.

Periodicity and Availability

The ABS is administered annually with a reference period of the previous calendar year. Data are released the calendar year after survey administration. A variety of tables are published by NCSES and the Census Bureau. Data tables are available from the initial survey year of 2017 through 2022. Data are also used in the *Science and Engineering Indicators* reports for the National Science Board.

Demographic and Other Information

The survey collects demographic and other information about business owners, including age, sex, ethnicity, race, military service, place of birth and citizenship, disability status, education and field of highest degree, and reasons for owning a business. The survey also collects business-level information, including the number and types of employees, use of technology, development of IP, sales, expenses, and revenue. Information is collected about R&D activities at businesses of 1–9 employees only.

Cybersecurity Workforce Relevance and Gaps

The ABS collects company-level information on the number of employees and types of workers (e.g., full time, part time). Businesses have industry NAICS codes associated with them. The major gap with this data set is that cybersecurity cuts across several NAICS codes. Future ABS surveys could potentially include a cybersecurity question or questions in the rotating content in an upcoming year. Employee-level occupation codes and demographic or educational information are not available. However, demographic information on owners of these companies under these industry codes could be useful.

Web Links

- General: <https://nces.nsf.gov/surveys/annual-business-survey/2022>
- Methodology: <https://nces.nsf.gov/surveys/annual-business-survey/2022#methodology>
- Data: <https://nces.nsf.gov/surveys/annual-business-survey/2022#data>
- 2022 ABS Questionnaire: <https://nces.nsf.gov/surveys/annual-business-survey/2022#questionnaires>

Current Population Survey; Census Bureau

The CPS is a monthly household survey conducted by the Census Bureau for BLS. It provides estimates and trends in labor force characteristics and characteristics of the population. In addition, the CPS is used to collect data for a variety of other studies through a set of question modules supplemental to the basic monthly CPS questions. The ASEC of the CPS collects more-detailed data on economic and poverty indicators. The ASEC would be more useful for analyzing the cybersecurity workforce because it collects detailed occupation information.

Coverage and Sample Size

The CPS is a nationally representative sample survey. A stratified probability sample of about 54,000 households respond per month, covering approximately 105,000 individuals aged 16 years or older each month. Demographic data are also collected for children under 16 years old. Households are in the sample for 4 months, out for 8 months, and then return for another 4 months before leaving the sample permanently. The ASEC currently samples approximately 95,000 households.

Periodicity and Availability

The BLS publishes monthly news releases with labor force statistics using CPS data. The BLS also uses CPS data for various quarterly and annual news releases. Public-use data files for basic monthly CPS data are available from 1994 through February 2024. The annual ASEC supplemental data are collected in April or March and usually published 6 months later in September. Public-use data files for ASEC are available from 1998 through 2023.

Demographic and Other Information

The basic monthly CPS survey collects information on demographics (age, sex, race, ethnicity, marital status, disability), education (highest attainment, current active certification or license), labor force participation, employment (employment status, hours, employer, employer type, industry, occupation, work and job duties, number of jobs earnings), or reasons for not working. The ASEC contains the same demographic and labor force data described above, plus additional data on sources and amounts of income, health insurance coverage, participation in assistance programs, migration, property values, mortgages, and childcare.

Cybersecurity Workforce Relevance and Gaps

The CPS basic monthly survey does not publish occupational data detailed enough to be suitable for cybersecurity workforce analysis. The ASEC, like the ACS, provides data by codes that map to SOC codes. This alignment is beneficial, but the SOC lacks granularity to describe the cybersecurity workforce; emerging cybersecurity occupations captured in SOC codes 15-1299.05 and 15-1299.04 are represented in the more general category, SOC 15-1299, Computer Occupations, All Others, or in ACS 1008. The CPS does contain a variety of worker-level demographic and employment data.

Web Links

- Census Bureau: <https://www.census.gov/programs-surveys/cps.html>
- BLS: <https://www.bls.gov/cps/>; BLS SOC details: <https://www.bls.gov/soc/2018/home.htm>
- Methodology: <https://www2.census.gov/programs-surveys/cps/methodology/CPS-Tech-Paper-77.pdf>
- Supplements: <https://www.census.gov/programs-surveys/cps/about/supplemental-surveys.html>

Integrated Postsecondary Education Data System; Department of Education

IPEDS is a survey of U.S. postsecondary institutions administered by the National Center for Education Statistics (NCES) within the Department of Education. IPEDS is a system of 12 interrelated survey components that collects institution-level data from postsecondary institutions in the United States and other U.S. jurisdictions. The aim of the surveys is to provide basic data needed to describe and analyze trends in postsecondary education in the United States.

Coverage and Sample Size

Every college, university, and technical and vocational institution that participates in the federal student financial aid programs is required to report data to IPEDS. This group includes approximately 6,400 institutions enrolling about 25 million undergraduate and graduate students.

Periodicity and Availability

Data are collected annually over three different intervals during the academic year: fall (early September to mid-October), winter (early December to mid-February), and spring (early December to mid-April). Each of the collection periods collects different information. Data are available for the years 1980–2022.

Demographic and Other Information

Fall collection obtains information related to institutional characteristics, completions, and 12-month enrollment. Winter collection focuses on admissions, graduation rates, outcome measures, and student financial aid. Spring collection gathers information related to academic libraries, fall enrollment, revenues and expenses, and human resources. Data can be disaggregated by student demographics (e.g., race, ethnicity, age, and sex), degree or certificate programs identified by CIP code, institution level, and institution control.

Cybersecurity Workforce Relevance and Gaps

IPEDS is the definitive source for enrollment and graduation from higher education institutions and is the best source to understand the pipeline of new workers into any field requiring a postsecondary degree. There are more than a dozen CIP codes that can be considered part of the cybersecurity pipeline, including computer and information sciences and engineering. However, there is not a single CIP code or program that serves cybersecurity, and many cybersecurity workers can enter the workforce via various paths and pipelines, so CIP cannot comprehensively describe the cybersecurity workforce. Additionally, IPEDS does not track employment outcomes after graduation, so no employment data are available.

