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Report to Congressional Committees

September 2023

SMALL BUSINESS RESEARCH PROGRAMS

Most Agencies Allow Applicants to Define Needs and Propose Solutions

Accessible Version

GAO-23-106338

GAO Highlights

Highlights of GAO-23-106338, a report to congressional committees

September 2023

SMALL BUSINESS RESEARCH PROGRAMS

Most Agencies Allow Applicants to Define Needs and Propose Solutions

Why GAO Did This Study

Small businesses are important drivers of economic growth, but they can face challenges accessing capital to fund research and development. Through the SBIR and STTR programs, agencies provide awards to small businesses to spur technological innovation, among other goals. For these awards, agencies release solicitations that include topics. Small businesses submit proposals with technical solutions to problems. Under open topics, the small businesses define the problems, whereas under conventional topics, agencies define the problems.

The SBIR and STTR Extension Act of 2022 includes provisions for GAO to review agencies' use of open topics. This report examines, among other things, (1) the extent to which agencies have used open topics, (2) how open and conventional topic awards compare, and (3) agency considerations about which topic type to use.

GAO compiled and analyzed data from multiple sources, including the 11 participating agencies and the Small Business Administration (SBA). The scope of the review covers fiscal years 2019 through 2021, because SBA award data for fiscal year 2022 were not yet available at the time of GAO's review. GAO also reviewed agency documentation and interviewed officials from the 11 participating agencies and SBA.

View GAO-23-106338. For more information, contact Candice N. Wright at (202) 512-6888 or wrightc@gao.gov.

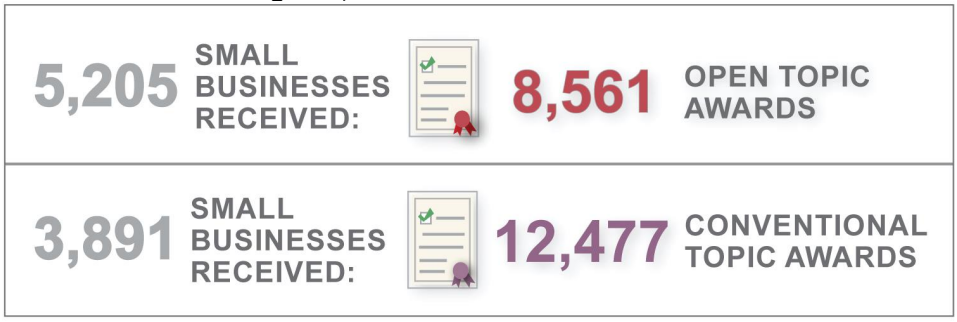
What GAO Found

Seven of 11 federal agencies participating in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs used open topics from fiscal years 2019 through 2021. In response to solicitations with open topics, small businesses submit proposals that both define research needs and propose solutions to address them. The remaining four agencies only used conventional topics. For these topics, agencies define needs and small businesses propose solutions. Officials from the 11 agencies said they expect to continue their existing use of topic types in future years.

Over the 3-year period, open topic awards accounted for about 40 percent of all awards and $4.1 billion. The percentage of awards originating from open topics increased from 36 percent in 2019 to 40 percent in 2020 and 46 percent in 2021.

Open and conventional topic awards differed in terms of small business participation from fiscal years 2019 through 2021, according to GAO analysis of award data. Based on several GAO analyses, businesses receiving conventional topic awards tended to receive multiple awards, which could indicate that open topics promote a more competitive environment.

Number of Businesses Receiving Open and Conventional Topic Awards in Small Business Research Programs, Fiscal Years 2019–2021



Source: GAO analysis of information from the Small Business Administration and the 11 Small Business Innovation Research and Small Business Technology Transfer agencies. | GAO-23-106338

Open topic awards also went to a higher percentage of small businesses owned by veterans and individuals from socially and economically disadvantaged groups, compared to conventional topic awards, but additional factors could explain this difference. For example, one agency stated that nontraditional businesses are less prevalent in certain fields, such as physics. This could contribute to lower proportions of nontraditional businesses receiving awards from agencies working in physics, regardless of the agencies' use of open topics.

In deciding whether to use open or conventional topics, agencies reported considering their goals for using the SBIR/STTR programs and available resources. For example, agencies aiming to meet the goal of increasing applicant competition may consider using open topics, according to officials. Additionally, agencies consider the availability and expertise of proposal reviewers, which is especially important given the greater variation in the types of technologies covered in research proposals for open topics.

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Abbreviations

CDC	Centers for Disease Control and Prevention
DHS	Department of Homeland Security
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FY	fiscal year
HHS	Department of Health and Human Services
NASA	National Aeronautics and Space Administration
NIH	National Institutes of Health
NSF	National Science Foundation
OSD	Office of the Secretary of Defense
OUSD R&E	Office of the Undersecretary of Defense for Research and Engineering
R&D	research and development
SAM.gov	System for Award Management
SBA	Small Business Administration
SBIR	Small Business Innovation Research
STTR	Small Business Technology Transfer
USDA	U.S. Department of Agriculture

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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Congressional Committees

Small businesses are important drivers of economic growth, but they can face challenges in accessing capital to fund research and development (R&D). Congress established the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs to enable small businesses to undertake and obtain the benefits of R&D.[1] The programs aim to

- stimulate technological innovation,
- meet federal R&D needs,
- foster diverse participation in innovation and entrepreneurship, and
- increase private-sector commercialization of innovations derived from federal R&D funding.[2]

Pursuant to the Small Business Act, federal agencies with an extramural research or R&D budget greater than $100 million are required to participate in the SBIR program, and agencies with such obligations greater than $1 billion are required to participate in the STTR program.[3] According to the Small Business Administration (SBA), which oversees

[1]The Small Business Innovation Development Act of 1982 established the SBIR program. Pub. L. No. 97-219, 96 Stat. 217. This act amended section 9 of the Small Business Act, Pub. L. No. 85-536, 72 Stat. 384 (1958), codified as amended at 15 U.S.C. § 638. The Small Business Technology Transfer Act of 1992 established the STTR program. Pub. L. No. 102-564, §§ 201-02, 106 Stat. 4249, 4256-61. This act made additional amendments to section 9 of the Small Business Act.

[2]The SBIR and STTR programs are similar in that participating agencies identify topics for R&D projects and make awards to qualified small businesses. The STTR program also requires the small business awardees to partner with a nonprofit research institution, such as a university or federally funded research and development center. Both programs are to be carried out in accordance with statutory and regulatory requirements and under oversight and guidance of the Small Business Administration. See 15 U.S.C. § 638.

[3]15 U.S.C. §§ 638(f)(1), (n)(1)(A). Agencies' R&D programs generally include funding for two types of R&D: intramural and extramural. Intramural R&D is conducted by employees of a federal agency in or through government-owned, government-operated facilities. Extramural R&D is generally conducted by nonfederal employees outside of federal facilities. Federal agency, as defined under the statute, does not include agencies within the intelligence community. 15 U.S.C. § 638(e)(2).

the programs, 11 federal agencies and their subcomponents participate in the SBIR program or in both the SBIR and STTR programs.[4] According to SBA data, in fiscal year (FY) 2021 participating agencies issued approximately $3 billion in new SBIR and STTR awards. Agencies generally make SBIR and STTR awards in the form of grants, contracts, or cooperative agreements.[5]

