



September 2023

SCIENCE AND ENGINEERING STATISTICS

Improved
Communication
Needed with
Stakeholders on Data
Needs

Why GAO Did This Study

Governments at all levels, businesses, and the public rely on federal statistics to inform evidence-based decisions and enable the development of sound policies. Housed within the National Science Foundation, NCSES is the nation's source for science and engineering information and statistics. NCSES produces data and analysis on how the United States compares to other countries on key topics such as producing science and engineering graduates and spending on research and development in the context of rising global economic competition.

The Research and Development, Competition, and Innovation Act includes a provision for GAO to examine to what extent NSF has processes to ensure NCSES data and analyses meet current and future needs. This report (1) describes how NCSES ensures its data and analyses meet data quality standards including relevance, and (2) evaluates the extent to which NCSES has processes to identify emerging needs.

GAO reviewed NCSES planning documents, and interviewed NCSES officials and stakeholders of its statistical products. GAO compared NCSES processes to relevant standards and guidelines published by Office of Management and Budget and National Academies of Sciences, Engineering, and Medicine.

What GAO Recommends

GAO is recommending that NCSES update its current communication plan to identify methods and tools for communicating with stakeholders on data collection and priorities. NCSES concurred with the recommendation.

View [GAO-23-106361](#). For more information, contact Candice N. Wright at (202) 512-6888 or wrightc@gao.gov.

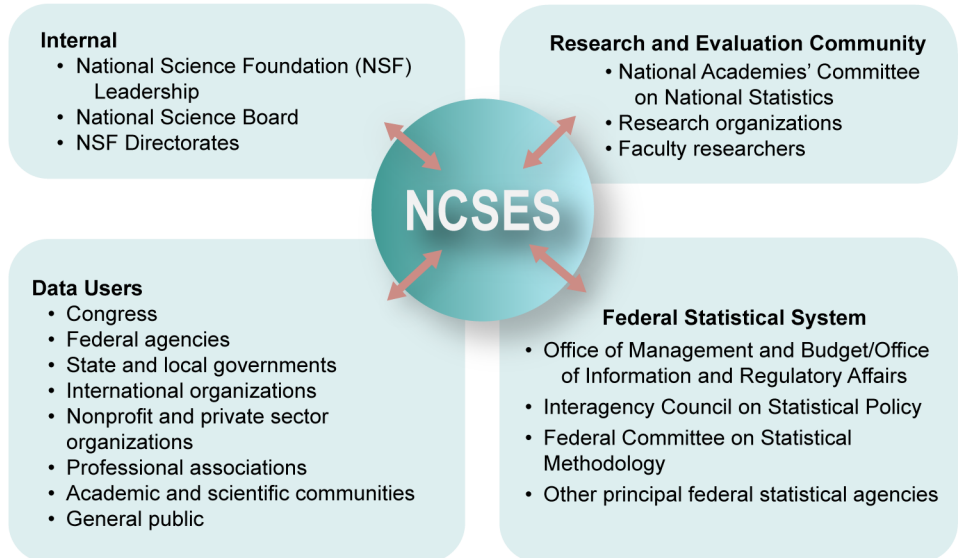
SCIENCE AND ENGINEERING STATISTICS

Improved Communication Needed with Stakeholders on Data Needs

What GAO Found

To address its responsibilities as a federal statistical agency, the National Center for Science and Engineering Statistics (NCSES) evaluates its data quality and coordinates with agencies about current data needs. NCSES evaluates data accuracy, relevance, and timeliness, and it reports the results of these evaluations. To supplement its internal evaluation efforts, NCSES contracts with the research and evaluation community. These external evaluations can identify priority focus areas to ensure data remain relevant and can result in recommendations to improve processes. NCSES also coordinates with federal agencies, primarily through interagency groups, to communicate and plan new data collections and standardize data collection measures. Through its evaluation and coordination activities, NCSES interacts with a range of stakeholders to address science and engineering statistical needs (see figure).

Examples of National Center for Science and Engineering Statistics (NCSES) Stakeholders



Source: GAO analysis. | [GAO-23-106361](#)

To identify emerging data needs, NCSES conducts research activities, but it has not communicated with stakeholders about agency priorities. In 2019, NCSES developed a strategic communication plan to guide engagement with stakeholders, but it has not updated this plan to account for new priorities. NCSES has also developed priority-setting documents, including a learning agenda, which identifies priority questions for evidence building. But NCSES has not engaged with external stakeholders about these priorities, potentially missing opportunities to better address needs, such as enabling academics to align their research to relevant policy questions. Communications strategies designed to ensure consistent, broad outreach could expand users' awareness of NCSES planned data collection, which could, in turn, more effectively enlist opportunities for stakeholders to provide input to ensure the relevance of these data.

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Abbreviations

IT	information technology
NCSES	National Center for Science and Engineering Statistics
NSF	National Science Foundation
NTEWS	National Training, Education, and Workforce Survey
OECD	Organisation for Economic Cooperation and Development
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
R&D	research and development
STEM	science, technology, engineering, and mathematics

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September 27, 2023

The Honorable Maria Cantwell
Chair
The Honorable Ted Cruz
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Frank D. Lucas
Chair
The Honorable Zoe Lofgren
Ranking Member
Committee on Science, Space, and Technology
House of Representatives

The United States leads the world in its support for research and development (R&D), with total R&D spending estimated at over \$700 billion in fiscal year 2020 from all sources, including the public, non- and for-profit sectors. This spending is widely seen as critical to ensuring the nation's economic and national security, and for securing innovations that can improve people's lives.

The National Center for Science and Engineering Statistics (NCSES) is the nation's source for science and engineering information in a global context. Housed within the National Science Foundation (NSF), NCSES produces data and analysis on how the United States compares to other countries on key topics such as producing science and engineering graduates and spending on R&D in the context of rising global economic competition. One of 13 principal federal statistical agencies, NCSES is responsible for statistical data on the following broad areas of interest:

- Research and development
- The science and engineering workforce
- U.S. competitiveness in science, technology, and innovation
- The condition and progress of science, technology, engineering, and mathematics (STEM) education in the United States

Governments at all levels, businesses, and the public rely on federal statistics to inform evidence-based decisions, enable the development of sound policies, and enhance equitable delivery of services and programs.

Further, as a result of the Foundations for Evidence-Based Policymaking Act of 2018 (the Evidence Act), federal agencies are expected to facilitate greater use of data for statistical purposes and evidence-building.¹ However, federal statistical agencies face growing challenges in producing accurate, relevant, and timely data. For example, declining survey response rates may decrease the quality and timeliness of data produced with these methods. It is therefore critical that NCSES has processes to effectively coordinate and collaborate with other agencies and stakeholders to collect accurate, timely, and relevant data to meet the needs of a broad group of stakeholders, including those in academia, state government, and the non- and for-profit sectors.

The Research and Development, Competition, and Innovation Act includes a provision for GAO to examine to what extent NSF has processes to ensure NCSES data and analyses meet current and future needs.² This report (1) describes how NCSES ensures its data and analyses meet data quality standards, and (2) evaluates the extent to which NCSES has processes to identify emerging needs.

To address these objectives, we interviewed agency officials and reviewed agency priority-setting documents and survey planning documents. Additionally, we compared NCSES processes to relevant standards and guidelines published by Office of Management and Budget (OMB) and National Academies of Sciences, Engineering, and Medicine. We interviewed officials from OMB and the Office of Science and Technology Policy (OSTP) to discuss NCSES's coordination activities. To obtain additional non-generalizable perspectives, we also interviewed 13 data users and other stakeholders from academia, nonprofit, and international organizations. We selected these stakeholders by identifying an initial set of three stakeholders from online searches of NCSES data users, subject matter experts in federal statistical data, and policy advocates in NCSES topic areas. We selected 10 additional stakeholders to interview based on referrals from earlier interviews. For more information on our scope and methodology, see appendix I.

We conducted this performance audit from November 2022 to September 2023 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to

¹Pub. L. No. 115-435, 132 Stat. 5554 (2019), codified at 5 U.S.C. §§ 311-15.

²Pub. L. No. 117-167, § 10314(b)(4), 136 Stat. 1366, 1530 (2022), to be codified at 42 U.S.C. § 18994.

obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

NCSES's primary role originated in the National Science Foundation Act of 1950, which called for a central clearinghouse for the collection, interpretation, and analysis of data on scientific and engineering resources and provision of a source of information for policy formulation by federal government agencies.³ Called the Division of Science Resources Statistics, it was originally responsible for statistical data on the science and engineering workforce, education, R&D funding, and research facilities.