Web Links

- General: <https://nces.ed.gov/ipeds/about-ipeds>
- Methodology: <https://nces.ed.gov/ipeds/survey-components/ipeds-survey-methodology#sec2>
- Data: <https://nces.ed.gov/ipeds/use-the-data>

Longitudinal Employer-Household Dynamics Program; Census Bureau

The LEHD is sponsored by the Center for Economic Studies at the Census Bureau. The LEHD integrates existing administrative data from state-supplied administrative records with existing censuses, surveys, and other administrative records to create a longitudinal data system on U.S. employment. The LEHD program produces five statistical data products.

Coverage And Sample Size

Coverage varies across the five data products. The source data for the Quarterly Workforce Indicators (QWI), the LEHD Origin-Destination Employment Statistics (LODES), and the Job-to-Job Flows (J2J) come from partnerships with state agencies and include unemployment insurance (UI), tax return records, and Social Security records, among others. Coverage is for all 50 states, Washington, DC, the U.S. Virgin Islands and Puerto Rico, and the data are estimated to cover 95% of U.S. private-sector jobs. The percentage of graduates covered by the Post-Secondary Employment Outcomes (PSEO) data depends on partnerships with states. Varying degrees of coverage is currently available for 30 states.⁹ Veteran Employment Outcomes (VEO) data covers about 650,000 veterans who completed their initial term of service and were discharged between 2000 and 2015.

Periodicity and Availability

QWI data are released quarterly at the national, state, metropolitan/micropolitan area, county, and Workforce Investment Board area levels. Note that national QWI data are currently released as beta. LODES and J2J data are released quarterly at the census block level. PSEO and VEO data are released annually at the state level.

Demographic and Other Information

The QWI provides information about trends in employment, hiring, job creation and destruction, and earnings, with detail on geography, age, sex, and industry. LODES provides annual employment statistics linking home and work locations at the census block level. J2J provides access to worker flows between states, industries, and nonemployment. The experimental releases of PSEO and VEO data provide statistics on the earnings and employment outcomes of graduates and military veterans, respectively. Demographic data varies slightly among the five products, but all contain sex, age, race, education, employment status, pay, and industry.

Cybersecurity Workforce Relevance and Gaps

Neither SOC code nor detailed occupation is available in the LEHD program data products. VEO does contain the three-digit Department of Defense Occupation Code. PSEO data show the earnings by level of degree and four-digit CIP code. However, there is not only one CIP code associated with cybersecurity professionals, and PSEO coverage is not available for all graduates in all states.

Web links

- General: <https://lehd.ces.census.gov/>; <https://lehd.ces.census.gov/doc/LEDonepager.pdf>
- Data: <https://lehd.ces.census.gov/data/>

National Postsecondary Student Aid Study; Department of Education

NPSAS is a sample survey of postsecondary students sponsored by NCES within the Department of Education. NPSAS examines the characteristics of students in postsecondary education, with a special focus on how they finance their education. NPSAS connects multiple data sources, including student surveys, institution records, and administrative sources.

Coverage and Sample Size

NPSAS is a nationally representative cross-sectional study of undergraduate and graduate students enrolled in postsecondary education. Postsecondary institutions are sampled first, and then students are selected from the sampled institutions' enrollment lists. NPSAS:20, the most recent NPSAS, contains about 80,800 undergraduate and 19,700 graduate student survey respondents attending approximately 2,200 postsecondary institutions in the United States and Puerto Rico. It contains an additional 196,000 students who did not take the survey for whom administrative data were collected.

Periodicity and Availability

NPSAS has been administered 11 times, covering the academic years ending in 1987, 1990, 1993, 1996, 2000, 2004, 2008, 2012, 2016, 2018, and 2020. The 12th administration of NPSAS will be in 2024. Data are available for all administrations of NPSAS through 2020.

Demographic and Other Information

The student survey collects information about postsecondary enrollment; educational experiences; financial aid; information included on the Free Application for Federal Student Aid, such as age, marital status, and family information; employment while enrolled; income and expenses; and background, including demographic characteristics, such as U.S. citizenship, immigration status, race, ethnicity, sex, sexual orientation, and gender identity. The students' postsecondary institutions are also asked to provide student-level data on general student information, enrollment, budget, and financial aid.

Cybersecurity Workforce Relevance and Gaps

NPSAS collects information about jobs held by students while enrolled in postsecondary education, including work-study jobs and fellowships. Job titles map to SOC codes. However, NPSAS does not track workforce outcomes after graduation. Relevant variables may include educational history, field of study, grade point average, and relevance of the job the student has while enrolled to the student's major. However, data are only available every 4 years, and the sample is comprised of individuals who are primarily students, not members of the workforce.

Web Links

- General: <https://nces.ed.gov/surveys/npsas/>
- Technical documentation: <https://nces.ed.gov/pubs2024/2024482.pdf>
- Data: <https://nces.ed.gov/datalab>

National Survey of College Graduates; NSF-NCSES

The NSCG is a sample survey of college graduates administered by NCSES. The NSCG provides data on the characteristics of individuals with a bachelor's degree or higher. The survey places a special focus on individuals in the science and engineering workforce. The survey aims to provide a view into the relationship between degree field and occupation, as well as the relationship between college education and career opportunities.

Coverage and Sample Size

The 2021 NSCG includes a sample of approximately 164,000 individuals from a population of approximately 68.6 million individuals. The sample includes individuals who have at least a bachelor's degree, are younger than 76, are not institutionalized, and reside in the United States or Puerto Rico at the time of the survey. Since 2010, a rotating panel design has been used. Each panel receives a baseline survey interview and three biennial follow-up interviews before rotating out of the sample.