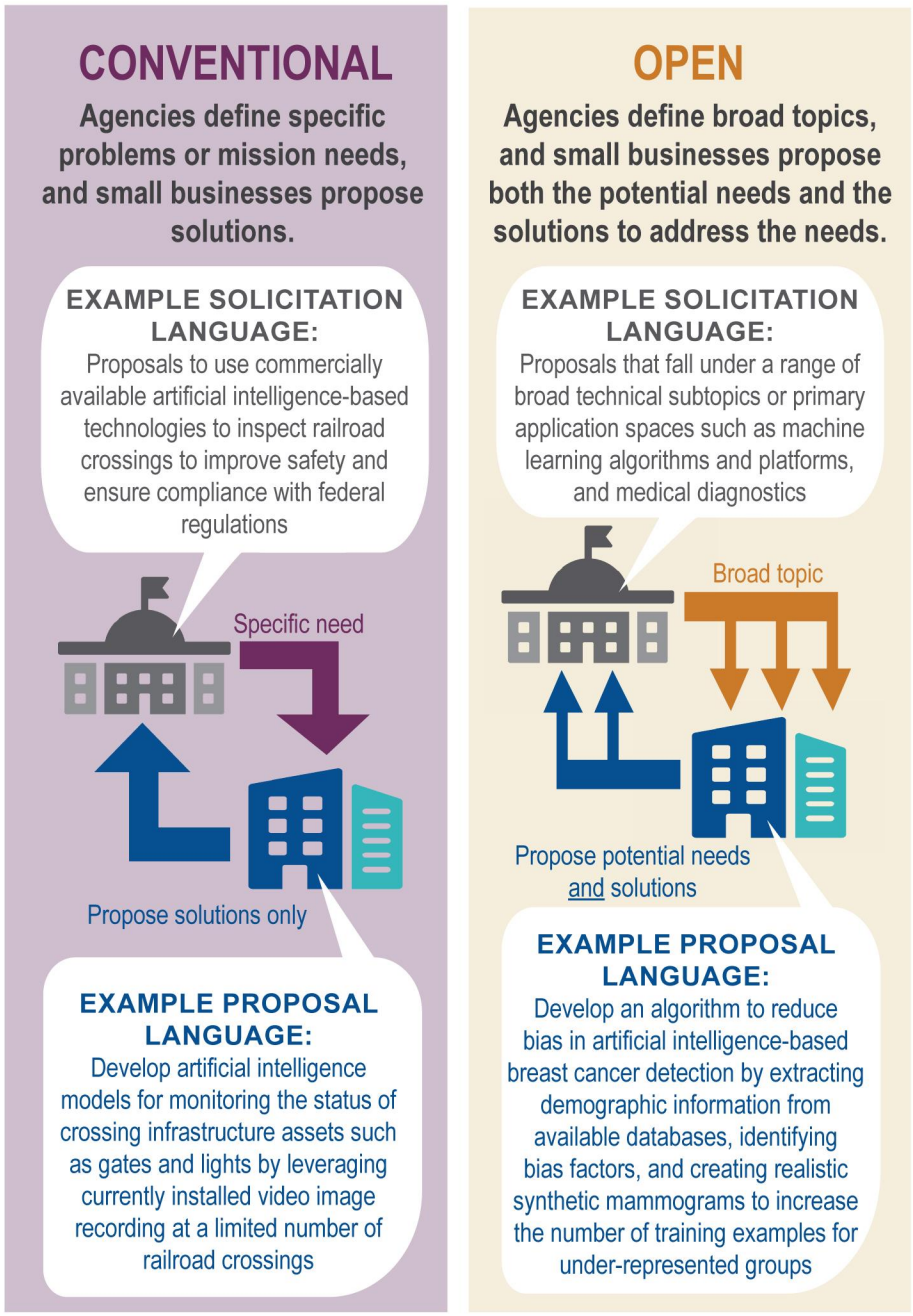
Participating agencies provide these awards to small businesses to meet agency mission needs for R&D in different technology areas. In some instances, these mission needs focus on supporting R&D that would ultimately provide benefit beyond the agency, such as for the American public at large. In other instances, agencies' mission needs focus on advancing the development of technologies that would be used by the agencies themselves.

To meet these needs, the participating agencies solicit proposals from small businesses in one or more annual cycles. Solicitations include topics, which can take two forms: open or conventional (see fig. 1).

[4]In this report, we refer to the agencies that issue SBIR and STTR awards as "participating agencies." Five agencies participated in STTR during the scope of our review. In addition, the U.S. Department of Agriculture began participating in STTR in fiscal year 2023.

[5]The Department of Defense also uses other transaction authorities for a limited number of awards, according to agency officials.

Figure 1: Open and Conventional Topics in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs



Source: GAO analysis of information from the Small Business Administration and the 11 SBIR/STTR agencies. | GAO-23-106338

Text for Figure 1: Open and Conventional Topics in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs

CONVENTIONAL	OPEN
Agencies define specific problems or mission needs, and small businesses propose solutions.	Agencies define broad topics, and small businesses propose both the potential needs and the solutions to address the needs.
EXAMPLE SOLICITATION LANGUAGE: Proposals to use commercially available artificial intelligence-based technologies to inspect railroad crossings to improve safety and ensure compliance with federal regulations	EXAMPLE SOLICITATION LANGUAGE: Proposals that fall under a range of broad technical subtopics or primary application spaces such as machine learning algorithms and platforms, and medical diagnostics
Specific need	Broad topic
Propose solutions only	Propose potential needs and solutions
EXAMPLE PROPOSAL LANGUAGE: Develop artificial intelligence models for monitoring the status of crossing infrastructure assets such as gates and lights by leveraging currently installed video image recording at a limited number of railroad crossings	EXAMPLE PROPOSAL LANGUAGE: Develop an algorithm to reduce bias in artificial intelligence-based breast cancer detection by extracting demographic information from available databases, identifying bias factors, and creating realistic synthetic mammograms to increase the number of training examples for under-represented groups

Source: GAO analysis of information from the Small Business Administration and the 11 SBIR/STTR agencies. | GAO-23-106338

The SBIR and STTR Extension Act of 2022 includes provisions for GAO to issue a series of reports comparing several aspects of open and conventional topics.[6] The act also requires participating Department of Defense (DOD) subcomponents to conduct at least one open topic per fiscal year.[7] Subcomponents are military departments, agencies, or offices. GAO is also to report on DOD's efforts to encourage and prepare new small businesses to respond to these solicitations.

This report examines (1) the extent to which participating agencies have used open topics in carrying out their SBIR/STTR programs, (2) how participating agencies' open topics and conventional topics compare in terms of award outcomes and timeliness of awards, (3) factors that participating agencies reported considering in deciding whether to use

[6]Pub. L. No. 117-183, §7(b), 136 Stat. 2180, 2188-89. The act does not define open and conventional topics, but it states that open topics are intended to increase the transition of commercial technology, expand the small business nontraditional industrial base, increase commercialization derived from federal investments, and expand the ability for qualifying small businesses to propose technology solutions to meet federal needs.

[7]Codified at 15 U.S.C. § 638(ww). No other agencies are required by the act to use open topics.

open or conventional topics, and (4) the extent to which DOD has taken steps to conduct at least one open topic at each component per fiscal year and to attract new and diverse applicants.

The scope of our work included SBA and the 11 participating agencies. We interviewed officials from these 12 agencies and analyzed data on awards made from FY 2019 through 2021, the most recent 3 years of data available when we began our review. These data included:

- award data, company registry data, and timeliness data from SBA;
- timeliness data that we collected from the 11 participating agencies for past GAO reports; and
- System for Award Management (SAM.gov) registration data on veteran ownership from the General Services Administration.[8]

We assessed the reliability of the data, cleaned the data to improve reliability, and merged the data into a single data set. After doing so, we found the data elements we used for the purposes of our report to be sufficiently reliable.

To examine the extent to which agencies have used open topics, we developed definitions for open and conventional topics based on multiple sources, including our past work and input from participating agencies.[9] We then collected and analyzed agency data on use of open and conventional topics. We assessed the reliability of these data and found them to be sufficiently reliable for our purposes.

[8]We collected timeliness data for the following reports: GAO, *Small Business Research Programs: Reporting on Award Timeliness Could Be Enhanced*, GAO-23-105591 (Washington, D.C.: Oct. 12, 2022); *Small Business Research Programs: Agencies Should Further Improve Award Timeliness*, GAO-22-104677 (Washington, D.C.: Oct. 14, 2021); and *Small Business Research Programs: Many Agencies' Award Issuances Are Not Timely; Some Practices May Improve Timeliness*, GAO-20-693 (Washington, D.C.: Sept. 30, 2020).

[9]For our past work on open topics, see GAO, *Small Business Research Programs: Air Force Had Success in Some Areas with New Awards Process*, GAO-22-105223 (Washington, D.C: July 21, 2022).

To compare open and conventional topic awards, we analyzed merged Phase I and Phase II award data on outcomes and timeliness.[10] We used regression analysis to estimate the statistical significance associated with any differences between open and conventional topic awards.

To examine factors that agencies reported considering when deciding whether to use open or conventional topics, we interviewed officials from the 11 participating agencies. We also analyzed the award data to identify any correlations between attributes of agencies' SBIR/STTR programs (e.g., budget, typical end users, and technology types funded) and the extent to which the agencies use open topics. Finally, we interviewed a non-generalizable selection of knowledgeable stakeholders from four academic, nonprofit, and industry organizations.

To examine any steps DOD has taken to establish open topics and attract new and diverse applicants, we reviewed DOD documentation and interviewed officials. See appendix I for additional information on our objectives, scope, and methodology.

We conducted this performance audit from October 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.