NCSES was formally established as a federal statistical agency in the America COMPETES Reauthorization Act of 2010.⁴ The COMPETES Act also expanded NCSES's responsibilities to include collection of data related to U.S. STEM education and U.S. competitiveness in science, engineering, technology, and R&D.

Within NSF, NCSES is organizationally housed in the Social, Behavioral, and Economic Sciences Directorate, but has been delegated authority for statistical activities, according to officials.⁵ Consistent with OMB standards, officials said that NCSES is independent from some of NSF's policy and programmatic activities.⁶ However, NCSES is bound by NSF

³42 U.S.C. § 1862(a)(6). National Science Foundation Act of 1950, as amended, Pub. L. No. 81-507, 64 Stat. 149 (1950), codified at 42 U.S.C. §§ 1861-75.

⁴America COMPETES Reauthorization Act of 2010, Pub. L. No. 111-358, § 505, 124 Stat. 3982, 4007 (2011), codified at 42 U.S.C. § 1862p.

⁵The Social, Behavioral, and Economic Sciences Directorate is one of eight NSF directorates that support research and education across all fields of science and engineering.

⁶OMB's Statistical Policy Directive No. 1 specifies responsibilities that provide a framework that supports federal statistical policy and serves as a foundation for federal statistical activities, promoting trust among statistical agencies, data providers, and data users. Responsibility 3 states that statistical agencies should conduct objective statistical activities, including functioning in an environment clearly separate and autonomous from other administrative, regulatory, law enforcement, or policy-making activities within their respective departments. Office of Management and Budget, *Statistical Policy Directive No. 1: Fundamental Responsibilities of Federal Statistical Agencies and Recognized Statistical Units*, 79 Fed. Reg. 71,610, 71,615 (Dec. 2, 2014).

policies on information technology (IT), budget, media relations, and other infrastructure support.

Statistical Agency Guidance

As a federal statistical agency, NCSES is subject to key guidance documents in conducting its statistical activities. For example, NCSES follows OMB Statistical Policy Directive No. 1 which establishes its fundamental responsibilities to produce and disseminate relevant and timely information; to conduct credible, accurate, and objective statistical activities; and to protect the trust of information providers. In planning, collecting, analyzing, and disseminating its survey data products, NCSES also uses guidance from OMB Statistical Policy Directive No. 2, which provides 20 standards and related guidelines to ensure high quality statistical surveys.⁷

In addition to OMB guidance, the National Academies' *Principles and Practices* informs NCSES about the standards and ideals fundamental to its work as a federal statistical agency.⁸ As shown in figure 1, the OMB Statistical Policy Directives and the *Principles and Practices* establish the fundamental responsibilities, standards, guidelines, principles, and practices of a federal statistical agency. (See app. II for more information on these directives, principles, and practices.)

⁷Office of Management and Budget, *Statistical Policy Directive No. 2: Standards and Guidelines for Statistical Surveys* (Sept. 2006).

⁸National Academies of Sciences, Engineering, and Medicine, *Principles and Practices for a Federal Statistical Agency, Seventh Edition* (Washington, D.C.: 2021).

Figure 1: Summary of Selected OMB Guidance and National Academies Recommended Practices and Principles for Federal Statistical Agencies

OMB Statistical Policy Directive No. 1: Fundamental Responsibilities of Federal Statistical Agencies

- Responsibility 1: Produce and disseminate relevant and timely information
- Responsibility 2: Conduct credible and accurate statistical activities
- Responsibility 3: Conduct objective statistical activities
- Responsibility 4: Protect the trust of information providers by ensuring the confidentiality and exclusive statistical use of their responses

OMB Statistical Policy Directive No. 2: Standards and Guidelines for Statistical Surveys

- Section 1: Development of concepts, methods, and design
- Section 2: Collection of data
- Section 3: Processing and editing of data
- Section 4: Production of estimates and projections
- Section 5: Data analysis
- Section 6: Review procedures
- Section 7: Dissemination of information products

National Academies *Principles and Practices for a Federal Statistical Agency*

- Principle 1: Relevance to policy issues and society
- Principle 2: Credibility among data users and stakeholders
- Principle 3: Trust among the public and data providers
- Principle 4: Independence from political and other undue external influence
- Principle 5: Continual improvement and innovation

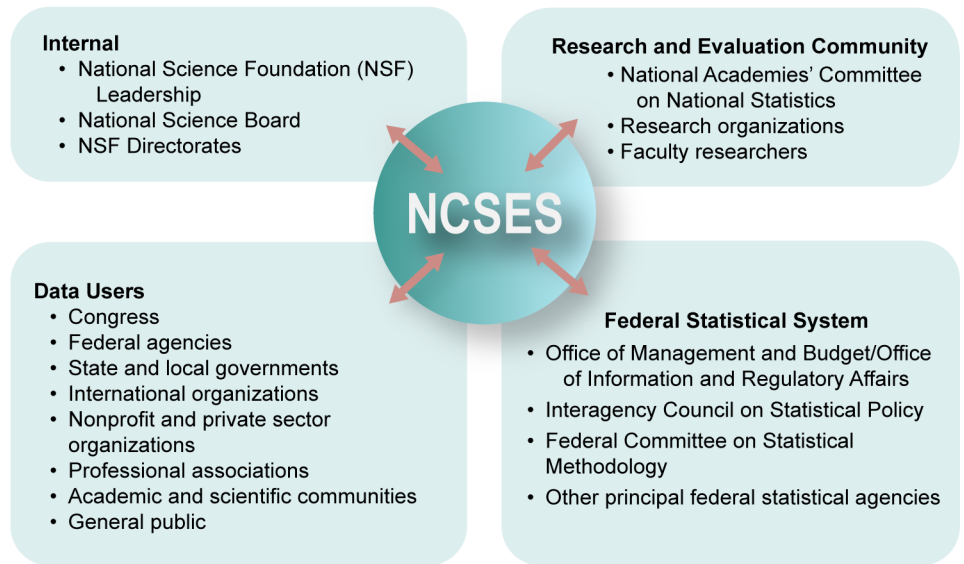
- Practice 1: Clearly defined and well-accepted mission
- Practice 2: Necessary authority and procedures to protect independence
- Practice 3: Commitment to quality and professional standards of practice
- Practice 4: Professional advancement of staff
- Practice 5: An active research program
- Practice 6: Strong internal and external evaluation processes for an agency's statistical programs
- Practice 7: Coordination and collaboration with other statistical agencies
- Practice 8: Respect for data providers and protection of their data
- Practice 9: Dissemination of statistical products that meet users' needs
- Practice 10: Openness about sources and limitations of the data provided

Source: Office of Management and Budget (OMB) Statistical Policy Directives No. 1 and No. 2 and National Academies of Science, Engineering, and Medicine *Principles and Practices for a Federal Statistical Agency, Seventh Edition*. | GAO-23-106361

NCSES Stakeholders

To produce accurate, relevant, and timely information, NCSES interacts with different groups of stakeholders (see fig. 2). These include internal stakeholders within NSF and external stakeholders within the federal statistical system, the research and evaluation community, and the data user community. Each stakeholder group plays a unique role in NCSES's data processes.

Figure 2: Examples of National Center for Science and Engineering Statistics (NCSES) Stakeholders in the Science Policy and Statistical Ecosystem



Source: GAO analysis. | GAO-23-106361

NCSES's internal stakeholders include NSF leadership and the National Science Board, which establish NSF policy based on legislative and executive priorities. According to officials, these internal stakeholders provide input to NCSES leadership when budgeting and planning strategic priorities. In addition, NCSES works with different groups of external stakeholders to improve its data products. NCSES communicates with its data user community, including federal, state, and local government officials, professional associations, and academic communities, to gain a better understanding of the relevance and quality of its data.

To improve the effectiveness of the federal statistical system and its own data efforts, NCSES coordinates with additional external stakeholders. NCSES coordinates with OMB and other statistical agencies, including international agencies, to collect and analyze data more effectively. In addition, NCSES also periodically arranges external evaluations of its own efforts, primarily with the National Academies Committee on National Statistics in the research and evaluation community.

NCSES Surveys and Data Products

As illustrated in table 1, NCSES currently conducts 17 ongoing surveys in six topical areas.⁹ In addition, it produces two statutorily mandated reports every two years: *Science and Engineering Indicators* in even-numbered years and *STEM and Diversity: Women, Minorities, and Persons with Disabilities in Science and Engineering* in odd-numbered years.¹⁰ Additionally, NCSES meets a variety of stakeholder needs through smaller data products, such as *InfoBriefs*, special reports, one-pagers, infographics, and interactive data tools.