Periodicity and Availability

The initial survey was launched in 1993. It is a biennial survey. Public-use data are available from the years 1993, 2003, 2010, 2013, 2015, 2017, 2019, and 2021.

Demographic and Other Information

The survey collects information about demographics (e.g., age, race, sex, ethnicity, and citizenship), education (field of study, date, and institution for highest degree), professional certifications and licenses (name, year issued, field of study and issuing body for the most recent certification or license), and employment (employment status, occupation, work tasks, salary, benefits, hours, relatedness of job to highest degree, and job satisfaction).

Cybersecurity Workforce Relevance and Gaps

The NSCG uses CIP codes for field of degree (including double majors) and occupation codes that can be mapped to the Census and SOC codes. This alignment is beneficial, but as with the ACS, CPS, and IPEDS, SOC and CIP codes cannot be used to identify the entire cybersecurity workforce; there are no SOC or CIP codes that map directly to cybersecurity. The NSCG includes information on certifications held and the field of the most recent certification, which could also be used to identify those who may be working in cybersecurity. The NSCG is a potential source of information on cybersecurity workers with college degrees. See the *Cybersecurity Workforce Supply and Demand Report* for more details and analysis of data from the NSCG.

Web Links

- General: <https://nces.nsf.gov/surveys/national-survey-college-graduates/2021>
- Methodology: <https://nces.nsf.gov/surveys/national-survey-college-graduates/2021#methodology>
- Data: <https://nces.nsf.gov/surveys/national-survey-college-graduates/2021#data;>
<https://ncesdata.nsf.gov/datadownload/>

Occupational Employment and Wage Statistics; BLS

The OEWS is an establishment survey administered by BLS. The OEWS program surveys nonfarm establishments to produce annual employment and wage estimates for approximately 830 occupations, identified by SOC codes. Estimates are available for the nation, for individual states, and for metropolitan and nonmetropolitan areas; national occupational estimates for specific industries are also available.

Coverage and Sample Size

Two semiannual panels of approximately 179,000–187,000 establishments are surveyed. The sample is drawn from the UI database. Estimates are constructed from six panels totaling approximately 1.1 million establishments. Data are collected from establishments in nonfarming industries only. Total six-panel unweighted employment covers approximately 80 million employed workers, out of the total employment of almost 139 million in businesses covered by UI. Data are modeled based on the six panel surveys to represent the U.S. workforce.

Periodicity and Availability

Estimates are released annually. The survey began in 1997, and data are available for the years 1997–present. May 2022 estimates were released in April 2023. In 2021, the OEWS survey incorporated a new estimation methodology, making it unsuitable for time-series estimates prior to 2021.

Demographic and Other Information

Estimates are provided for each occupation (identified by SOC code) for number of individuals employed, mean and median hourly wages, and mean annual wages. Estimates can be viewed at the national, state, or metropolitan or nonmetropolitan area level. Estimates can also be viewed by industry (identified by NAICS code). Worker-level data are not available, so demographic characteristics are not included.

Cybersecurity Workforce Relevance and Gaps

The OEWS program provides estimates for the entirety of the U.S. workforce broken down by SOC code, several of which are aligned with cybersecurity work, although there is not a singular SOC code to represent cybersecurity. It also provides an updated 10-year job growth forecast annually. However, the OEWS survey does not collect data on the details of work roles or on the number of work roles related to cybersecurity for each occupation. It also does not provide information on credential attainment, and worker-level demographic data are also not available.

Web Links

- General: <https://www.bls.gov/oes/>
- Data: <https://www.bls.gov/oes/data-overview.htm>; <https://www.bls.gov/oes/tables.htm>
- Methodology: <https://www.bls.gov/oes/notices/2023/the-may-2021-estimates.htm>
- More information about the 2018 SOC system: www.bls.gov/soc/2018/home.htm

Occupational Information Network; Department of Labor

O*NET is an establishment survey sponsored by the Employment and Training Administration within the Department of Labor. O*NET is the nation's primary source of occupational information. It has hundreds of standardized and occupation-specific descriptors on about 1,000 occupations covering the entire economy. The database is continually updated from input by a broad range of workers in each occupation.

Coverage and Sample Size

O*NET is a comprehensive database of worker attributes and job characteristics, including 1,110 occupational titles, of which 840 are 2010 SOC occupations and 152 are "new and emerging" occupations. Information is collected using a statistically random sample of businesses and a random sample of workers in occupations within those businesses. The number of establishments and workers surveyed is dependent on the specific occupations targeted in a given year.

Periodicity and Availability

The O*NET online database operates as a continuous database of occupational characteristics. Currently, O*NET updates its database quarterly, but not all data categories for each occupation are updated each time.





Demographic and Other Information

O*NET occupation profiles include information about tasks, skills, work activities, environmental context, knowledge, abilities, work style traits, required education and training, wages, number of workers, and projected job growth and job openings pertaining to the occupation. Worker-level data are not available, so demographic characteristics are not included.

Cybersecurity Workforce Relevance and Gaps

O*NET is the most comprehensive database of worker attributes and job characteristics in the United States. O*NET contains knowledge and skills statements, and O*NET version 28.2 contains Technology Skills that map to United Nations Standard Products and Services Codes, which include "transaction security and virus protection software," "network security and virtual private network software," and "cloud-based protection or security software," which are all related to cybersecurity. O*NET has several eight-digit SOC codes related to cybersecurity that are more detailed than those from the OEWS program. O*NET does not yet align with the tasks, knowledge, and skills in the NICE Framework.

Web Links

- General: <https://www.onetonline.org/> 
- Methodology: https://www.onetcenter.org/dl_files/omb2018/Supporting_StatementB.pdf 
- Questionnaires: <https://www.onetcenter.org/questionnaires.html> 
- Taxonomy of occupations: <https://www.onetcenter.org/reports/Taxonomy2010.html> 
- Occupational characteristics downloadable files:
<https://www.onetcenter.org/database.html#overview> 

Occupational Requirements Survey; BLS

The ORS is an establishment survey conducted by BLS. BLS conducts the ORS under an agreement with the Social Security Administration. The goal of the ORS is to collect and publish information about the job requirements of different occupations, identified by SOC codes. ORS data are used to inform decisions about Social Security Administration disability insurance programs.