Background

Participating Agencies

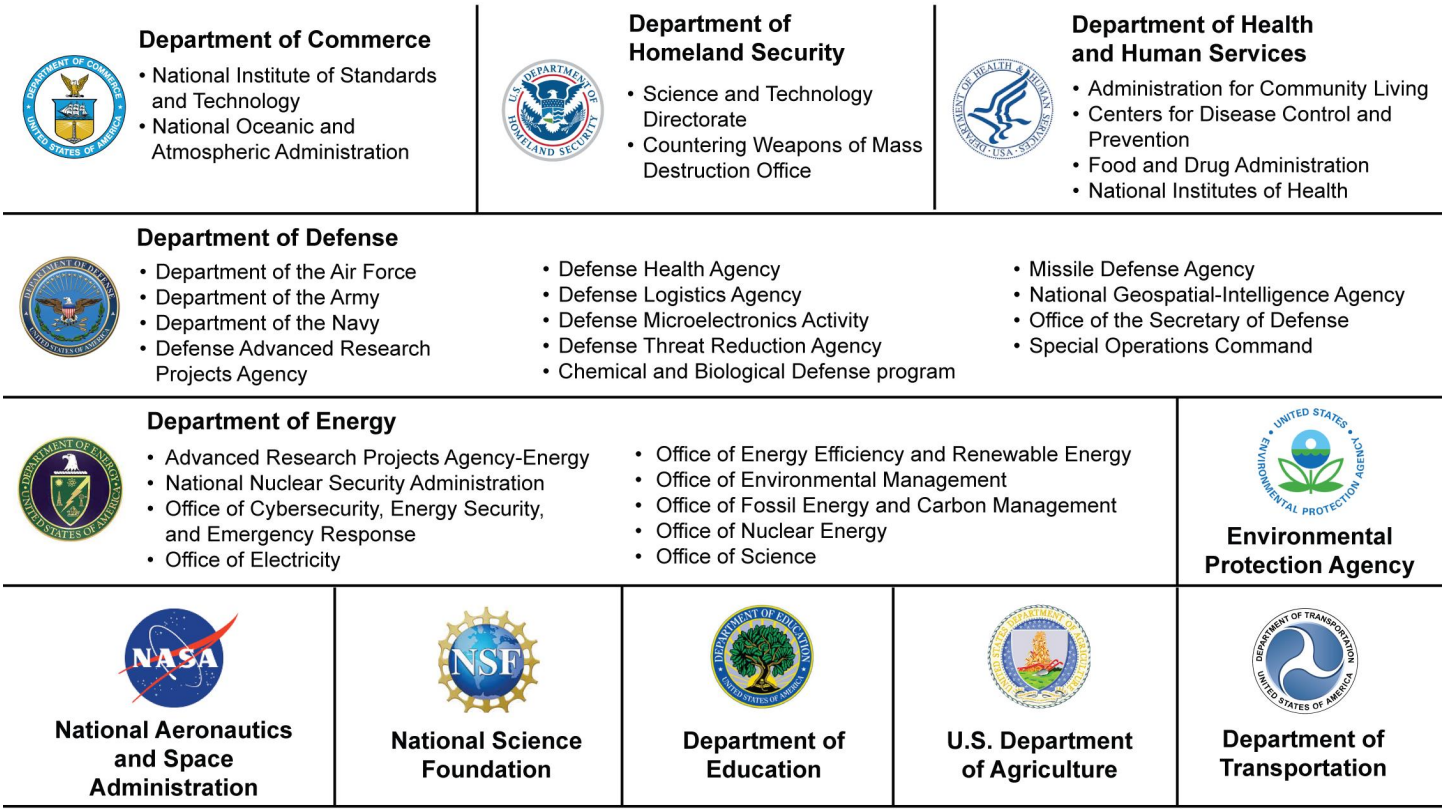
Agencies that participate in the SBIR and STTR programs implement their programs using different structures. Some of the agencies develop solicitation topics at the agency level, including determining whether topics will be open or conventional. Other agencies develop topics at the

[10]SBIR/STTR awards can occur in three phases. Phase I awards are typically to determine scientific and technical merit, and Phase II awards may involve developing a prototype or other advancements. Phase III awards are to commercialize technologies developed in earlier phases. As discussed below, information on commercialization was limited, so our analysis focused on outcomes related to participation of nontraditional small businesses (e.g., women-owned small businesses).

subcomponent level. At some agencies, subcomponents other than those that develop solicitation topics may have key responsibilities such as reviewing applications or issuing awards. See figure 2 for a list of the 11 participating agencies and their subcomponents that developed topics during the scope of our review.

Figure 2: Eleven Agencies Participating in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs

Subcomponents shown (e.g., Office of Science) developed solicitation topics from fiscal years 2019 through 2021



Source: GAO analysis of agency information. | GAO-23-106338

Text for Figure 2: Eleven Agencies Participating in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs

Agency	Subcomponents
Department of Commerce	National Institute of Standards and Technology
	National Oceanic and Atmospheric Administration
Department of Homeland Security	Science and Technology Directorate
	Countering Weapons of Mass Destruction Office

Agency	Subcomponents
Department of Health and Human Services	Administration for Community Living
	Centers for Disease Control and Prevention
	Food and Drug Administration
	National Institutes of Health
Department of Defense	Department of the Air Force
	Department of the Army
	Department of the Navy
	Defense Advanced Research Projects Agency
	Defense Health Agency
	Defense Logistics Agency
	Defense Microelectronics Activity
	Defense Threat Reduction Agency
	Chemical and Biological Defense program
	Missile Defense Agency
	National Geospatial-Intelligence Agency
	Office of the Secretary of Defense
	Special Operations Command
Department of Energy	Advanced Research Projects Agency-Energy
	National Nuclear Security Administration
	Office of Cybersecurity, Energy Security, and Emergency Response
	Office of Electricity
	Office of Energy Efficiency and Renewable Energy
	Office of Environmental Management
	Office of Fossil Energy and Carbon Management
	Office of Nuclear Energy
	Office of Science
Environmental Protection Agency	NA
National Aeronautics and Space Administration	NA
National Science Foundation	NA
Department of Education	NA
U.S. Department of Agriculture	NA
Department of Transportation	NA

Source: GAO analysis of agency information. | GAO-23-106338

Note: From fiscal years 2019 through 2021, all 11 agencies participated in SBIR, and five of those agencies participated in STTR (Department of Defense, Department of Energy, Department of Health and Human Services, National Aeronautics and Space Administration, and National Science Foundation).

Award Notification and Issuance Time Frames

SBA developed and periodically updates a policy directive to guide the general operation of agencies' SBIR and STTR programs.[11] According to SBA's SBIR/STTR policy directive, at least annually, each participating agency is to issue a solicitation requesting proposals that address certain topics. Each participating agency is then to:

1. review the proposals it receives,
2. determine which small businesses should receive awards,
3. notify pending awardees within required time frames, and
4. issue awards within recommended time frames.

Under SBA's policy directive, most agencies must notify applicants of award decisions within 90 calendar days after a solicitation closes.[12] The directive recommends that agencies issue awards within 180 days after the solicitation closes.[13]

We have issued a series of reports examining agencies' timeliness for proposal review and award issuance.[14] We found that many agencies exceeded notification and award issuance time frames. We also reported on factors that agency officials said can affect award timeliness. In our most recent report, issued in October 2022, we found that agencies have made some limited progress. Government-wide timeliness rates for issuance improved overall since FY 2016 when we began reviewing agencies' timeliness. Notification timeliness declined slightly overall.

[11]In April 2023, SBA proposed amendments to the SBIR/STTR Policy Directive. SBIR and STTR Policy Directive, 88 Fed. Reg. 19,704 (Apr. 3, 2023). These changes went into effect May 3, 2023. SBA issues policy directives for the general conduct of the SBIR and STTR programs per 15 U.S.C. §§ 638(j), (p).

[12]The directive requires one agency and one agency subcomponent—the National Science Foundation (NSF) and the Department of Health and Human Services' National Institutes of Health (NIH)—to notify applicants no more than 1 year after the closing date of the solicitation. SBIR/STTR Policy Directive § 7(c)(1).

[13]SBA recommends that NSF and NIH issue awards no more than 15 months after the closing date. SBIR/STTR Policy Directive § 7(c)(1).

[14]GAO-23-105591; GAO-22-104677; GAO-20-693; and *Small Business Research Programs: Many Agencies Took Longer to Issue Small Business Awards than Recommended*, GAO-19-620 (Washington, D.C.: Sept. 26, 2019).

We also issued a July 2022 report examining the Department of the Air Force's implementation of open topics starting in FY 2018.[15] We found that the Air Force's open topics process was more effective than its conventional process in some ways, such as attracting new applicants and reducing the time needed to issue awards. However, because of assessment and data gaps, the Air Force has not been able to fully assess open topics' effectiveness in commercialization and other areas. We made two recommendations to improve the Air Force's reporting and data reliability on certain small business participation. DOD concurred with one recommendation and partially concurred with the other.[16]

Program Phases

Under the SBIR/STTR awards process, participating agencies issue awards for three phases of technology development (see fig. 3):

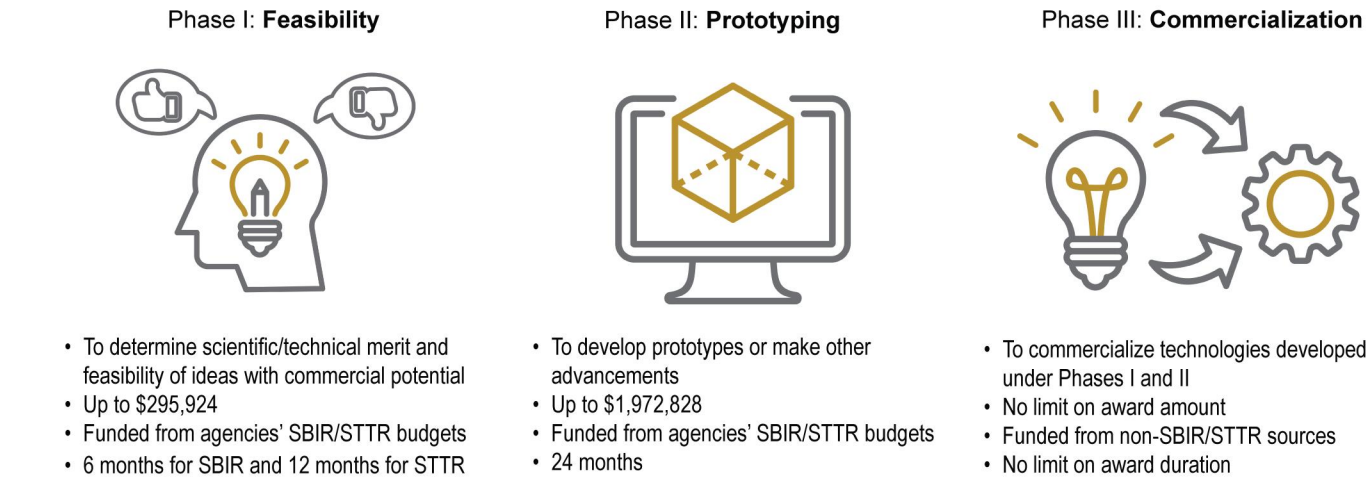
- **Phase I: Feasibility.** Small businesses conduct R&D activities to determine the scientific and technical merit and the feasibility of ideas that may have commercial potential. Businesses compete for these awards in response to agency solicitations.
- **Phase II: Prototyping.** Small businesses develop prototypes or make other advancements. Phase I awardees with projects that demonstrate scientific and technical merit may compete for Phase II awards to continue R&D. Some agencies issue Direct-to-Phase-II awards to businesses that did not receive a Phase I award but completed equivalent work using non-SBIR/STTR funds.[17]
- **Phase III: Commercialization.** Small businesses work toward commercializing technologies developed under Phases I and II, including further R&D or testing. Federal agencies may issue Phase III awards without further competition. Unlike Phase I and II awards, agencies do not fund Phase III awards with the portions of their budgets that are designated for SBIR/STTR.