Table 1: Overview of National Center for Science and Engineering Statistics (NCSES) Surveys

Topic area	Topic description	Survey name	Frequency
Government Funding for Science and Engineering	Federal and state government research and development (R&D) funding data and trends	Survey of Federal Funds for Research and Development	Annual
		Survey of State Government Research and Development	Annual
		Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions	Annual
Higher Education Research Development	R&D data and trends at U.S. higher education institutions	Higher Education Research and Development Survey	Annual
		Survey of Science and Engineering Research Facilities	Biennial
Research and Development	Data and trends within U.S. research and development	Federally Funded Research and Development Center Research and Development Survey	Annual
		Nonprofit Research Activities Survey	Annual
		Federal Facilities Research and Development Survey	Annual
Innovation and Global Competitiveness	Data and trends within U.S. R&D innovation and expenditures	Annual Business Survey	Annual
		Business Enterprise Research and Development	Annual
Science and Engineering Workforce	Data trends within the U.S. science and engineering workforce	Early Career Doctorates Survey	TBD ^a
		National Survey of College Graduates	Biennial
		National Training, Education, and Workforce Survey	Biennial
		Survey of Doctorate Recipients	Biennial

⁹The six topical areas are (1) Government Funding for Science and Engineering, (2) Higher Education and Research Development, (3) Research and Development, (4) Innovation and Global Competitiveness, (5) Science and Engineering Workforce, and (6) STEM Education.

¹⁰42 U.S.C. §1863(j)(1) and 42 U.S.C. §1885(d).

Topic area	Topic description	Survey name	Frequency
		Survey of Postdocs at Federally Funded Research and Development Centers	Biennial
Science, Technology, Engineering, and Mathematics (STEM) Education	U.S. postsecondary science and engineering education	Survey of Earned Doctorates	Annual
		Survey of Graduate Students and Postdoctorates in Science and Engineering	Annual

Source: GAO summary of National Center for Science and Engineering Statistics information. | GAO-23-106361

^aOfficials said NCSES has not determined the planned frequency of the Early Career Doctorates Survey.

Evaluations and Coordination with Other Agencies Help NCSES Meet Quality Standards

As a federal statistical agency, NCSES has the responsibility to conduct credible statistical activities and produce accurate, relevant, and timely statistical products as efficiently as possible. NCSES addresses these responsibilities through ongoing evaluations of its data accuracy, relevance, and timeliness. In addition, NCSES coordinates with other federal statistical agencies to avoid duplication and collect and analyze data more effectively.

NCSES Evaluates Data Accuracy, Relevance, and Timeliness

NCSES conducts evaluations to address its primary responsibilities of producing accurate, relevant, and timely data and publicly communicates results to maintain credibility with data users. These include internal evaluations of data quality before, during, and after data collection and external reviews to evaluate NCSES processes and topical areas for future surveys.

Accuracy. To address data accuracy, NCSES has processes designed to follow OMB and NSF guidelines, such as OMB Statistical Directive No. 2, which covers methods for designing surveys and collecting data. For example, NCSES officials said that they test survey items using pretesting methods, such as cognitive testing and focus groups, which improves accuracy by ensuring respondents correctly interpret questions.¹¹

To communicate to users about the accuracy of its data products, NCSES publishes information on strengths and limitations of its survey data and

¹¹OMB Statistical Policy Directive No. 2 provides standards and guidelines for statistical surveys, and includes seven sections. Each section is tied to a phase of the survey cycle: survey design, data collection, data processing and editing, production of estimates, data analysis, data review, and data dissemination. Standard 1.4 states that agencies “must ensure that all components of a survey function as intended . . . by conducting a pretest of the survey components or by having successfully fielded the survey components on a previous occasion.” Office of Management and Budget, *Statistical Policy Directive No. 2: Standards and Guidelines for Statistical Surveys*, §1.4 (Sept. 2006).

analyses. By publishing this information, NCSES helps address statistical directives on maintaining user credibility in producing accurate data.¹² NCSES staff and contractors analyze survey data and calculate statistical metrics, such as standard errors and non-response rates, and communicate the results through technical documentation.

According to officials, NCSES communicates its data accuracy through three types of documents with varying levels of information on data strengths and limitations. The documentation ranges in detail from basic survey summaries of data sources and survey error to more detailed technical notes with descriptions of data estimates and survey items. NCSES lists the most expansive descriptions in a methodology report, which is a standardized review of processes ranging from data planning and collection to data analysis and dissemination. NCSES officials said they follow a formal review process to help ensure that methodology reports adhere to guidance on periodic evaluation.¹³ NCSES does not currently post methodology reports to its website, but the reports can be obtained by request. Officials said they are working to find a technological solution to begin releasing methodology reports online, while ensuring compliance with accessibility standards.¹⁴

As a check on data accuracy, NCSES officials said that all data products are reviewed for adherence to NSF Informational Quality Guidelines, which “describe the basic standard of quality that NSF adopts, including objectivity, utility, and integrity.”¹⁵ Additionally, NCSES officials use a standardized checklist during review of data products to help ensure that all published information meets quality requirements before dissemination to the public (see fig. 3).

¹²OMB Statistical Policy Directive No. 1 delineates four specific responsibilities. Responsibility 2 explains that agencies should be clear and transparent in known potential data limitations so data users can evaluate the suitability of data for their purpose.

¹³Guideline 7.3.3 in OMB Statistical Policy Directive No. 2 states that for recurring surveys, agencies should produce a periodic evaluation report, such as a methodology report, that identifies sources of error, calculates error, and assesses the survey quality.

¹⁴Accessibility compliance is governed by Section 508 of the Rehabilitation Act of 1973, as amended in 1998. 29 U.S.C. § 794d. This federal law requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency.

¹⁵National Science Foundation. *Information Quality Guidelines* (Alexandria, VA: n.d.).

Figure 3: Excerpt of National Center for Science and Engineering Statistics (NCSES) Publications Standards Checklist

Standard/ Guideline	Check	Yes	N/A	Notes
1.1	National Center for Science and Engineering Statistics (NCSES) publication estimates have been generated using verified data that has undergone internal review for accuracy.			
1.2	All necessary documentation to conduct a statistical review has been supplied to the reviewer.			
1.2a	Authors must provide to their reviewers detailed citation for each data source used in the publication. Data citations for review should include the data provider, title, year of publication, publisher or distributor, URL, identifier, or other access location.			

Source: National Center for Science and Engineering Statistics Statistical Standards for Information Products. | GAO-23-106361

Relevance. To ensure that its data are relevant to policy and research needs, NCSES officials said that they periodically seek input from data users through different venues including workshops and meetings with professional associations. For example, NCSES officials solicit feedback from experts in doctoral education at the annual meeting of the Council of Graduate Schools to inform the development of the Survey of Earned Doctorates and Survey of Doctorate Recipients. In addition, NCSES convenes small advisory panels of technical experts to discuss emerging

topical areas, such as measuring federal facilities' R&D expenditures and establishing a formal longitudinal design for the Survey of Doctorate Recipients.¹⁶

NCSES also gathers input on which topics are relevant through standing advisory committees. For example, it consults with the advisory committee for NSF's Social, Behavioral, and Economic Sciences Directorate on survey research methods and other emerging topics in the social, behavioral, and economic sciences. Additionally, for the statutorily mandated *STEM and Diversity: Women, Minorities, and Persons with Disabilities in Science and Engineering*, NCSES officials said they receive input on relevant topical areas from the Committee on Equal Opportunities in Science and Engineering.¹⁷

To support science and technology policymaking, NCSES officials said that they have periodic meetings with NSF leadership and the National Science Board to help ensure NCSES data are relevant for planning and evaluation purposes in national initiatives. For example, NCSES works with the National Science Board in developing NCSES education and workforce data that can inform its Missing Millions initiative, which seeks to decrease STEM workforce participation gaps for underrepresented populations. NCSES officials stated that NCSES also will likely participate in analyzing and visualizing data to inform decision making for the newly

¹⁶Beginning in the 2015 Survey of Doctorate Recipients survey cycle, NCSES first implemented a sustainable survey design with the goal of maintaining existing estimates while producing reliable data to support longitudinal analysis, i.e., analysis of variables over time. From August 2013 to December 2014, NCSES convened four human resources expert panel meetings to better understand science and engineering career pathways and best practices for collecting occupational data in longitudinal designs.