Coverage and Sample Size

The ORS is a nationally representative establishment-based survey. The 2023 estimates were produced from a probability sample of 56,300 establishments, from which data were collected over a 5-year period. From 2018–2023, there were 25,100 private industry and 5,000 state and local government responding establishments that provided approximately 148,600 occupational observations. The 2023 estimates represent 145,866,200 civilian workers.

Periodicity and Availability

Estimates are available for the reference years 2018 (an aggregation of data collected from 2015 to 2018) and 2023 (an aggregation of data collected from 2018 to 2023).

Demographic and Other Information

The ORS provides details about job requirements for different occupations, including physical demands; environmental conditions; required education, training, and experience; and cognitive and mental requirements. It estimates the percentage of occupations that have certain job roles, certificates, requirements, and hazards. Data are available at a national level, disaggregated by SOC code. Worker level data are not available, so demographic characteristics are not included.

Cybersecurity workforce relevance and gaps

ORS data on education requirements, workplace hazards, cognitive and mental requirements, experience, and training can offer detail about the job requirements for a subset of SOC codes that are related to cybersecurity. ORS methodology of estimating percent of job roles by occupation could potentially be applied to cybersecurity, which the NICE Framework defines as a job role rather than an occupation.

Web Links

- General information: <https://www.bls.gov/opub/hom/ors/home.htm>
- Data: <https://www.bls.gov/ors/data.htm>
- Methodology: <https://www.bls.gov/opub/hom/ors/design.htm>

Quarterly Census of Employment and Wages; BLS

The QCEW is an establishment survey conducted by BLS. QCEW publishes a quarterly count of employment and wages reported by employers. State UI programs are the basis for data from QCEW. These data are supplemented by data from two additional surveys: the Annual Refiling Survey (ARS), and the Multiple Worksite Report (MWR).

Coverage and Sample Size

All private-sector employers, plus state and local governments in the state that are eligible for UI, report job levels and wages paid to the Quarterly Contributions Report. However, such data are inadequate for statistical purposes for employers with multiple establishments in a state or for employers engaged in different industrial activities within a state. Therefore, QCEW administers two surveys to supplement administrative data from state UI agencies: the ARS, and the MWR. In 2022, QCEW reported data from 11,351,426 establishments covering more than 148 million workers, or an estimated 95% of U.S. employment.

Periodicity and Availability

QCEW is published quarterly. Annual estimates are also published. NAICS-based data files are available by industry for 1975–2023 and by area for 1990–2023. Data using the Standard Industrial Classification system are available for 1975–2000.

Demographic and Other Information

For each industry classified under NAICS, QCEW provides quarterly counts of establishments of different sizes, the number of individuals employed per month, total quarterly wages, and average weekly wages. The annual data contains the average quarterly establishment counts, average monthly employment, annual total wages, average weekly wage, and average pay. Data are available at the county, core-based statistical area, state, and national levels. Data may be suppressed at detailed geographic levels or in industries with few establishments so as to protect confidentiality.

Cybersecurity workforce relevance and gaps

QCEW releases reliable time-series labor market data at the industry level but does not provide data related to individual occupations within an industry. Cybersecurity work and workers are represented across multiple NAICS sectors, and QCEW does not capture the number of cybersecurity workers by industry or geography. QCEW does not provide demographic or educational attainment data.

Web Links

- General information and methodology: <https://www.bls.gov/opub/hom/cew/data.htm>
- Data: <https://www.bls.gov/cew/>

Survey of Doctorate Recipients; NSF-NCSES

The SDR is a sample survey co-sponsored by NCSES and the National Institutes of Health (NIH). The SDR provides data on the characteristics of science, engineering, and health (SEH) doctoral degree holders. The data collected can be used to assess the supply and characteristics of U.S.-trained SEH doctorate holders employed across a range of sectors, including educational institutions, private industry, professional organizations, and government in the United States or other countries.

Coverage and Sample Size

The SDR uses a fixed panel design with a sample of approximately 10,000 new doctoral graduates added to the panel in each biennial survey cycle. The 2021 SDR contained a sample of 125,938 individuals from a population of approximately 1,185,700 individuals. The sample includes individuals who have earned an SEH research doctoral degree from a U.S. academic institution, who are less than 76 years of age, and who are not institutionalized or terminally ill at the time of the survey.

Periodicity and Availability

The SDR was initially launched in 1973. It is a biennial survey. Public-use data are available from the years 2001, 2003, 2006, 2008, 2010, 2013, 2015, 2017, 2019, and 2021.

Demographic and Other Information

The survey collects information about demographics (e.g., age, race, sex, ethnicity, and citizenship), educational history, field of doctorate, place of residence (United States or non–United States), employment status, sector of employment, salary, benefits, hours, primary work activities, occupation, if the job is related to the respondent’s field of doctorate, and job satisfaction.

Cybersecurity Workforce Relevance and Gaps

Although the data collected in the survey do not use the CIP or SOC taxonomies, the titles of the fields of study and occupations in the survey could be mapped to the cybersecurity workforce. For example, there are several fields of study that relate to cybersecurity, including “computer science,” “information science, studies,” and so forth. Likewise, occupations include data for “computer and information scientists” that relate to cybersecurity. For both fields of study and occupations, the sample size is small and does not provide enough detail to conduct granular analysis. In addition, the sample size is limited to those with doctoral degrees and so excludes a significant percentage of the cybersecurity workforce.