[15]GAO-22-105223.

[16]As of August 2023, the Air Force has not yet taken action to implement the recommendations. The Air Force stated that it plans to improve annual reporting on women-owned small businesses and ensure that data on small, disadvantaged businesses are reliable by the end of FY 2023.

[17]DOD, NIH, and the Department of Education are authorized to issue Direct-to-Phase-II awards through FY 2025. 15 U.S.C. § 638(cc).

Figure 3: Phases of the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs
Authorized award amounts as of October 2022



Source: GAO analysis of information from the Small Business Administration (SBA). Galuh Sekar/stock.adobe.com. | GAO-23-106338

Text for Figure 3: Phases of the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs

Phase I: Feasibility	Phase II: Prototyping	Phase III: Commercialization
To determine scientific/technical merit and feasibility of ideas with commercial potential	To develop prototypes or make other advancements	To commercialize technologies developed under Phases I and II
Up to $295,924	Up to $1,972,828	No limit on award amount
Funded from agencies' SBIR/STTR budgets	Funded from agencies' SBIR/STTR budgets	Funded from non-SBIR/STTR sources
6 months for SBIR and 12 months for STTR	24 months	No limit on award duration

Source: GAO analysis of information from the Small Business Administration (SBA). Galuh Sekar/stock.adobe.com. | GAO-23-10633

Note: Maximum award amounts include any modifications to the original award amount. Agencies may seek a waiver from SBA to issue awards above the maximum values. In addition, agencies may provide longer performance periods where appropriate for particular projects. SBIR/STTR budget refers to the portion of an agency's extramural research or R&D budget designated for the SBIR/STTR programs.

Agencies Funded About 40 Percent of Awards through Open Topics in Recent Years

We found, based on our analysis of topic data from participating agencies and SBIR/STTR award data, that seven of the 11 participating agencies used open topics to fund about 40 percent of all SBIR/STTR awards from

FY 2019 through 2021 (see table 1).[18] This amounted to approximately $4.1 billion in open topic awards. The remaining four agencies only used conventional topics during this period. The same 11 agencies used open and conventional topics in FY 2022, and they anticipate doing so in the future, according to agency officials.

Table 1: Participating Agencies' Use of Open Topic Awards in Small Business Research Programs, FY 2019-2021

Open topic awards issued in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	Number of awards			Dollars awarded		
	Open topic awards	All SBIR/STTR awards	Percentage	Open topic dollars awarded	All SBIR/STTR dollars awarded	Percentage
National Science Foundation	1,481	1,481	100%	$575,669,487	$575,669,487	100%
U.S. Department of Agriculture	327	327	100%	$80,154,963	$80,154,963	100%
Department of Education	72	76	95%	$32,617,869	$34,881,003	94%
Department of Health and Human Services	3,121	4,378	71%	$2,197,971,958	$3,236,558,049	68%
Department of Commerce	75	178	42%	$14,977,936	$44,704,049	34%
Department of Defense	3,329	10,705	31%	$1,143,431,049	$5,065,679,798	23%
Department of Energy	156	1,939	8%	$55,220,007	$962,360,023	6%
Department of Homeland Security	0	128	0%	$0	$56,533,211	0%
Department of Transportation	0	97	0%	$0	$35,190,146	0%
Environmental Protection Agency	0	98	0%	$0	$16,805,499	0%
National Aeronautics and Space Administration	0	1,631	0%	$0	$566,294,601	0%
Total	**8,561**	**21,038**	**41%**	**$4,100,043,269**	**$10,674,830,829**	**38%**

Source: GAO analysis of data from the Small Business Administration and the 11 SBIR/STTR agencies. | GAO-23-106338

Note: Information includes SBIR and STTR awards. From fiscal years (FY) 2019 through 2021, all 11 agencies participated in SBIR, and five of those agencies participated in STTR. Award amounts are in 2021 dollars. Percentages are rounded to the nearest 1 percent.

Among the seven agencies with open topic awards, five agencies had both open and conventional topic awards: DOD and the Departments of Commerce, Education, Energy (DOE), and Health and Human Services

[18]The Department of Energy's (DOE) open topic awards outside the Advanced Research Projects Agency-Energy originated from open subtopics. These open subtopics were part of topics that also included conventional subtopics. According to DOE officials, restrictions on the agency's appropriated funds provide limited flexibility in what topics may be funded.

(HHS). The remaining two, the National Science Foundation (NSF) and the U.S. Department of Agriculture (USDA), only had open topic awards.

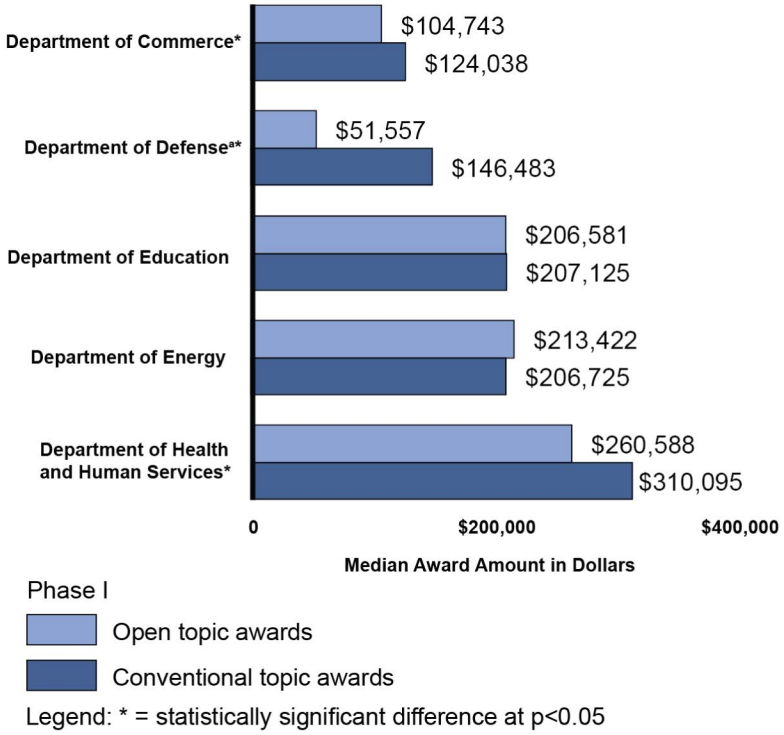
These five agencies' conventional topic awards were generally larger than their open topic awards (see figs. 4 and 5). For example:

- At DOD, the median conventional topic award was nearly three times the dollar amount of the median open topic award for Phase I. According to our analysis, the Air Force primarily drove this difference, issuing the highest number of open topic awards among DOD subcomponents. Looking just at the Air Force, the difference in award size was slightly larger. The Air Force's median Phase I award was $51,526 for open topics and $155,048 for conventional topics.[19]
- At DOE, the median conventional topic award was over four times the amount of the median open topic award for Phase II. The Advanced Research Projects Agency-Energy drove this difference. Its median Phase II award was $253,984 for open topics and $1,356,048 for conventional topics.

[19]We previously reported that the Air Force intentionally issues an overall higher number of Phase I open topic awards with a shorter period of performance and smaller award amount, when compared to its conventional topic awards. GAO-22-105223.