¹⁷The Committee on Equal Opportunities in Science and Engineering advises NSF on policies, programs, practices and activities to encourage the full participation of women, underrepresented racial/ethnic populations, and persons with disabilities within all levels of the nation's STEM enterprise. In 1980, the committee (then called the Committee on Equal Opportunities in Science and Technology) was established by the Science and Engineering Equal Opportunities Act to promote growth and diversity in America's STEM workforce. Science and Technology Equal Opportunities Act, as amended, Pub. L. No. 96-516, 94 Stat. 3007, 3010, pt. B, § 36, codified at 42 U.S.C. §§ 1885-85d. (1980). This act was later amended to substitute "Engineering" for "Technology," Pub. L. No. 99-159, §§ 110-11, 99 Stat. 887, 890-93, (1985).

formed NSF Technology, Innovation, and Partnership Directorate, although planning discussions are ongoing.¹⁸

NCSES further helps ensure that data are relevant to policymakers by meeting with other federal agencies and offices that use NCSES data. For example, it has frequent, informal communication with OSTP, which is a continual user of NCSES data on global R&D funding, STEM education, and the STEM workforce. OSTP officials said that they communicate with NCSES on interpretations of existing survey data and analyses and their future data needs.¹⁹ These officials said NCSES data and communication processes meet their needs overall. For some surveys, NCSES includes key federal agency stakeholders in the development of policy relevant topical area modules. For the Annual Business Survey, NCSES officials said that they gathered input from several executive branch and independent agencies to improve the quality and relevance of the statistical data for their respective policy and programmatic missions.²⁰

NCSES officials said that evaluating data relevance is a challenge because evaluations of relevance often occur at the end of a multi-year survey cycle when policy and research needs may have evolved. To maintain user relevance, NCSES has implemented other strategies, such as tracking the use of NCSES data in published research and creating new data products to meet evolving user needs. For example, to help users with differing sophistication levels find and use data relevant to their needs, NCSES has developed products with data summarized at varying levels of detail. In response to user feedback, NCSES officials said that they created a “middle-tier” data tool that reports data in greater detail

¹⁸In March 2022, NSF announced the new Technology, Innovation, and Partnerships Directorate, which seeks to accelerate discovery and innovation to rapidly bring to market new technologies that address pressing societal and economic challenges. The Directorate plans to launch a set of integrated initiatives to advance critical and emerging technologies and cultivate new education pathways for a diverse and skilled future technical workforce.

¹⁹OSTP officials stated that NCSES data will be used in developing the Quadrennial Science and Technology Review that was mandated by § 10613 of the Research and Development, Competition, and Innovation Act, to be codified at 42 U.S.C. § 6615b.

²⁰Executive branch agency stakeholders include the Department of Commerce’s Census Center for Economic Studies, Environmental Protection Agency, and the Department of Labor. The National Endowment for the Arts and the Federal Reserve System are independent federal government agency stakeholders.

than high-level estimates, but does not require a restricted use data license.²¹

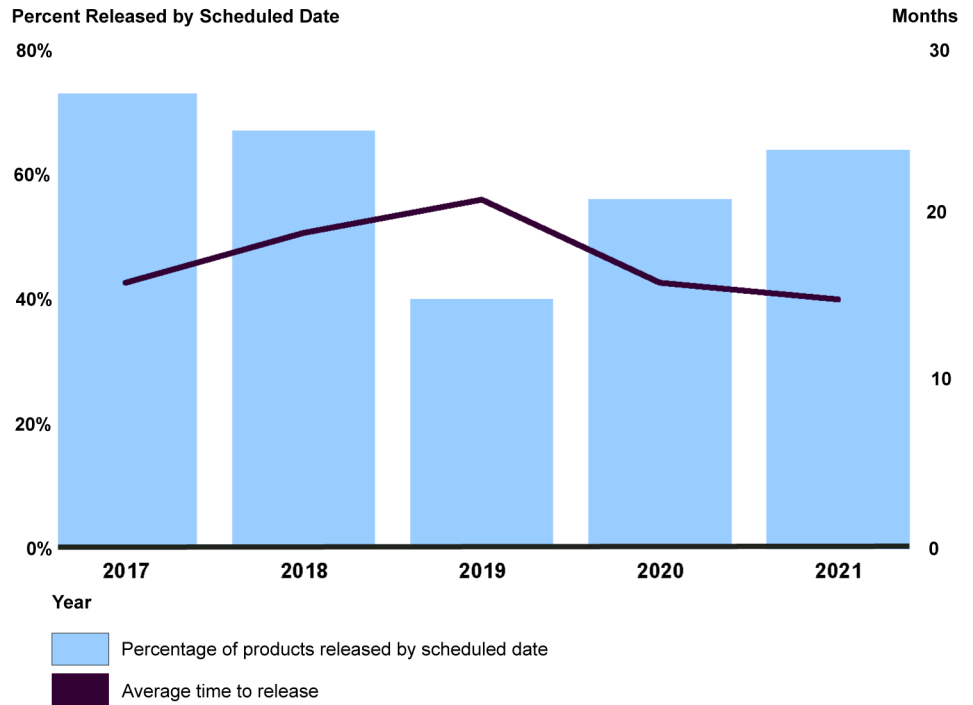
Timeliness. NCSES works to help ensure timeliness of its data by maintaining a publicly accessible schedule of release dates for surveys and other data products and tracking its rate of on-time releases.²² According to performance data provided by the agency, the percentage of survey products issued by the scheduled release date has varied from 40 percent to 73 percent for each year between 2017 and 2021 (see fig. 4).²³ NCSES officials said that one factor that contributes to the length of time it takes to issue products is the time spent developing quality survey questions.

²¹NCSES grants licenses to securely access restricted use microdata files for 6 of its surveys. Individuals employed at a U.S. based institution or organization can apply for access to restricted use data files and requests for restricted use data will be judged based on the purpose of data use, methods for protecting confidentiality, and feasibility of the research project. See, 44 U.S.C. § 3506, and America COMPETES Reauthorization Act of 2010, Pub. L. No. 111-358, §505, 124 Stat. 3982, 4007 (codified at 42 U.S.C. 1862p).

²²OMB Statistical Policy Directive No. 4 provides data release procedures to agencies “to ensure that statistical data releases adhere to data quality standards through equitable, policy-neutral, and timely release of information to the general public.” Under OMB’s guidance, agencies must “provide the public with a schedule of when each regular or recurring statistical product is expected to be released during the upcoming calendar year by publishing it on its Web site. Agencies must issue any revisions to the release schedule in a timely manner on their Web sites.” Office of Management and Budget, *Statistical Policy Directive No. 4: Release and Dissemination of Statistical Products Produced by Federal Statistical Agencies*, 73 Federal Register 12622 (Mar. 7, 2008).

²³NCSES officials explained that the government shutdown that occurred from December 2018 to January 2019 caused stoppages in survey data collection activities that resulted in schedule revisions to numerous NCSES publications. They said that this was a likely cause of the decreased timeliness and increased average time to release that occurred in 2019.

Figure 4: Release Times of National Center for Science and Engineering Statistics' Statistical Products



Source: National Center for Science and Engineering Statistics. | GAO-23-106361

Delays in data availability mean some policy and research questions cannot be addressed in a timely manner. For example, some stakeholders said that effects from the COVID-19 pandemic on education, workforce, and R&D activities are not well understood because NCSES has not yet published data collected during the height of the pandemic.

NCSES officials said that they are attempting to better meet timeliness needs by developing new data products using preliminary survey estimates. In doing so, stakeholders said that NCSES would meet user needs in a more timely way while it undergoes the resource-intensive process of ensuring the accuracy of its statistical products for full publication. One stakeholder said that interim reports have helped mitigate the effects of delays in releasing data products.

External evaluations. To supplement its internal evaluation efforts, NCSES contracts with the research and evaluation community to

evaluate the accuracy and relevance of its current data programs and processes and to research the relevance of emerging topical areas. NCSES primarily contracts with the National Academies Committee on National Statistics to convene expert panels to discuss topics of interest and develop recommendations.

For example, NCSES asked the Committee on National Statistics to convene a panel to review, assess, and provide guidance on NCSES's approach to measuring the science and engineering workforce. This led to the publication of the National Academies report, [Measuring the 21st Century Science and Engineering Workforce Population: Evolving Needs](#), which identified priority focus areas to ensure NCSES workforce data remain relevant.²⁴ The committee recommended that NCSES strengthen its science and engineering workforce surveys to better understand the complex career pathways and skillsets of modern scientists and engineers.