Web Links

- General: https://nces.nsf.gov/424/assets/0/file/nces_sdr.pdf
- Methodology: <https://nces.nsf.gov/surveys/doctorate-recipients/2021#methodology>
- Data: <https://nces.nsf.gov/surveys/doctorate-recipients/2021#data>;
<https://ncesdata.nsf.gov/datadownload/>

Survey of Graduate Students and Postdoctorates in Science and Engineering; NSF-NCSES

The GSS is a census of postsecondary institutions co-sponsored by NCSES and NIH. The GSS collects counts of enrolled master's and doctoral students, postdoctoral researchers (postdocs), and doctorate-holding nonfaculty researchers (NFRs) at U.S. academic institutions by field of study, demographic characteristics, and other characteristics, such as source and mechanism of financial support. The study aims to assess trends in graduate enrollment, postdoc and NFR appointments, and financial support.

Coverage and Sample Size

The GSS is a census of all academic institutions in the United States and its territories (Guam and Puerto Rico) granting research-based master's degrees or doctorates in SEH fields as of the fall of the survey year, including branch campuses, affiliated research centers and health facilities, and separately organized components, such as medical or dental schools, schools of nursing, and schools of public health. The 2022 GSS included 22,519 components at 690 institutions.

Periodicity and Availability

The initial survey year was 1966. The GSS is an annual survey. Not all data items were collected from all institutions in all survey years, and eligibility criteria for institutions and fields have undergone periodic revision. The technical notes describe changes in the GSS over time to support trend analysis. Public-use data are available for the years 1972–2022.

Demographic and Other Information

The survey collects information about demographics (e.g., sex, race, ethnicity, and citizenship) and financial source and mechanism of support. Data vary for graduate students, postdocs, and NFRs. All counts are collected and reported by field. Since 2017, separate master's and doctoral counts have been collected.

Cybersecurity Workforce Relevance and Gaps

Since 2020, the GSS has reported data for the detailed field of computer and information systems security, which consists only of CIP code 11.1003, Computer and information systems security/auditing/information assurance. Thus, this survey provides context regarding one degree type that is being earned by individuals who aspire to be part of the cybersecurity workforce. However, the sample is limited to master's and doctoral students, so it excludes a significant percentage of the cybersecurity workforce. The GSS also does not collect data on employment outcomes after leaving the institution.

Web Links

- General: <https://nces.nsf.gov/surveys/graduate-students-postdoctorates-s-e/2022#survey-info>
- Methodology: <https://nces.nsf.gov/surveys/graduate-students-postdoctorates-s-e/2022#methodology>
- Data: <https://nces.nsf.gov/surveys/graduate-students-postdoctorates-s-e/2022#data>; https://www.nsf.gov/statistics/srvygradpostdoc/pub_data.cfm
- Technical Notes: <https://nces.nsf.gov/surveys/graduate-students-postdoctorates-s-e/2022#technical-notes>

Survey of Income and Program Participation; Census Bureau

SIPP is a household survey administered by the Census Bureau. The SIPP is the premier source of information for income and government program participation. SIPP is a longitudinal survey that collects data and measures change for many topics, including economic well-being, family dynamics, education, assets, health insurance, childcare, and food security.

Coverage and Sample Size

SIPP is a nationally representative, household-based survey designed as a continuous series of national panels. Each panel features a nationally representative sample interviewed annually over an approximately 4-year period. The current panel began in February 2022. 2022 SIPP public-use data include about 29,942 interviews from people aged 16–75 years from three panels: 2022 (17,930 interviews), 2021 (5,656 interviews), and 2020 (6,356 interviews).

Periodicity and Availability

SIPP is an annual survey. SIPP data from the years 1984–93, 1996, 2004, 2008, 2014, and 2018–22 are available for download on the Census website. The Census website also has data tools to extract data and produce estimates.

Demographic and Other Information

SIPP's primary goal is to collect nationally representative information on income and program participation for individuals and households, but the survey also collects demographic information (age, sex, race, ethnicity, disability status, citizenship, marital status, and language), education (highest attainment, current postsecondary enrollment, and current professional certifications or licenses), and employment (employment status, occupation, income, and salary range). It also collects additional economic indicators such as family dynamics, housing expenditures, asset ownership, health insurance, disability, childcare, and food security.

Cybersecurity Workforce relevance and gaps

SIPP collects data about respondents' current occupation. The data are coded using the Census four-digit codes, which can be cross-walked to SOC codes. This alignment is beneficial, but as with the other surveys that use SOC codes, SOC codes are limited in their ability to describe the cybersecurity workforce. The sample size of the cybersecurity workforce population defined by the seven relevant SOC codes is small; for example, according to December 2021 data, there were 295 people working in the seven relevant SOC codes out of 34,090 people aged 16–75 years (1% of the sample population), and only 17 of those were Information Security Analysts (SOC: 15-1212). SIPP also does not have as much educational attainment and employment information as some of the other surveys covered here.

Web Links

- General: <https://www.census.gov/programs-surveys/sipp.html>
- Microdata: <https://www.census.gov/programs-surveys/sipp/data/datasets.html>
- Documentation: <https://www.census.gov/programs-surveys/sipp/tech-documentation.html>
- Users' Guide: <https://www.census.gov/programs-surveys/sipp/guidance/users-guide.html>

Appendix: Summary of Sources Reviewed

Table A-1

Summary of surveys reviewed for analysis

(Survey source, acronym, and detailed characteristics)