Figure 4: Selected Agencies' Open and Conventional Topic Phase I Award Amounts in Small Business Research Programs, FY 2019-2021

Median dollar amounts of Phase I awards issued in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs



Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Data for Figure 4: Selected Agencies' Open and Conventional Topic Phase I Award Amounts in Small Business Research Programs, FY 2019-2021

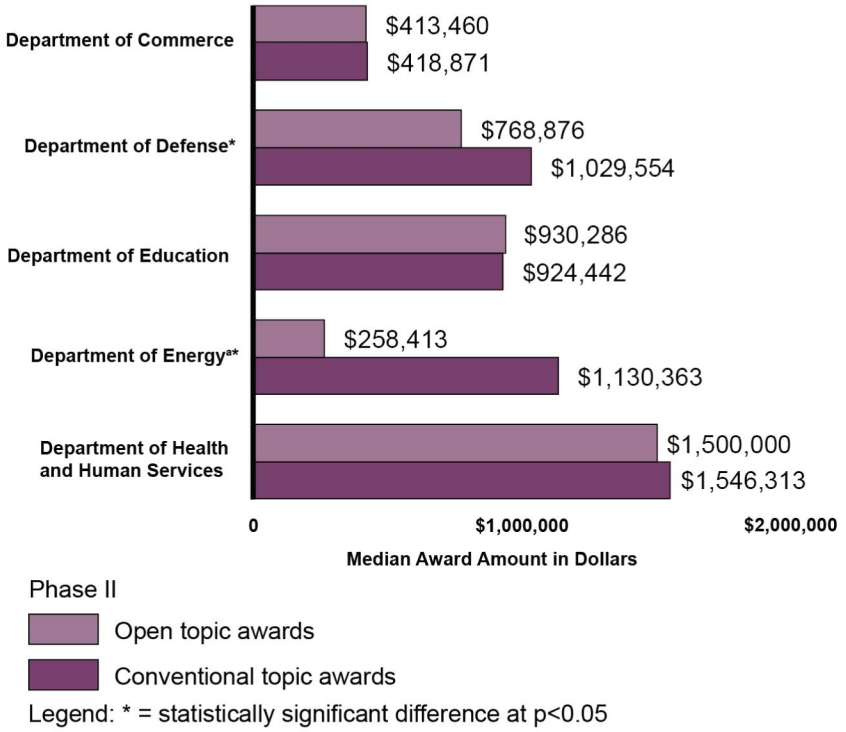
Agency	Open topic awards	Conventional topic awards
Department of Commerce	$104,743	$124,038
Department of Defense[a]	$51,557	$146,483
Department of Education	$206,581	$207,125
Department of Energy	$213,422	$206,725
Department of Health and Human Services	$260,588	$310,095

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. Award amounts are in 2021 dollars. FY = fiscal year.

[a]The Department of the Air Force primarily drove this difference in open and conventional topic awards. The Air Force issued the highest number of open topic awards among Department of Defense subcomponents. Its median Phase I award was $51,526 for open topics and $155,048 for conventional topics.

Figure 5: Selected Agencies' Open and Conventional Topic Phase II Award Amounts in Small Business Research Programs, FY 2019-2021
Median dollar amounts of Phase II awards issued in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs



Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Data for Figure 5: Selected Agencies' Open and Conventional Topic Phase II Award Amounts in Small Business Research Programs, FY 2019-2021

Agency	Open topic awards	Conventional topic awards
Department of Commerce	$413,460	$418,871
Department of Defense[a]	$768,876	$1,029,554
Department of Education	$930,286	$924,442
Department of Energy	$258,413	$1,130,363
Department of Health and Human Services	$1,500,000	$1,546,313

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. Award amounts are in 2021 dollars. Typically, only Phase I awardees are eligible for Phase II awards, which are generally larger. FY = fiscal year.

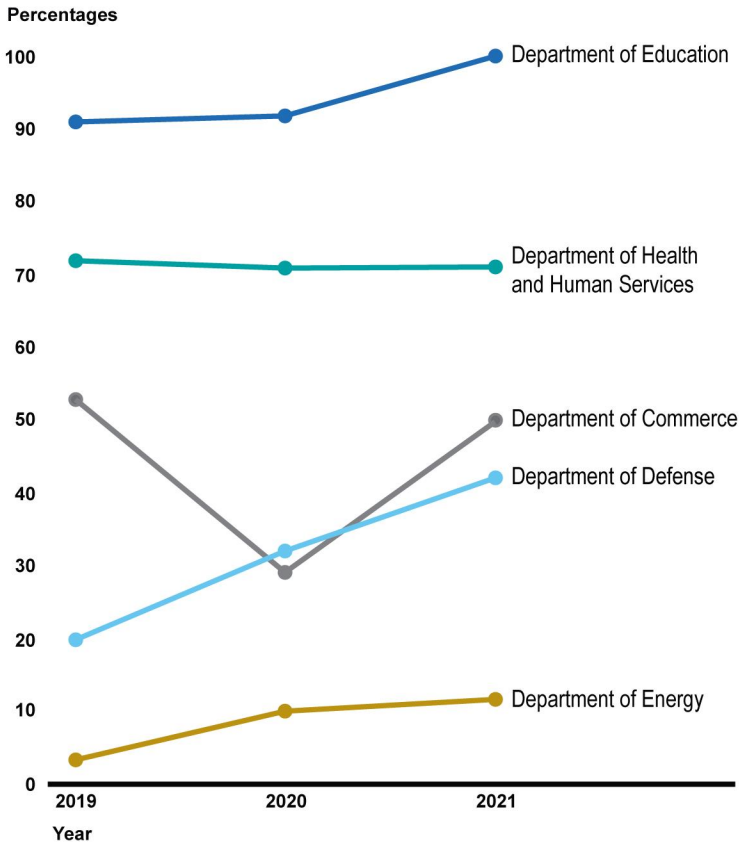
[a]The Advanced Research Projects Agency-Energy drove this difference. Its median Phase II award was $253,984 for open topics and $1,356,048 for conventional topics.

Open topic awards generally accounted for an increasing share of both awards and total dollars awarded from FY 2019 through 2021 (see figs. 6 and 7).

- **Number of awards.** The percentage of awards that originated from open topics increased from 36 percent (2,521 awards) in FY 2019 to 40 percent (2,927 awards) in 2020 and 46 percent (3,113 awards) in 2021. DOD—and more specifically, the Air Force—represented the greatest increase. The percentage of Air Force awards that originated from open topics increased from 42 percent (703 awards) in FY 2019 to 75 percent (1,179 awards) in 2020 and 82 percent (1,416 awards) in 2021. This was part of an Air Force initiative to ramp up use of open topics starting in FY 2018, as discussed previously. Education and DOE also increased in their use of open topic awards. Education officials told us that they typically use open topics, but they released one conventional topic in FY 2019, which resulted in two Phase I awards in FY 2019 and two Phase II awards in FY 2020. Commerce's use of open topic awards did not increase over the period, but officials told us that they transitioned to all open topics in FY 2022.
- **Award amounts.** The percentage of total dollars for open topic awards changed from 35 percent ($1.3 billion) in 2019 to 42 percent ($1.6 billion) in 2020 to 38 percent ($1.2 billion) in 2021.

Figure 6: Selected Agencies' Open Topic Awards in Small Business Research Programs by Year, FY 2019-2021

Percentage of awards from open topics issued in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs



Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

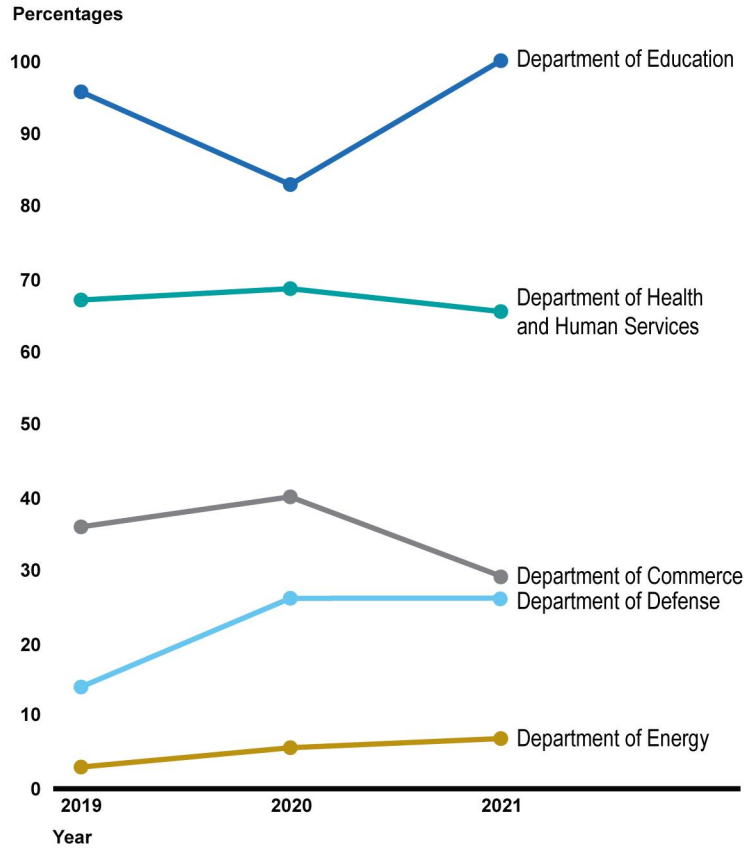
Data for Figure 6: Selected Agencies' Open Topic Awards in Small Business Research Programs by Year, FY 2019-2021

Agency	2019	2020	2021
Department of Commerce	53%	29%	50%
Department of Defense	20%	32%	42%
Department of Education	91%	92%	100%
Department of Energy	3%	10%	11%
Department of Health and Human Services	72%	71%	71%

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Figure 7: Selected Agencies' Open Topic Award Amounts in Small Business Research Programs by Year, FY 2019-2021
Percentage of dollars awarded from open topics in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs



Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Data for Figure 7: Selected Agencies' Open Topic Award Amounts in Small Business Research Programs by Year, FY 2019-2021

Agency	2019	2020	2021
Department of Commerce	36%	40%	29%
Department of Defense	14%	27%	27%
Department of Education	96%	83%	100%
Department of Energy	3%	6%	7%
Department of Health and Human Services	68%	69%	66%

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. Award amounts are in 2021 dollars. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Another agency that used both open and conventional topics during the time frame of our analysis—Commerce—began shifting its approach just prior to FY 2019. One of its subcomponents, the National Institute of Standards and Technology, transitioned from all conventional topics in 2018 to all open topics in 2019 and later. Commerce's other subcomponent that participates in the SBIR program, the National Oceanic and Atmospheric Administration, incrementally increased the number of open topic awards over the period. Commerce officials within the National Institute of Standards and Technology told us that they shifted to open topics to attract more innovative proposals and a higher number of applicants. Commerce officials from both subcomponents also provided summary data on the number of proposals received during the transition, but the data do not show a clear trend.