More recently, NCSES contracted with the Committee on National Statistics to study how NCSES documents and archives its statistical products. The committee convened the Panel on Transparency and Reproducibility of Federal Statistics, which considered current standards and tools and made recommendations to improve transparency in federal statistics. In its final report, *Transparency in Statistical Information for the National Center for Science and Engineering Statistics and All Federal Statistical Agencies*, the committee recommended that NCSES emphasize timely distribution and accessibility of methodology reports and other information underlying statistical programs.²⁵ Some recommendations were directed not only at NCSES, but at OMB and all primary federal statistical agencies.

²⁴National Academies of Sciences, Engineering, and Medicine, *Measuring the 21st Century Science and Engineering Workforce Population: Evolving Needs* (Washington, D.C.: The National Academies Press, 2018) accessed Jan. 30, 2023, <https://doi.org/10.17226/24968>.

²⁵National Academies of Sciences, Engineering, and Medicine, *Transparency in Statistical Information for the National Center for Science and Engineering Statistics and All Federal Statistical Agencies* (Washington, D.C.: The National Academies Press, 2022) accessed Dec. 5, 2023, <https://doi.org/10.17226/26360>.

NCSES Coordinates with Other Statistical Agencies to Help Improve Effectiveness

NCSES coordinates with OMB and other federal and international statistical agencies to help improve its own processes and to collect and analyze data more effectively. NCSES officials said that they designed their process to align with recommended practices, such as the *Principles and Practices*, which states that an effective statistical agency actively seeks opportunities to conduct research and carry out other activities in collaboration with other statistical agencies to enhance the value of its own information and that of the system as a whole.²⁶

Coordination to Collect Sexual Orientation and Gender Identity Data

To coordinate the collection of sexual orientation and gender identity (SOGI) data across the federal government, the Office of the Chief Statistician of the United States developed recommendations on the current best practices for the collection of self-reported SOGI data on federal statistical surveys. Best practices include using tested terminology and translations, considering respondent sensitivity and burden, and using response options, such as write-in responses, to improve data quality. OMB officials said measures should also be adapted over time to maintain usefulness and ensure data are collected in a manner consistent with each study's purpose. National Center for Science and Engineering Statistics (NCSES) officials said that they coordinate across the federal statistical system to address issues surrounding the collection and availability of SOGI data in federal surveys.

Source: OMB and NCSES. | GAO-23-106361

NCSES coordinates with U.S. principal statistical agencies and units (see table 3), as well as with statistical officials from other federal agencies. This coordination occurs primarily through the Interagency Council on Statistical Policy and the Federal Committee on Statistical Methodology, two interagency groups for collaboration, coordination, and information sharing.²⁷ According to officials, NCSES works with interagency groups to understand and use existing data for cross-agency purposes, communicate and plan new data collections, and standardize data collection measures, such as race, ethnicity, sexual orientation, and gender identity data.

²⁶National Academies, *Principles and Practices*, "Practice 7: Coordination and Collaboration with Other Statistical Agencies."

²⁷In addition to representatives from the 16 principal statistical agencies and units, the Interagency Council for Statistical Policy membership includes statistical officials from all 24 Chief Financial Officers Act agencies.

Table 2: Principal Federal Statistical Agencies and Other Recognized Statistical Units

13 Principal Statistical Agencies

- Bureau of Economic Analysis
- Bureau of Justice Statistics
- Bureau of Labor Statistics
- Bureau of Transportation Statistics
- Census Bureau
- Economic Research Service
- Energy Information Administration
- National Agricultural Statistics Service
- National Center for Education Statistics
- National Center for Health Statistics
- National Center for Science and Engineering Statistics
- Office of Research, Evaluation, and Statistics, Social Security Administration
- Statistics of Income Division, Internal Revenue Service

3 OMB-Recognized Statistical Units

- Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration
- Microeconomic Surveys Section, Federal Reserve Board
- National Animal Health Monitoring System Program Unit, Animal and Plant Health Inspection Service, United States Department of Agriculture

Source: Office of Management and Budget (OMB). | GAO-23-106361

NCSES officials said that when they submit their Information Collection Requests to OMB, as required for all new and ongoing information collection efforts, OMB provides guidance to ensure NCSES's efforts align with and do not duplicate efforts by other federal statistical agencies. OMB reviews the collection requests to promote an effective use of resources by ensuring the agency has properly justified the data collection, has minimized estimated response burden, and anticipates meaningful uses of the data.²⁸

In addition, NCSES is leading multiple government-wide evidence-building initiatives designed to improve the effectiveness of the federal statistical system. For example, it is leading the first-ever Standard Application Process for applying to access restricted-use data from

²⁸The OMB clearance process is required by the Paperwork Reduction Act of 1980 for surveys and other statistical information collections. 44 U.S.C. §§ 3506-07.

statistical agencies.²⁹ NCSSES is also the project lead for the National Secure Data Service demonstration project, which is building a data infrastructure designed to facilitate data access, enable data linkages, and develop privacy-enhancing techniques to increase evidence building activities.

Beyond federal coordination, NCSSES also works with international agencies to help ensure that science and technology research and innovation data are collected and disseminated in accordance with international statistical guidance.³⁰ As part of this coordination, NCSSES is a member of the Organisation for Economic Co-operation and Development (OECD) Working Party of National Experts on Science and Technology Indicators, which monitors and coordinates statistical work on science, technology, and innovation. Through its work with OECD officials, NCSSES officials said data are standardized and disseminated to other international organizations, including the International Monetary Fund, World Bank, United Nations, and other international statistical agencies. According to officials, NCSSES works when necessary with international officials to align data classifications across separate standards, such as merging data across business classification systems, the Standard Industrial Classification and the North American Industrial Classification System.

For some of its data collection, NCSSES enters into formal interagency agreements that define the nature of coordination in a statement of work. Three typical agreements are survey co-sponsorships, contracts, and data sharing agreements.

Co-sponsorships. According to officials, NCSSES has co-sponsors for some of its surveys. The co-sponsors provide funding to support the survey cost or provide in-kind support related to the survey's operational tasks. The National Institutes of Health cosponsors three surveys, the Census Bureau and the National Center for Education Statistics cosponsor two surveys respectively, and the National Endowment for the Humanities cosponsors one survey. NCSSES works collaboratively with

²⁹Officials said the Standard Application Process portal was launched in December 2022 and is available at www.researchdatagov.org. As of its launch, the portal included metadata for over 1,000 confidential data sets from 16 federal statistical agencies.

³⁰For example, the Frascati Manual is an internationally recognized methodology for collecting and using R&D statistics and is developed through collaboration among experts in OECD Working Parties.

survey co-sponsors in modifying survey items to achieve their respective missions.

Contracts. According to officials, NCSES contracts with the Census Bureau for certain data collection and analysis efforts, including utilizing Census Bureau’s data collection infrastructure and sampling using Census Bureau data, such as the American Community Survey. For the National Survey of College Graduates, NCSES contracted with the Census Bureau to collect and analyze data and to prepare data files for publication. In addition, the Census Bureau conducted methodological research to improve data quality, timeliness, and cost efficiency.

Data sharing agreements. NCSES has data sharing agreements with both the Census Bureau and Bureau of Economic Analysis. Data sharing agreements can include the storage of NCSES confidential data in a Federal Statistical Research Data Center for access by restricted use license holders in a secure research environment.³¹ According to officials, NCSES grants restricted use data licenses for six data sources, which are housed in Federal Statistical Research Data Centers.³²

NCSES Assesses Emerging Needs but Has Missed Opportunities to Better Communicate with Stakeholders

As a federal statistical agency, NCSES maintains a research program to assess emerging data needs, but it has not communicated with stakeholders about agency priorities, as called for in relevant guidance.

³¹Supported by the Census Bureau, the 33 Federal Statistical Research Data Centers are partnerships between federal statistical agencies and leading research institutions. These provide secure environments to support qualified researchers in using restricted data while protecting respondent confidentiality.

³²The six data sources include five surveys (Early Career Doctorate Survey, National Survey of College Graduates, National Survey of Recent College Graduates, Survey of Doctorate Recipients, Survey of Earned Doctorates) and the Scientists and Engineers Statistical Data System, which is an integrated data system of longitudinal information on the education and employment of the college educated U.S. science and engineering workforce.