Source	Survey acronym	Agency responsible	Relevance	Ability to map to existing taxonomies and frameworks	Granularity of demographic data	Ability to provide information on credential attainment	Ability to provide information on employment outcomes	Survey coverage and sample size	Coverage of cybersecurity workforce	Accessibility	Timeliness
American Community Survey	ACS	Census Bureau, Department of Commerce	High. Aligned to Standard Occupational Classification (SOC), variety of worker level demographic data, variety of employment information, and high coverage of the workforce and labor force. However, lacks sufficient information on credential attainment.	Aligned to SOC.	Collects respondent age, sex, race, ethnicity, disability status, marital status, citizenship, and language spoken other than English.	Highest level of education and if the respondent has a bachelor's degree, the major field of study for that bachelor's degree.	Labor force participation, hours worked, employment sector, employer, occupation, work tasks, income	Household survey; 3.5 million households annually. Nationally representative sample.	Working age population ages 16 and over, whether currently employed, looking for work, or not in the labor force.	Updated annually. Data tables, public-use data files, and interactive data tool available.	Previous year's data are available at a high-level in September, detailed microdata released in October, and 5-year estimates released in December and January of the following year.
Annual Business Survey ^a	ABS	National Center for Science and Engineering Statistics (NCSES), National Science Foundation	Low. Sample is limited to business owners only and maps to North American Industry Classification System (NAICS) codes, which cannot be reliably mapped to cybersecurity.	Aligned to NAICS.	Collects business owner sex, age, race, ethnicity, citizenship, military status, and disability. However, demographic data are not available at the employee level.	Highest level of education and major field of highest degree for the business owners.	Characteristics about the employer business such as industry, revenue, and number of employees.	Business survey; approximately 300,000 privately owned employer businesses. Nationally representative sample of nonfarm businesses.	Employer businesses and business owners only.	Public-use data files available from 2017 to 2022. Key data tables available for view or download on NCSES website.	Most recent data refer to the calendar year 2021.

Source	Survey acronym	Agency responsible	Relevance	Ability to map to existing taxonomies and frameworks	Granularity of demographic data	Ability to provide information on credential attainment	Ability to provide information on employment outcomes	Survey coverage and sample size	Coverage of cybersecurity workforce	Accessibility	Timeliness
Current Population Survey ^b	CPS	Bureau of Labor Statistics (BLS), Department of Labor	High. Aligned to SOC, variety of worker level demographic data, variety of employment information, and high coverage of the workforce and labor force. However, lacks sufficient information on credential attainment.	The ASEC supplement is aligned to SOC. The basic monthly CPS is not aligned to SOC.	Collects respondent age, sex, race, ethnicity, disability status, and marital status.	Highest level of education, if the respondent has a current active certification or license, and if that certification or license was issued by federal state, or local government.	Labor force participation, reasons for unemployment or not participating in labor force, employment status, number of jobs, hours, employer, employer type, industry, occupation, work and job duties, earnings.	Household survey; estimated 54,000 households per month. Nationally representative sample of a panel of households.	Working age population ages 16 and over, whether currently employed, looking for work, or not in the labor force.	BLS news releases monthly, public-use data files are available monthly, and Annual Social and Economic Supplement (ASEC) data are released annually in September.	Most recent data refer to February 2024. Basic CPS data are updated monthly; ASEC supplement annually.
Integrated Postsecondary Education Data System	IPEDS	National Center for Education Statistics (NCES), Department of Education	Low. No information on employment outcomes after graduation.	Aligned to Classification of Instructional Program (CIP).	Collects student sex, age, race, and ethnicity. Data can also be disaggregated by field of study, level of award, and institution level and control.	Degree or certificate completions by field of study and award level.	None. IPEDS does not track employment outcomes after graduation.	Institutional survey; estimated 6,400 higher education institutions representing 25 million students.	All postsecondary institutions that participate in federal student aid programs; that is only students in the labor force pipeline who attend a postsecondary institution.	Data are available from the years 1980 to the present; .csv files can be downloaded, and there are numerous interactive online data tools.	Most recent available data refer to 2022.

Source	Survey acronym	Agency responsible	Relevance	Ability to map to existing taxonomies and frameworks	Granularity of demographic data	Ability to provide information on credential attainment	Ability to provide information on employment outcomes	Survey coverage and sample size	Coverage of cybersecurity workforce	Accessibility	Timeliness
Longitudinal Employer-Household Dynamics	LEHD	Census Bureau, Department of Commerce	Low. Limited alignment to existing taxonomies, no granular worker level demographic data, and insufficient information on credential attainment.	Post-Secondary Employment Outcomes (PSEO) is aligned to four-digit CIP codes. None of the other data products are aligned to existing taxonomies.	Estimates provided at the geographic area level. No worker-level data are available.	PSEO provides statistics on the earnings and employment outcomes of graduates by degree level, major, and postsecondary institution.	PSEO: earnings and employment outcomes of graduates; Veteran Employment Outcomes (VEO): earnings and employment outcomes of Veterans; Job-to-Job Flows (J2J): job changes and mobility; Quarterly Workforce Indicators (QWI): employment, employment change, and earnings.	Merge of data from five data products with a coverage of all 50 states plus the District of Columbia and territories; coverage of estimated 95% of private-sector jobs.	Some data products cover all 50 states and territories, but for PSEO coverage is not complete; only 30 states participate.	LEHD publishes several interactive and downloadable data products available online.	J2J and QWI are available quarterly; PSEO and VEO are available annually at the state level.
National Postsecondary Student Aid Study	NPSAS	National Center for Education Statistics (NCES), Department of Education	Low. No information on employment outcomes after graduation; only about employment while enrolled. Sample is undergraduate and graduate students, not primarily members of the workforce.	Aligned to CIP and SOC.	Collects student sex, age, race, ethnicity, citizenship status, veteran status, and dependency status, and marital status.	Educational history (prior degrees or certificates before the survey year and prior institutions attended), major field of study, and grade point average.	NPSAS collects information on student employment while enrolled at their postsecondary institution but does not track employment outcomes after graduation.	Cross-sectional student survey, covering approximately 100,000 undergraduate and graduate students at 2,200 postsecondary institutions.	Only students in the labor force pipeline who attend a postsecondary institution.	Public-use data files available from 1987, 1990, 1993, 1996, 2000, 2004, 2008, 2012, 2016, 2020. Online interactive data tools available.	Most recent available data refer to 2020.