Topic Type May Influence Small Business Participation, but Effects on Timeliness and Technology Commercialization Are Unclear

Open and conventional topic awards differed in terms of small business participation from FY 2019 through 2021, but comparisons of timeliness and commercialization were less clear. Across several analyses, we found that small businesses receiving conventional topic awards tended to receive multiple awards, which could indicate that open topics promote a more competitive environment. Open topic awards also went to a higher percentage of nontraditional small businesses, as compared to conventional topic awards.[20] We did not identify any overall associations between topic type and either timeliness of award notifications or commercialization of technologies funded.

[20]The SBIR and STTR Extension Act of 2022 required GAO to examine nontraditional small businesses including those owned by women, minorities, and veterans. For the purposes of this report, we refer to businesses as being owned by individuals from socially and economically disadvantaged groups rather than minority-owned, consistent with SBA's SBIR/STTR award data. Nontraditional small businesses may include other groups, which are outside the scope of this analysis.

Small Business Participation

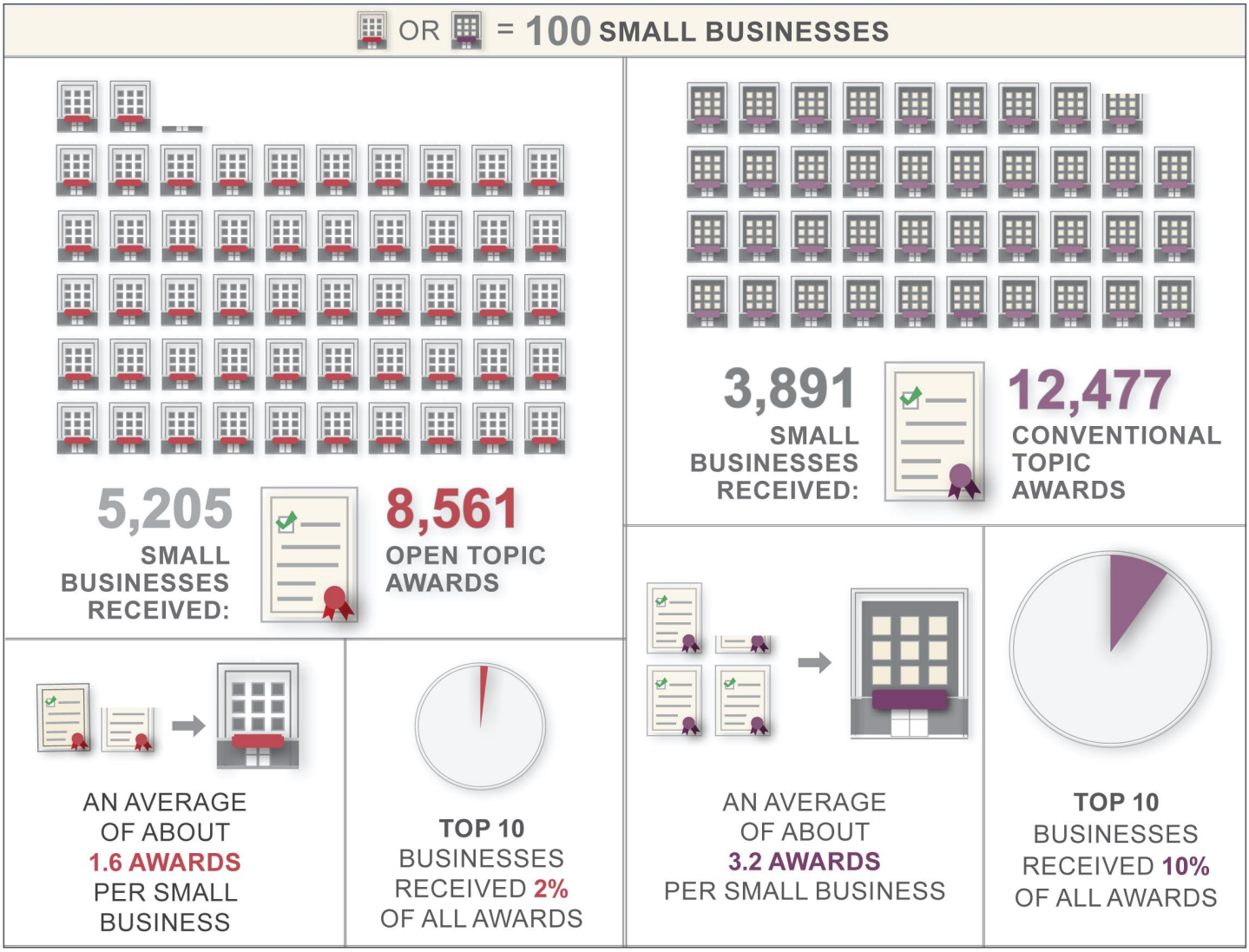
Competition for Awards

Our analysis found that open topics may be more competitive. Part of our basis for this conclusion was that awardees under conventional topics tended to receive multiple awards from FY 2019 through 2021. A smaller number of open topic awards were spread across a larger number of small businesses, as compared to conventional topics (see fig. 8).[21] Over the 3-year period, 5,205 unique small businesses received 8,561 open topic awards (an average of about 1.6 awards per business). The 10 businesses that received the most open topic awards received approximately 2 percent of all open topic awards. In that same period, 3,891 unique small businesses won 12,477 conventional topic awards (an average of about 3.2 awards per business). The 10 businesses that received the most conventional topic awards received approximately 10 percent of all conventional topic awards.

[21]We have previously reported that a greater number of entities receiving awards is associated with increased competition. See *Federal Contracting: Opportunities Exist to Increase Competition and Assess Reasons When Only One Offer Is Received,* GAO-10-833 (Washington, D.C.: July 26, 2010).

Figure 8: Number of Businesses Receiving Open and Conventional Topic Awards in Small Business Research Programs, FY 2019-2021

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs



Source: GAO analysis of information from the Small Business Administration and the 11 SBIR/STTR agencies. | GAO-23-106338

Note: Average numbers of awards are rounded to the nearest one-tenth. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

First-Time Applicants to Small Business Research Programs

Agencies participating in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs are not required to track first-time applicants, and 10 of 11 agencies did not track first-time applicants for fiscal years (FY) 2019 through 2021. Five of these agencies have begun collecting at least some data on first-time applicants since FY 2020, according to officials.

The National Aeronautics and Space Administration (NASA) has historically tracked first-time applicants, according to officials. First-time applicants comprised 12 percent of all proposals to NASA's Phase I solicitations and 20 percent of all Phase I awards during the 3-year period.

Source: GAO analysis of information from the 11 agencies participating in SBIR/STTR. | GAO-23-106338

In addition, we identified 22 small businesses that won 50 or more Phase II awards from FY 2011 through 2020, which we refer to as "multiple award recipients." These multiple award recipients received 133 open topic awards and 1,867 conventional topic awards from FY 2019 through 2021.

However, market concentration is just one indicator of competition, and it is difficult to draw a direct link between the two. Other indicators include applicant success rates, presence of first-time and diverse applicants (see sidebar), and barriers to entry. In our July 2022 report on the Air Force's small business research programs, we found that open topics were successful in attracting new applicants.[22] Many small business representatives we interviewed for the 2022 report said at that time that the Air Force's open topics made it easier to participate in the programs because, for example, the broad nature of the topics meant they did not need to wait for a conventional topic that aligns with their work.[23]

Nontraditional Small Businesses

Among the 11 participating agencies, the percentage of awards that went to businesses we refer to as nontraditional small businesses—those owned by women, people from socially and economically disadvantaged groups, and veterans—was higher for open topic awards (25 percent) than for conventional topic awards (20 percent). However, there could be multiple explanations for this difference. In particular, agencies that use certain topic types could be different in other ways that affect nontraditional small business participation. For example, DOE officials said that nontraditional businesses are less prevalent in certain fields such as physics. This could contribute to lower proportions of

[22]GAO-22-105223.