NCSES Identifies and Assesses Emerging Needs through Research Activities

To identify emerging data needs, NCSES conducts research activities that relate to guidelines for statistical agencies. In particular, the National Academies' *Principles and Practices* notes that an effective statistical agency research program includes research on substantive issues within an agency's subject-matter domain, as well as research to improve statistical methods.³³

NCSES researches substantive issues to assess whether to collect new data in emerging topic areas. For example, in a *Federal Register* notice, NCSES stated a need to better understand education, training, and career pathways of the skilled technical workforce, which led to the development of the National Training, Education, and Workforce survey (see textbox).³⁴ As part of its efforts to better understand the landscape of data on the skilled technical workforce, NCSES funded research to identify, assess, and analyze existing data on non-degree credentials. Officials said they also send staff to conferences to engage with research communities, which is important to ensuring the relevance of agency data, according to *Principles and Practices*.³⁵

³³National Academies, *Principles and Practices*, "Practice 5: An Active Research Program," 67.

³⁴86 Fed. Reg. 54250 (Sept. 30, 2021). The skilled technical workforce is defined as workers in occupations that use significant levels of science and engineering expertise and technical knowledge and whose educational attainment is less than a bachelor's degree. NCSES, *Skilled Technical Workforce Initiative*, accessed June 28, 2023, <https://www.nsf.gov/statistics/stw/skilled-technical-workforce.cfm>.

³⁵National Academies, *Principles and Practices*, "Practice 9: Dissemination of Statistical Products That Meet Users' Needs," 91.

The National Training, Education, and Workforce Survey Will Collect New Data on the Skilled Technical Workforce

In 2022, the National Center for Science and Engineering Statistics (NCSES) initiated the first cycle of the National Training, Education, and Workforce Survey (NTEWS) to collect data on the educational and training characteristics of the nation's skilled technical workforce. Data from the survey will provide information on work-related credentials (such as certificates and licenses) and the relationship between these credentials and employment outcomes, with a focus on those who have not obtained a bachelor's degree.

Prior to developing NTEWS, NCSES committed resources to its Skilled Technical Workforce Initiative and established a Skilled Technical Workforce Working Group. The Working Group identified existing data sources and engaged with stakeholders. For example, in August 2020 it held three workshops to present a framework for defining and measuring the skilled technical workforce and to gather input from the science, technology, engineering, and mathematics (STEM) workforce community—those who help educate, train, employ, support, sustain, and advance STEM workers.

To develop NTEWS, NCSES worked with its survey cosponsor, the National Center for Education Statistics, to identify priority research questions and draft questionnaire items. NCSES assessed the utility and quality of the questionnaire items and compiled documents that summarized these assessments, the agency's review of existing data sources, and its justification for NTEWS. These documents were included in NCSES's Information Collection Request submitted in September 2021 and approved by OMB. Data from NTEWS are scheduled to be released in April 2024.

Source: GAO analysis of NCSES and OMB documents. | GAO-23-106361

According to officials, NCSES studies the feasibility of new data initiatives by reviewing the data that currently exist on a topic and assessing the resources needed to collect new data. For example, NCSES recently studied the feasibility of collecting reliable sexual orientation and gender identity data from the nation's college-educated population. To do so, NCSES and its contractor collected data from a sample of National Survey of College Graduates survey respondents and assessed nonresponse, changed answers, completion times, and other quality metrics. NCSES views the feasibility study as part of its responsibility to provide objective data on the science and engineering enterprise. However, the agency conducted a human capital assessment that identified a need for additional staff if NCSES is to expand efforts to collect data on other emerging topics. Additionally, officials said that, due to limited staff and the agency's other responsibilities, NCSES does not have the capacity to pursue any new large-scale survey initiatives similar to the NTEWS.

NCSES researches ways to improve statistical methods and publishes the results in working papers. Working papers are intended to report exploratory results of research and analysis undertaken by the agency. One recent working paper reported alternative estimates from the 2016 Nonprofit Research Activities Survey to assess the accuracy of results

and identify lessons learned to inform future data collections. NCSES has increased its output of working papers. According to its online publications database, as of May 2023, NCSES has issued 11 working papers since 2021 after issuing three from 2015 through 2020. Officials said the working papers help address their goal of improving data access and dissemination.

This research includes experiments with survey designs to improve response rates and assess the effects of potential survey changes. For example, the National Survey of College Graduates includes methodological experiments to investigate how incentives, Quick Response (QR) codes, and text message reminders influence survey response and completion rates. In some of its surveys, NCSES is also using small, representative samples whose data will not be included in final published estimates (referred to as a bridge panel) to test the effect of question wording modifications and quantify the effect on key survey estimates. For example, analysis of NTEWS results will compare non-response rates, estimates, and other information to determine if modified items should be included in future survey cycles.

Additionally, NCSES has explored the use of administrative data sources to supplement survey data.³⁶ Some researchers we spoke to said NCSES could link respondents' data to existing data sources like administrative records, which would enhance the utility of its survey data and enable researchers to conduct more extensive analyses. To that end, NCSES has explored the potential of linking data from the Survey of Doctorate Recipients with NSF's grant-funding records to assess new ways to evaluate the outcomes of NSF investments. Its working paper on the subject concluded that linking records between the two data sources demonstrated a way to improve the utility of NCSES survey data. NCSES is also exploring the use of administrative data from a variety of sources to inform measurement error and serve as a supplementary sampling frame for the National Survey of College Graduates. Officials said the agency has undertaken several other efforts, including collaboration with international and academic partners to assess the potential of

³⁶Administrative data include administrative, regulatory, law enforcement, adjudicatory, financial, or other data held by agencies and offices of the government or their contractors or grantees (including states or other units of government) and collected for other than statistical purposes. Administrative data are typically collected to carry out the basic administration of a program, such as processing benefit applications or tracking services received. These data relate to individuals, businesses, and other institutions. Office of Management and Budget, *Guidance for Providing and Using Administrative Data for Statistical Purposes*, OMB-M-14-06 (Feb. 14, 2014).

administrative data sources to complement survey sources in measuring topics such as research activities, R&D, and innovation.

NCSES Communication Plan Is Outdated, and It Has Not Fully Engaged Stakeholders

NCSES meets OMB requirements for notifying the public about its individual surveys through *Federal Register* notices, but it has not updated its communication plan. Further, the agency has not involved external stakeholders in the development of key priority-setting documents or released information about these priorities publicly.

In 2019, NCSES developed a strategic communication plan to guide engagement with stakeholders and strengthen these partnerships. Officials said one purpose of the plan is to help NCSES meet OMB's directive that agencies seek input regularly from the broadest range of private- and public-sector data users.

The plan identifies strategies and tactics for engagement and outreach to NCSES stakeholders. These strategies include conducting outreach to data user communities, which officials said helps NCSES assess the relevance of its data products. For example, according to officials, NCSES has solicited expert feedback on new survey questions and collected feedback from data users through its website and user community listserv.

We interviewed stakeholders about communication with NCSES and heard anecdotal evidence of both positive and negative outcomes. For example:

- One researcher described initiating communication with NCSES that resulted in NCSES funding a workshop to explore new data collection.
- Officials at one research institute said there are few opportunities to discuss new data that need to be collected, and it is not clear how NCSES uses the information it gathers from stakeholders at conferences.
- Another researcher who is a regular user of NCSES data said he and his collaborators did not learn of planned changes to the sample

design of a survey until after they were implemented, and, as a result of these changes, they could not continue ongoing research.³⁷

- We reached out to representatives from four nonprofit organizations that work with state governments on career technical education and STEM initiatives. Of these, one reported experience using NCSES data or products, one did not use NCSES data, and two were not familiar with NCSES data.

Standards for Internal Control in the Federal Government states that agency managers should select appropriate methods of communication and periodically evaluate these methods to ensure the organization has the appropriate tools to communicate quality information externally.³⁸ However, NCSES may not be selecting the most appropriate communications methods because its strategic communication plan is based in part on outdated information. For example, the communication plan draws from the NCSES 2016–2020 strategic plan instead of aligning with its more recently updated 2018–2023 strategic plan. In addition, officials said the communication plan has not been updated to reflect the recent reorganization of NCSES. For example, in the time since the plan was developed, NCSES has reorganized its survey teams under one organizational group, which officials said was designed to promote consistent communication across survey teams through shared responsibilities. But, without updating the communication plan accordingly, teams may be unable to implement communications activities to meet NCSES goals as the plan intends. Officials also said the plan needs to be updated to more clearly define goals and responsibilities. According to them, the plan was designed as a living document to keep pace with the changing environment, but the agency has not updated the plan due to a lack of devoted resources and other agency priorities.

³⁷NCSES acknowledged the concern in its information collection request submitted to OMB and stated that the motivation for the sample design change was to produce reliable cross-sectional estimates and that the results of the change would provide a richer source of data and greater opportunities for longitudinal research in the future. National Science Foundation, SF-83-1, *Supporting Statement for the 2017 Survey of Doctorate Recipients* (June 15, 2017).