Source	Survey acronym	Agency responsible	Relevance	Ability to map to existing taxonomies and frameworks	Granularity of demographic data	Ability to provide information on credential attainment	Ability to provide information on employment outcomes	Survey coverage and sample size	Coverage of cybersecurity workforce	Accessibility	Timeliness
National Survey of College Graduates ^a	NSCG	National Center for Science and Engineering Statistics (NCSES), National Science Foundation	High. Aligned to SOC, variety of worker-level demographic data, credential attainment information, and employment outcomes information. Limitation is that sample is limited to individuals with a bachelor's degree or higher.	Aligned to the Census occupation codes, which crosswalk with SOC codes.	Collects student race, ethnicity, sex, and disability status. Can view employment outcomes by field of degree and level of degree.	Field of study, date awarded, and institution for the highest postsecondary degree; number of active certifications or licenses; name, year issued, field of study, and issuing body for the most recent certification or license.	Labor force participation, employment status, occupation, primary work activities, employer, employer sector, current job start date, work related to highest degree, salary, hours, job satisfaction, benefits.	Biennial panel survey of 164,000 individuals under age 76 with at least a bachelor's degree. Nationally representative sample.	College graduates with a bachelor's degree or higher whether currently employed, looking for work, or not in the labor force.	Public-use data files available from 1993, 2003, 2010, 2013, 2015, 2017, 2019, and 2021. Key data tables available for view or download on the NCSES website.	Most recent available data refer to February 2021.
Occupational Employment and Wage Statistics	OEWS	Bureau of Labor Statistics (BLS), Department of Labor	Low. Aligned to SOC and provides some employment information but no information on credential attainment, no worker-level demographic data; excludes unemployed members of the labor force.	Aligned to SOC and NAICS.	Estimates provided at national, state, and metro area level. No worker-level data available.	None.	Estimates of wages and number of people employed per SOC code.	Employer survey; semiannual panel of up to 187,000 establishments. Estimates are constructed based on six panels to cover the 139 million individuals working in businesses covered by unemployment insurance.	All establishments covered by unemployment insurance except for farming industries and private households (e.g., self-employed). Does not capture unemployed individuals in the labor force.	Tables of estimates available for the years from 1997 to the present. However, a new estimation methodology was introduced in 2021, making time-series estimates unsuitable.	Most recent available data refer to May 2022.

Source	Survey acronym	Agency responsible	Relevance	Ability to map to existing taxonomies and frameworks	Granularity of demographic data	Ability to provide information on credential attainment	Ability to provide information on employment outcomes	Survey coverage and sample size	Coverage of cybersecurity workforce	Accessibility	Timeliness
Occupational Information Network	O*NET	Employment and Training Administration, Department of Labor	Medium. Aligned to SOC. Provides information about needed education and experience. Only source with knowledge, skills, and abilities (KSA) statements with the potential to be aligned to the NICE Framework in the future. High coverage of occupations. Limitation is that data are not at worker level.	Aligned to SOC.	Data are at an occupational level; no worker-level data provided.	At the occupation level, provides information on level of education and experience requirements for occupations. No data on worker-level credential attainment.	At the occupation level, wages, projected job growth, and job openings. Includes knowledge, skills, and ability statements for each occupation under SOC.	Employee survey, covering 235,179 employees at 210,680 establishments between 2001 and 2022, with ongoing data collection from individual employees.	High. Covers all occupations classified under SOC.	Continuously updated since 2003.	Most recent update to the database was in February 2024.
Occupational Requirements Survey	ORS	Bureau of Labor Statistics (BLS), Department of Labor	Low. Provides information about occupational requirements for jobs, but the data are not worker level and are not about outcomes.	Aligned to SOC.	Data are at an occupational level, no worker-level data provided.	At the occupation level, provides information about years of vocational preparation, certificates and licenses required, and minimum education level required for occupations. No data on worker credential attainment.	At the occupation level, requirements for doing the job, such as cognitive and physical demands, and hazards and environmental conditions an employee may face in that job.	Establishment survey, representing an estimated 30,000 employer establishments (private and state or local), collected over a 5-year period.	Private-sector establishments and state and local government. Excludes farming industries, federal government, and private households (e.g., self-employed).	Estimates are available for 2018 (a aggregation of 3 years of data collection) and for 2023 (a aggregation of 5 years of data collection). There is an interactive online data tool and downloadable Excel files.	Most recent available data refer to 2023.

Source	Survey acronym	Agency responsible	Relevance	Ability to map to existing taxonomies and frameworks	Granularity of demographic data	Ability to provide information on credential attainment	Ability to provide information on employment outcomes	Survey coverage and sample size	Coverage of cybersecurity workforce	Accessibility	Timeliness
Quarterly Census of Employment and Wages	QCEW	Bureau of Labor Statistics (BLS), Department of Labor	Low. Maps to NAICS codes, which cannot be reliably mapped to cybersecurity. No information on credential attainment and no worker-level demographic data.	Aligned to NAICS.	Estimates provided at the county, metropolitan area, state, and national levels. No worker-level data available.	None.	Estimates of wages and number of people employed per NAICS code.	Quarterly employer census, representing over 11 million establishments employing over 158 million workers, or 95% of U.S. employment.	All workers who received pay for the pay period that included the 12th day of the month. Excludes only self-employed and federal national security agencies. Does not capture unemployed individuals in the labor force.	NAICS-based data files are available by industry from 1975 to 2023 and by area from 1990 to 2023. There is an interactive online data tool and downloadable .csv files.	Most recent available data refer to 2023.
Survey of Doctorate Recipients	SDR	National Center for Science and Engineering Statistics (NCSES), National Science Foundation	Low. Sample is limited to holders of doctoral degrees. No alignment to existing taxonomies.	None.	Collects student race, ethnicity, sex, and citizenship status. Can also be disaggregated by field of doctorate.	Field of doctorate and current enrollment information if enrolled at time of the survey. If respondent completed another degree in the two years prior to the survey, collects level, field of study, date, and institution of that degree.	Employment status, employer, employer sector, job related to field of doctorate, start date, salary, primary work activities, hours, job satisfaction, benefits.	Fixed panel survey of an estimated 125,000 doctoral recipients under the age of 76. Estimated 10,000 individuals added to the panel annually.	Individuals who have earned a science, engineering, and health (SEH) doctoral degree.	Public-use data files available from 2001, 2003, 2006, 2008, 2010, 2013, 2015, 2017, 2019, and 2021. Key data tables available for view or download on NCSES website.	Most recent available data refer to February 2021.
Survey of Graduate Students and Postdoctorates in Science and Engineering	GSS	National Center for Science and Engineering Statistics (NCSES), National Science Foundation	Low. Sample is limited to master's and doctoral students. Does not track employment outcomes after graduation.	None.	Collects student race, ethnicity, and citizenship.	If student has attained a master's degree or doctoral degree. Type of doctoral degree is collected for postdoctoral researchers and nonfaculty researchers only. Origin of degree is collected for postdoctoral researchers only.	None. IPEDS does not track employment outcomes after graduation.	Census of 690 academic institutions granting research-based master's or doctoral degrees.	Institutions granting research-based master's or doctoral degrees.	Public-use data files available from 1972 to 2022. Key data tables available for view or download on NCSES website.	Most recent available data refer to fall 2022.