[23]For the 2022 report, we interviewed small business representatives from a non-generalizable sample of awards issued during fiscal years 2019 and 2020. We use the term "many" to mean six or more.

nontraditional businesses receiving awards from agencies working in physics, regardless of those agencies' use of open topics.

Among the five agencies that had both open and conventional topic awards, the difference narrowed slightly (24 percent as opposed to 20 percent), as shown in table 2. In addition, the difference was not consistent across the five agencies.

Table 2: Selected Agencies' Open and Conventional Topic Research Awards Made to Nontraditional Small Businesses, FY 2019-2021

Awards in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	Open topic awards		Conventional topic awards	
	Number	Percentage	Number	Percentage
Department of Commerce	20	27%	12	20%
Department of Defense*	839	25%	1,489	20%
Department of Education	24	33%	2	50%
Department of Energy	27	17%	273	15%
Department of Health and Human Services*	687	22%	328	26%
Overall*	**1,597**	**24%**	**2,104**	**20%**

Legend: * = statistically significant difference at p<0.05

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. For the purposes of this table, nontraditional small businesses are owned by women, people from socially and economically disadvantaged groups, or veterans. Awards with missing data on nontraditional small businesses are not included in the denominators for percentage calculations. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Among the five agencies, the percentage of awards that went to nontraditional small businesses also varied for the three types of nontraditional small businesses:[24]

- **Socially and economically disadvantaged.** The percentage of awards that went to businesses owned by individuals in socially and economically disadvantaged groups was higher for open topic awards (10 percent) than for conventional topic awards (7 percent), as shown in table 3.
- **Women-owned.** There was little difference in awards to women-owned businesses between open and conventional topics (see table 4).

[24]Categories of nontraditional small businesses are not mutually exclusive. For example, a business could be both women- and veteran-owned.

- **Veteran-owned.** The percentage of awards that went to veteran-owned business was higher for open topic awards (7 percent) than for conventional topic awards (5 percent), as shown in table 5.

Table 3: Selected Agencies' Open and Conventional Topic Research Awards Made to Socially and Economically Disadvantaged Small Businesses, FY 2019-2021

Awards in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	Open topic awards		Conventional topic awards	
	Number	Percentage	Number	Percentage
Department of Commerce*	7	9%	1	2%
Department of Defense*	257	8%	436	6%
Department of Education	0	0%	0	0%
Department of Energy	14	9%	142	8%
Department of Health and Human Services*	401	13%	193	15%
Overall*	679	10%	772	7%

Legend: * = statistically significant difference at p<0.05

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. Awards with missing data on socially and economically disadvantaged small businesses are not included in the denominators for percentage calculations. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Table 4: Selected Agencies' Open and Conventional Topic Research Awards Made to Women-Owned Small Businesses, FY 2019-2021

Awards in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	Open topic awards		Conventional topic awards	
	Number	Percentage	Number	Percentage
Department of Commerce	14	19%	10	14%
Department of Defense*	295	9%	764	10%
Department of Education*	24	33%	0	0%
Department of Energy	12	8%	135	8%
Department of Health and Human Services*	322	10%	177	14%
Overall	667	10%	1,086	10%

Legend: * = statistically significant difference at p<0.05

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. Awards with missing data on women-owned small businesses are not included in the denominators for percentage calculations. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Table 5: Selected Agencies' Open and Conventional Topic Research Awards Made to Veteran-Owned Small Businesses, FY 2019-2021

Awards in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	Open topic awards		Conventional topic awards	
	Number	Percentage	Number	Percentage
Department of Commerce	2	3%	3	3%
Department of Defense*	409	12%	441	6%
Department of Education	2	3%	2	50%
Department of Energy	1	1%	30	2%
Department of Health and Human Services	47	2%	17	1%
Overall*	**461**	**7%**	**493**	**5%**

Legend: * = statistically significant difference at p<0.05

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Agency officials we interviewed had different views on the benefits of open and conventional topics for nontraditional small business participation. Officials from seven of 12 agencies said that open topics may increase diversity, in part because they allow more businesses to apply.[25] Officials from two other agencies—the Department of Homeland Security (DHS) and the National Aeronautics and Space Administration (NASA)—said that conventional topics may level the playing field for applicants, because the topics specify exactly what the agency is seeking. Therefore, according to DHS officials, small businesses do not need to have existing relationships with the agencies to understand their needs.

Timeliness to Notify Small Businesses and Issue Awards

Among the 11 participating agencies, timeliness was generally higher for open topic awards (89 percent on-time notification and 94 percent on-time issuance) than for conventional topic awards (87 percent on-time notification and 73 percent on-time issuance). However, this analysis does not necessarily show that agencies' use of open topics improves timeliness, because other agency-specific factors can affect timeliness. For example, NSF and HHS's National Institutes of Health (NIH) issue

[25]The seven agencies were Commerce, DOD, DOE, Education, HHS, NSF, and USDA.

mostly open topic awards, and they have longer notification and issuance timelines compared to other agencies.[26]

Timeliness varied across the five agencies that used both open and conventional topics.

- **Notification.** Two agencies were more timely for open topic awards, two were more timely for conventional topic awards, and one had the same percentage for both (see table 6).
- **Issuance.** Three agencies were more timely for open topic awards, one was more timely for conventional topic awards, and one had the same percentage for both (see table 7).

Table 6: Selected Agencies' Timeliness in Notifying Businesses of Awards in Small Business Research Programs, FY 2019-2021

Percentage of open and conventional topic awards with on-time notifications in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	Open topic awards	Conventional topic awards
Department of Commerce*	60%	0%
Department of Defense*	79%	82%
Department of Education	100%	100%
Department of Energy*	85%	100%
Overall, not including the Department of Health and Human Services (HHS)*	79%	84%
HHS*	97%	95%
Overall, including HHS	**88%**	**85%**

Legend: * = statistically significant difference at p<0.05

Source: GAO analysis of data from the Small Business Administration (SBA) and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. SBA's policy directive requires these agencies to notify businesses within 90 calendar days after a solicitation closes, except the National Institutes of Health within HHS, which has 1 year to notify businesses. Awards with missing data on notification timeliness are not included in the denominators for percentage calculations. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

[26]NIH represents the majority of HHS awards (4,253 of 4,378).

Table 7: Selected Agencies' Timeliness in Issuing Awards in Small Business Research Programs, FY 2019-2021

Percentage of open and conventional topic awards with on-time issuance in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	Open topic awards	Conventional topic awards
Department of Commerce	75%	65%
Department of Defense*	93%	60%
Department of Education	100%	100%
Department of Energy*	82%	96%
Overall, not including the Department of Health and Human Services (HHS)*	92%	67%
HHS	96%	94%
Overall, including HHS*	**94%**	**70%**

Legend: * = statistically significant difference at p<0.05

Source: GAO analysis of data from the Small Business Administration (SBA) and selected agencies. | GAO-23-106338

Note: Selected agencies are those that issued both open and conventional topic awards through SBIR or STTR during the period. SBA's policy directive recommends that these agencies issue an award within 180 calendar days after a solicitation closes, except the National Institutes of Health within HHS, which has 15 months. Awards with missing data on issuance timeliness are not included in the denominators for percentage calculations. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Commercialization of Technologies Funded

We found that available data were not sufficiently reliable to analyze commercialization outcomes for open and conventional topic awards. For example, we found that data on progression to Phase III—known as the commercialization phase—are limited and not sufficiently reliable to understand whether open or conventional topics lead to a greater likelihood of commercialization. The SBIR/STTR programs do not fund Phase III awards, and there are limited requirements for small businesses to report commercialization metrics beyond the award term.[27] According to several National Academies reports, finding links between federally funded R&D and any commercialization outcome is difficult.[28] There are

[27]Small businesses that receive more than 15 Phase II awards in the prior 5 fiscal years are required to report commercialization metrics.

[28]National Academies of Sciences, Engineering, and Medicine, *Review of the SBIR and STTR Programs at the National Science Foundation* (Washington, D.C.: The National Academies Press, 2023); *Assessment of the SBIR and STTR Programs at the National Institutes of Health* (Washington, D.C.: The National Academies Press, 2022); and *Review of the SBIR and STTR Programs at the Department of Energy* (Washington, D.C.: The National Academies Press, 2020).

typically long gaps in time between research and the eventual impact the research creates. And certain outcomes may be unobservable or difficult to measure, such as acquisitions, creation of spin-off businesses by principal investigators, and knowledge spillover. However, a 2021 working paper published by the National Bureau of Economic Research found that open topic awards were effective at increasing small businesses' subsequent venture capital funding and patents.[29] According to the paper, conventional topic awards had no statistically significant effects on these outcomes.

Officials from four of 12 agencies said that open topic awards may spur commercialization in emerging or nontraditional areas where the federal government is not the primary customer.[30] For example, according to these officials, (1) open topics allow businesses to identify market needs and solutions, and (2) open topics may result in stronger competition, which increases the number of proposals with higher commercialization potential.

Agencies Reported Considering Goals and Resources When Deciding to Use Open or Conventional Topics

In deciding whether to use open or conventional topics, officials from the 11 participating agencies reported considering their goals for using the SBIR/STTR programs and their available resources. Goals include fulfilling mission needs and agencies' priorities for applicant competition. Resources include availability of proposal reviewers and agency award budgets.