³⁸GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: Sept 2014).

Learning Agendas

According to Office of Management and Budget (OMB) guidance for implementing the Evidence Act, a learning agenda is a plan that defines and prioritizes relevant questions and identifies strategies for building evidence to answer them. In developing a learning agenda, an agency should involve key leaders and stakeholders, to help (1) meet their evidence needs for decision-making and (2) coordinate evidence-building activities across the agency.

Source: OMB M-19-23, at 5. | GAO-23-106361

Further, NCSES has developed strategic and learning priorities but has not engaged with external stakeholders about these priorities, potentially missing opportunities to better meet emerging needs. NCSES developed a strategic plan for fiscal years 2018–2023, but it did not include external stakeholders in its planning process, and officials said they have not publicly released the strategy. Related to the priorities in its strategic plan, NCSES developed a learning agenda for fiscal years 2022–2023 to address questions that it believed would be relevant to stakeholders, but officials said they did not engage with external stakeholders to obtain input on the agenda. Instead, NCSES staff chose the learning agenda questions and relied on their understanding of stakeholder needs as informed by existing documents, legislation, or efforts not directly related to NCSES’s process to develop the learning agenda. Officials said the agency did not release the learning agenda publicly.

OMB guidance for implementation of the Foundations for Evidence-Based Policymaking Act of 2018 (also known as the Evidence Act) states that in developing and implementing a learning agenda, agencies should consult with internal and external stakeholders throughout to identify learning priorities and build evidence.³⁹ While the Evidence Act does not require sub-agencies, such as NCSES, to meet this requirement, OMB strongly encourages sub-agencies and other entities to develop and implement their own learning agendas that are consistent with agency-wide agendas.⁴⁰ Learning agendas identify priority questions for evidence building and allow for related planning activities (see sidebar). The purpose of stakeholder engagement is to make sure that the learning agenda addresses relevant and meaningful questions that will result in learning that resonates with stakeholders.⁴¹

Officials said they did not publicly release the strategic plan because they viewed it as an internal document that would help them integrate NCSES’s priorities with those of NSF. They said they did not obtain external stakeholder input on the final draft of the learning agenda because they wanted to develop it in a timely manner. However, the strategic plan and learning agenda describe ways to address emerging

³⁹Office of Management and Budget, *Phase 1 Implementation of the Foundations for Evidence-Based Policymaking Act of 2018: Learning Agendas, Personnel, and Planning Guidance*, OMB-M-19-23 (July 10, 2019).

⁴⁰Office of Management and Budget, *Evidence-Based Policymaking: Learning Agendas and Annual Evaluation Plans*, OMB-21-27 (June 30, 2021).

⁴¹OMB M-19-23, at 16.

issues and potential changes to surveys that may be relevant to some stakeholders. According to OMB, agencies can use stakeholder consultation to better ensure priorities and evidence-building activities will be of use to those who need it.⁴² Additionally, by engaging with researchers on evidence needs, agencies allow academics to align their research to policy questions relevant to agencies.⁴³

Currently, NCSES's communication meets OMB requirements to notify the public of planned data collections through *Federal Register* notices, but officials said they want to do more to inform the public.⁴⁴ Officials said they would like for the public to learn about data NCSES intends to collect before they submit an information collection request to OMB. To do so, they said they primarily communicate this information when they participate in conferences of professional associations. One stakeholder said NCSES's public announcements are informative, but *Federal Register* notices do not reach a wide audience. This stakeholder and others said planned outreach using a variety of approaches would also allow NCSES more opportunities to obtain input from stakeholders. Some stakeholders said NCSES operates with limited staff, which may restrict its outreach activities. Similarly, NCSES's human capital assessment in November 2021 concluded that the agency would need additional staff in order to improve survey management. According to that assessment, the agency has 51 full-time federal staff, hosts about 15 interns and fellows every year, and oversees more than 2100 contractors.

According to *Principles and Practices*, agencies may need to expend considerable energy to open avenues of communication more broadly with current and potential users.⁴⁵ NCSES officials acknowledged the need to update the strategic communication plan. However, officials had not established a timeline for doing so and said they hoped to update the plan by the end of the 2023 fiscal year. They also noted they have taken other steps to strengthen communications. In April 2022, the agency hired

⁴²OMB, M-21-27, at 8.

⁴³OMB, M-21-27, at 8.

⁴⁴Before federal statistical agencies engage in information collection, they are required to solicit public comment, pursuant to the Paperwork Reduction Act. NCSES officials said they attempt to include sufficient information to make these documents as transparent as possible because they intend for these documents to communicate information and changes about surveys to the public. 5 C.F.R. § 1320.8.

⁴⁵National Academies, *Principles and Practices*, "Principle 1: Relevance to Policy Issues and Society."

a communications specialist where, previously, a science advisor was responsible for maintaining consistent communications. Officials said the new hire's communications responsibilities will include serving as a primary contact with data providers and helping communicate NCSES's priorities. Furthermore, they said they have obtained more resources to make working papers and documentation available to the user community, which they said should enable them to have more conversations with the user community about NCSES's ongoing efforts. However, without updating the plan to include strategies for stakeholder outreach on data collection and priorities, NCSES may miss opportunities to obtain input that could help ensure the relevance of data to its stakeholders.

Conclusions

Federal statistical agencies produce data that stakeholders rely upon to inform evidence-based decisions and policy. NCSES has developed a strategic communication plan to guide stakeholder engagement but has not updated this plan. Further, NCSES has not engaged stakeholders in key priority setting processes. Communication strategies designed to ensure consistent, broad outreach could expand current and potential users' awareness of NCSES planned data collection, which could, in turn, more effectively enlist opportunities for stakeholders to provide input to ensure the relevance of these data. By updating its communication plan to identify methods and tools for communicating with stakeholders, NCSES would be better positioned to directly communicate priorities and goals to its broad set of stakeholders and more readily involve them in developing priorities.

Recommendation for Executive Action

The Director of NCSES should update the agency's communication plan to identify appropriate methods and tools for communicating with stakeholders regarding data collection efforts, agency strategic priorities, and learning agendas. (Recommendation 1)

Agency Comments

We provided a draft of this report to National Science Foundation, Office of Management and Budget, and Office of Science and Technology Policy for review and comment. In its comments reproduced in Appendix III, NSF concurred with our recommendation. In addition, we received technical comments from NSF and OMB which we incorporated into the draft as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Director of NSF, and the Director of NCSES. In addition, the report is available at no charge on the GAO website at <https://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-6888 or WrightC@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix IV.



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Appendix I: Objectives, Scope, and Methodology

This report (1) describes how National Center for Science and Engineering Statistics (NCSES) ensures its data and analyses meet data quality standards, and (2) evaluates the extent to which NCSES has processes to address identify needs.

For both objectives, we interviewed National Science Foundation (NSF) and NCSES officials, officials at the Office of Management and Budget's (OMB) Office of Information and Regulatory Affairs and the Office of Science and Technology Policy, and two former NSF officials. We also reviewed NCSES documents including strategic planning documents, survey planning documents that NCSES submits to OMB for approval to collect information, and interagency agreements between NCSES and its statistical partners.

To evaluate the extent to which NCSES has processes to address needs, we reviewed standards and guidelines published by OMB and leading practices found in *Principles and Practices of a Federal Statistical Agency*, and we compared NCSES processes—as described to us in interviews and stated in agency documents—to relevant standards and guidelines.¹ We selected standards and guidelines that relate to statistical agencies' processes for meeting current and emerging needs. Among the OMB standards, we selected Statistical Policy Directive No. 1 because it broadly defines the fundamental responsibilities of federal statistical agencies to produce accurate, reliable, and timely data. We selected Directive No. 2 because it describes specific survey standards and guidelines for ensuring and maximizing the quality, objectivity, and utility of data. In addition, we found all National Academies' principles and practices to be relevant, but we excluded those that did not fall within our scope of reviewing processes for producing data and analyses to meet needs. For example, we did not examine NCSES activities related to its statutory authorities (Practice 2) or for protecting data confidentiality (Practice 8). According to the National Academies, the principles and practices are guidelines meant to assist statistical agencies but are not intended to be prescriptive. Because of this, we compared NCSES activities generally but did not evaluate the extent to which NCSES processes meet the guidelines. In addition, we determined that the information and communication component of internal control was significant to this analysis, along with the related principle that

¹National Academies of Sciences, Engineering, and Medicine. *Principles and Practices for a Federal Statistical Agency: Seventh Edition* (Washington, D.C.: The National Academies Press, 2021). <https://doi.org/10.17226/25885>.

management should externally communicate the necessary quality information to achieve objectives.