Source	Survey acronym	Agency responsible	Relevance	Ability to map to existing taxonomies and frameworks	Granularity of demographic data	Ability to provide information on credential attainment	Ability to provide information on employment outcomes	Survey coverage and sample size	Coverage of cybersecurity workforce	Accessibility	Timeliness
Survey of Income and Program Participation	SIPP	Census Bureau, Department of Commerce	High. Aligned to SOC, variety of worker level demographic data, some employment and credential attainment information, and high coverage of the workforce and labor force. However, needs more information on credential attainment and employment outcomes.	Aligned to SOC.	Collects respondent age, sex, race, ethnicity, disability status, marital status, and citizenship and whether the respondent is English-speaking.	Highest educational attainment, current postsecondary enrollment, if the respondent holds a certificate or license and issuing body.	Employment status, occupation, income, and salary range.	Household survey of a nationally representative panel covering nearly 30,000 households over 3 years (2020–22)	Working age population ages 16–75, whether currently employed, looking for work, or not in the labor force.	SIPP is an annual survey. SIPP microdata are available for download on the Census website.	Each panel features a nationally representative sample interviewed annually over an approximately 4-year period. The current panel began in February 2022.

^a Conducted by the Census Bureau on behalf of the sponsoring agency.

^b The BLS CPS Web page identifies the CPS as "conducted by the Bureau of Census for the Bureau of Labor Statistics," <https://www.bls.gov/cps/home.htm>, while the Census CPS Web page says the CPS is "sponsored jointly by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics," <https://www.census.gov/programs-surveys/cps.html>.

Source(s):

National Center for Science and Engineering Statistics, Cybersecurity Workforce Data Initiative (CWDI).

Notes

- ¹ There may be additional data sources that come forth after the publication of this paper.
- ² Federal Committee on Statistical Methodology (FCSM). 2020. *A Framework for Data Quality*. FCSM-20-04. Washington, DC. Available at https://www.fcsm.gov/assets/files/docs/FCSM.20.04_A_Framework_for_Data_Quality.pdf. Accessed 8 April 2024.
- ³ Casanovas M, Nghiem A. 2023. *Cybersecurity—Is the Power System Lagging Behind?* Paris, France: International Energy Agency. Available at <https://www.iea.org/commentaries/cybersecurity-is-the-power-system-lagging-behind> . Accessed 13 June 2024.
- ⁴ Maurer T, Nelson A. 2021. *The Global Cyber Threat*. Washington, DC: International Monetary Fund. Available at <https://www.imf.org/external/pubs/ft/fandd/2021/03/global-cyber-threat-to-financial-systems-maurer.htm> . Accessed 13 June 2024.
- ⁵ Department of Health and Human Services. 2023. *Healthcare Sector Cybersecurity: Introduction to the Strategy of the U.S. Department of Health and Human Services*. Washington, DC. Available at <https://aspr.hhs.gov/cyber/Documents/Health-Care-Sector-Cybersecurity-Dec2023-508.pdf>. Accessed 13 June 2024.
- ⁶ Gurinaviciute J. 2024. What Cybersecurity Threats Does the Education Sector Face? *Forbes* March 11. Available at <https://www.forbes.com/sites/forbestechcouncil/2024/03/11/what-cybersecurity-threats-does-the-education-sector-face/> . Accessed 13 June 2024.
- ⁷ O*NET and interviewees highlighted SOC 15-1212, Information Security Analysts, as the occupation code most closely linked to cybersecurity. O*NET includes 10 related occupations, including Blockchain Engineers, Computer Network Architects, Computer Network Support Specialists, Computer Systems Analysts, Computer Systems Engineers/Architects, Database Administrators, Digital Forensics Analysts, Information Security Engineers, Network and Computer Systems Administrators, and Penetration Testers. More information is available at <https://www.onetonline.org/link/summary/15-1212.00> . Accessed 9 July 2024.
- ⁸ Hogan M, Lilienthal K, Bean de Hernandez A, McHugh P, Arbeit CA, Sullivan P; National Center for Science and Engineering Statistics (NCSES). 2024. *Cybersecurity Workforce Data Initiative: Cybersecurity Workforce Supply and Demand Report*. Alexandria, VA: National Science Foundation. Available at <https://nces.nsf.gov/about/cybersecurity-workforce-data-initiative>.
- ⁹ A detailed coverage map for the PSEO can be found at https://lehd.ces.census.gov/data/pseo_experimental.html. Accessed 9 July 2024.