To obtain additional perspectives and illustrative but non-generalizable examples of NCSES's outreach to stakeholders, we interviewed three stakeholders with prior experience using or evaluating NCSES data products. Then, using a snowball methodology, we interviewed an additional eight stakeholders based on referrals from earlier interviews and others we requested to speak with. Including the two former NSF officials, the 13 stakeholders we interviewed included academic researchers and members of nonprofit and international organizations.

We conducted this performance audit from November 2022 to September 2023 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Statistical Directives and Guidelines for Federal Statistical Agencies

This appendix includes information on directives and guidelines for federal statistical agencies. The Office of Management and Budget (OMB) coordinates the U.S. federal statistical system. Among its responsibilities, OMB establishes Statistical Policy Directives and standards, along with guidance to describe ways to achieve these directives. Additionally, the National Academies of Sciences' *Principles and Practices for a Federal Statistical Agency (Principles and Practices)* provides managerial and technical guidance to statistical agencies.¹ Many of these principles and practices have been codified by OMB Statistical Policy Directives.

Selected OMB Statistical Policy Directives

OMB Statistical Policy Directives identify minimum requirements for federal principal statistical agencies when they engage in statistical activities. Selected directives are described below.²

- **Directive No. 1: Fundamental Responsibilities of Federal Statistical Agencies and Recognized Statistical Units.** The directive articulates four statistical agency responsibilities: (1) produce and disseminate relevant and timely information, (2) conduct credible and accurate statistical activities, (3) conduct objective statistical activities, and (4) protect the trust of information providers by ensuring the confidentiality and exclusive statistical use of their responses.³
- **Directive No. 2: Standards and Guidelines for Statistical Surveys.** The directive describes 20 standards with one or more associated guidelines for every aspect of survey methodology from planning through data release. This includes standards for survey planning, evaluation, review of information products, and survey documentation.⁴

¹National Academies of Sciences, Engineering, and Medicine. *Principles and Practices for a Federal Statistical Agency: Seventh Edition* (Washington, D.C.: The National Academies Press, 2021). <https://doi.org/10.17226/25885>.

²Other OMB Statistical Policy Directives, including OMB Statistical Policy Directive No. 4, can be found at <https://www.whitehouse.gov/omb/information-regulatory-affairs/statistical-programs-standards/>.

³Office of Management and Budget, *Statistical Policy Directive No. 1: Fundamental Responsibilities of Federal Statistical Agencies and Recognized Statistical Units*, 79 Fed. Reg. 71,610, 71,615 (Dec. 2, 2014).

⁴Office of Management and Budget, *Statistical Policy Directive No. 2: Standards and Guidelines for Statistical Surveys* (Sept. 2006).

National Academies' Principles and Practices

Five Principles

National Academies of Sciences' *Principles and Practices* identifies five fundamental principles to guide federal statistical agencies' mission and contributions to the public. The five principles are described below.

- **Principle 1: Relevance to Policy Issues and Society.** Federal statistical agencies must provide objective, accurate, and timely information that is relevant to important public policy issues.
- **Principle 2: Credibility Among Data Users and Stakeholders.** Federal statistical agencies must have credibility with those who use their data and information.
- **Principle 3: Trust Among the Public and Data Providers.** Federal statistical agencies must have the trust of those whose information they obtain.
- **Principle 4: Independence from Political and Other Undue External Influence.** Federal statistical agencies must be independent from political and other undue external influence in developing, producing, and disseminating statistics.
- **Principle 5: Continual Improvement and Innovation.** Federal statistical agencies must continually seek to improve and innovate their processes, methods, and statistical products to better measure an ever-changing world.

Ten Practices

In order to fulfill these five principles, *Principles and Practices* identifies 10 practices for statistical agencies to adopt. These practices represent the ways and means of making the basic principles operational and facilitating an agency's adherence to them. Practices 1 to 4 pertain to an agency's operations, internally and within the federal government; practices 5 to 7 bridge internal operations and external relations with the professional statistical and research communities; and practices 8 to 10 focus externally on an agency's key constituents: data users and data providers. The 10 practices are listed below along with selected guidance from each.

1. **A Clearly Defined and Well-Accepted Mission.** A statistical agency should publicly communicate its mission and disseminate its statistical

information and associated documentation on its website and other appropriate venues.

2. **Necessary Authority and Procedures to Protect Independence.** The proper functioning of the statistical agency and the entire federal statistical system requires that there be strong and uniform recognition that it has the authority to make decisions over the scope, content, and frequency of data compiled, analyzed, and disseminated within the agency's authorizing statutes based on sound scientific and professional considerations.
3. **Commitment to Quality and Professional Standards of Practice.** An effective statistical agency devotes resources to developing and implementing standards for data quality and professional practice.
4. **Professional Advancement of Staff.** An effective statistical agency maintains and develops a sufficiently large number of in-house staff, including mathematical statisticians, survey researchers, subject-matter specialists, and information technology experts, who are qualified to analyze the agency's data and to plan, design, carry out, and evaluate its core operations, so that the agency maintains the integrity of its data and its credibility in planning and fulfilling its mission.
5. **An Active Research Program.** An effective statistical agency's research program includes research on the substantive issues for which the agency's data are compiled as well as methodological research to improve statistical methods and operational procedures.
6. **Strong Internal and External Evaluation Processes for an Agency's Statistical Programs.** Statistical agencies should have processes in place to support regular evaluations of their major statistical programs and their overall portfolio of programs. Such evaluations should include internal reviews by staff and external reviews by independent groups.
7. **Coordination and Collaboration with Other Statistical Agencies.** An effective statistical agency actively seeks opportunities to conduct research and carry out other activities in collaboration with other statistical agencies to enhance the value of its own information and that of the system as a whole.
8. **Respect for Data Providers and Protection of Their Data.** Effective statistical agencies demonstrate respect for their data providers and protect the providers' data to ensure that agencies can fulfill their missions.

9. **Dissemination of Statistical Products That Meet Users' Needs.** A statistical agency should continually strive to obtain input from data users on its programs, products, and dissemination tools and methods. Understanding data users' needs and how they use data products is critical for making an agency's data services as relevant, accurate, timely, and accessible as possible.
10. **Openness About Sources and Limitations of the Data Provided.** Statistical agencies should treat the effort to provide information on the quality, limitations, and appropriate use of their data as an essential part of their mission.

Appendix III: Comments from National Science Foundation



National Science Foundation
Office of the Director

September 19, 2023

Candice N. Wright
Director, Science, Technology Assessment, and Analytics
U.S. Government Accountability Office
441 G Street NW
Washington, DC 20226

Dear Ms. Wright:

Thank you for the opportunity to review and provide comments on the Government Accountability Office (GAO) draft report, *Science and Engineering Statistics: Improved Communication Needed with Stakeholders on Data Needs* (GAO-23-106361). The National Science Foundation (NSF) values the GAO staff's professionalism and many constructive interactions during this GAO engagement.

NSF appreciates GAO's acknowledgement of agency efforts to ensure stakeholder engagement by the National Center for Science and Engineering Statistics (NCSES). NCSES is in the process of identifying strategic priorities and actionable objectives for stakeholder engagement, and it will update its Communication Plan to reflect emerging stakeholder priorities and needs given availability of resources. As part of the implementation of the updated Communication Plan, NCSES will widely share efforts through its public website and other stakeholder engagements.

NSF concurs with the recommendation made by GAO for additional actions the agency should take to update NCSES's Communication Plan to identify appropriate methods and tools for communicating with stakeholders regarding data collection efforts, agency strategic priorities, and learning agendas. NCSES will consult with the NSF Office of Legislative and Public Affairs on this important effort.

Again, thank you for the opportunity to review and comment on this draft report. Please feel free to contact Veronica Shelley at vshelley@nsf.gov or 703-292-4384 if you have any questions or require additional information. We look forward to working with you again in the future.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Sethuraman Panchanathan'.

Sethuraman Panchanathan
Director

2415 Eisenhower Avenue, Suite 19100 Alexandria, VA 22314

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

Candice N. Wright at (202) 512-6888 or WrightC@gao.gov

Staff Acknowledgments

In addition to the contact named above, Tind Shepper Ryen (Assistant Director), Michael Walton (Analyst-in-Charge), Jenny Chanley, Jehan Chase, Tim Kinoshita, Ben Licht, Curtis Martin, Linda Pheng, Ben Shouse, and Jared Smith made key contributions to this report. Other staff who contributed include Michael Holland and Umesh Thakkar.

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