[29]Sabrina T. Howell, Jason Rathje, John Van Reenen, and Jun Wong, *Opening up Military Innovation: Causal Effects of Reforms to U.S. Defense Research*, National Bureau of Economic Research (NBER) Working Paper No. 28700 (published Apr. 2021; updated July 2022). These findings were statistically significant, within a 95-percent confidence interval. The study's authors used an econometric model to estimate causal effects of award receipt on commercialization.

[30]The four agencies were Commerce, NSF, SBA, and USDA.

Goals for Fulfilling Mission Needs and Priorities for Applicant Competition

Mission Needs

Agencies reported that they consider their unique mission needs in deciding whether to use open or conventional topics. For example, agencies may need broad or specific R&D, or they may need to procure funded technologies.[31]

- **Broad R&D needs.** Agencies with broad R&D needs may be more likely to use open topics. For example, NSF, whose mission is "to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense," uses only open topics. Officials from nine of 12 agencies said that open topics allow for a broad range of innovative ideas, with few restrictions.[32] These may include ideas for solving problems that the agency has not considered.
- **Specific R&D needs.** Agencies with specific R&D needs may be more likely to use conventional topics. Officials from all 12 agencies stated that conventional topics help meet specific federal R&D needs, including innovation in targeted areas. For example, innovative ideas could focus on solving problems identified through internal agency analysis that may be classified and not public knowledge. Conventional topics can help businesses target applications to those problems without the agencies disclosing classified material.
- **Procurement needs.** Agencies with internal procurement needs may also be more likely to use conventional topics. Three agencies—DHS, DOD, and NASA—primarily use the programs to procure technologies that meet their mission needs, according to officials.[33] From FY 2019

[31]Agencies also have R&D needs for different areas of technology (e.g., artificial intelligence). However, agency officials we interviewed said that these needs generally do not influence use of open and conventional topics. See appendix II for a list of technology areas funded by participating agencies from FY 2019 through 2021.

[32]The nine agencies were Commerce, DHS, DOE, Education, HHS, NASA, NSF, SBA, and USDA.

[33]The Defense Advanced Research Projects Agency is one exception within DOD. Officials told us that it does not typically procure technologies funded. These three agencies may also fund technologies with other end users. For example, DHS officials told us that nonfederal entities such as municipal first responders and financial institutions also use technologies that DHS funds.

through 2021, these three agencies used all or a majority of conventional topics and issued awards through contracts, rather than grants or cooperative agreements. The remaining eight agencies funded technologies with a focus on external end users, according to officials. External end users may include other federal agencies, other public entities, or consumers. These agencies used a mix of topic types and funding mechanisms.

Priorities for Applicant Competition

Agencies reported that they consider their priorities for competition among applicants in deciding whether to use open or conventional topics.

- **Increased applicant competition.** Agencies aiming to encourage competition among applicants may be more likely to use open topics.[34] Officials from four agencies—Commerce, Education, NSF, and USDA—said that open topics result in agencies funding stronger proposals, in part because of increased competition among applicants. For example, NSF officials said that open topics allow small businesses to pursue their passions and propose solutions that agency officials could not have imagined. These may arise from emerging or multidisciplinary fields.
- **Higher applicant success rate.** Agencies aiming to maintain a high applicant success rate may be more likely to use conventional topics. Officials from six agencies said that conventional topics are more prescriptive, which could limit the number of proposals received and increase the applicant success rate, given the same awards budget.[35] Higher success rates could encourage new businesses to invest in developing proposals, according to some officials.

Resources for Reviewing Proposals and Making Awards

Reviewer Availability and Expertise

Agencies reported that they consider the availability and expertise of proposal reviewers in deciding whether to use open or conventional

[34]We previously reported that competition is a critical tool for achieving the best return on investment for taxpayers. See, for example, *Department of Energy Contracting: Additional Actions Could Further Strengthen Competition*, GAO-23-105209 (Washington, D.C.: Jan. 24, 2023).

[35]The six agencies were Commerce, DOD, DOE, the Environmental Protection Agency, NASA, and Transportation.

topics. Agency officials we interviewed generally stated that open topics lead to more applicants and greater variation in the types of technologies covered in proposals. This increase means that agencies may need to quickly identify more reviewers with different types of technical expertise while continuing to meet timeliness requirements for notifying applicants of awards.

Interagency Agreement for Small Business Innovation Research (SBIR) Grants

NIH and CDC, both within the Department of Health and Human Services, have an interagency agreement for NIH to perform certain SBIR functions on behalf of CDC:

- Solicitation. NIH includes CDC topics in omnibus grant solicitations.
- Proposal receipt. NIH collects applications on behalf of CDC and checks them for completeness.
- Proposal review. NIH will conduct an initial technical review for applications outside CDC officials' primary expertise, at CDC's request. NIH then provides summary statements to CDC.
- Training. CDC officials have access to NIH training on the SBIR program.

Source: GAO analysis of information from the National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC). | GAO-23-106338

All seven agencies that used open topics have access to networks of reviewers outside of the agency, among other strategies to manage proposal review. These include officials from other agencies (see sidebar) and peer reviewers in industry and academia. Agencies can recruit reviewers from these networks once they receive proposals, according to officials. One of the four agencies that only used conventional topics, NASA, has access to external reviewers.[36] Some agencies, such as DOE and NSF, also require applicants to submit a letter of intent or a project abstract prior to submitting a proposal.

Awards Budget

Some agencies reported that they consider their available SBIR/STTR awards budget in deciding whether to use open or conventional topics, but we did not identify clear associations (see table 8). Agencies with similarly sized budgets vary on their percentage of awards from open topics.

[36]The Environmental Protection Agency uses federal officials and contractors. The remaining two agencies, DHS and Transportation, use federal officials.

Table 8: Participating Agencies' SBIR/STTR Program Budgets and Use of Open Topic Awards, FY 2019-2021

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs

Agency	SBIR/STTR budget	Percentage of awards from open topics
Department of Defense	$6,466,361,183	31%
Department of Health and Human Services	$3,519,865,334	71%
Department of Energy	$908,489,826	8%
National Science Foundation	$655,232,015	100%
National Aeronautics and Space Administration	$588,415,852	0%
U.S. Department of Agriculture	$92,749,353	100%
Department of Homeland Security	$49,349,832	0%
Department of Commerce	$40,211,422	42%
Department of Transportation	$29,127,072	0%
Department of Education	$26,176,320	95%
Environmental Protection Agency	$11,574,303	0%

Source: GAO analysis of data from the Small Business Administration and selected agencies. | GAO-23-106338

Note: SBIR/STTR budget is defined as extramural research and research and development obligations minus exemptions, times 0.032 for SBIR and 0.0045 for STTR. The Department of Defense uses appropriations as a proxy for obligations. Agencies may allocate more funding to SBIR/STTR than shown here, in accordance with their appropriations. Budgets are rounded to the nearest dollar. Percentages are rounded to the nearest 1 percent. FY = fiscal year.

Among the three agencies with the smallest awards budgets, officials cited different reasons to use open versus conventional topics. Education officials said that open topics ensure that limited award dollars support the highest-quality proposals. Transportation officials said that conventional topics ensure that limited award dollars support R&D in priority areas. Environmental Protection Agency (EPA) officials said that conventional topics ensure that limited award dollars support a higher applicant success rate to give businesses a reasonable chance at being funded.

Most DOD Subcomponents Have Released Open Topics for Fiscal Year 2023

As of September 24, 2023, 10 of 12 relevant DOD subcomponents had released topics that the solicitations describe as open topics for FY 2023.[37] Officials from the remaining DOD subcomponents—the Chemical

[37]We did not independently assess that the topics meet statutory, DOD, or other definitions of open topics.

and Biological Defense program and the Defense Microelectronics Activity—told us that they plan to release open topics by the end of FY 2023.[38]

DOD issued guidance in March 2023 for subcomponents to release at least one open topic per fiscal year, starting in FY 2023. This guidance responds to the requirement in the SBIR and STTR Extension Act of 2022 that the Secretary of Defense is to establish innovation open topic activities using DOD's SBIR and STTR programs to

- increase the transition of commercial technology to DOD,
- expand the small business nontraditional industrial base,
- increase commercialization derived from DOD investments, and
- expand the ability for qualifying small business concerns to propose technology solutions to meet DOD needs.

The act also specifies that the Secretary of Defense shall conduct not less than one open topic announcement at each DOD component per fiscal year.

According to the guidance, open topics can use generalized mission requirements or specific technology areas to adapt commercial products or solutions to close capability gaps, improve performance, or provide technological advancements in existing capabilities. In contrast, DOD's Office of the Undersecretary of Defense for Research and Engineering (OUSD R&E) stated that conventional topics specify the desired technical objective and minimum performance specifications but do not limit the proposing company in formulating its approach to meeting the technical goals.

The guidance includes examples of open topics and a voluntary process that subcomponents can use to review and evaluate proposals. OUSD R&E officials told us that they expect open topics to result in a higher number of proposals, and the process will help subcomponents recruit proposal reviewers.

[38]The one exception is the National Geospatial-Intelligence Agency. Officials told us that they do not plan to release an open topic, because the agency is exempt from participating in SBIR/STTR. As noted above, agencies within the intelligence community are not required to participate in the SBIR/STTR programs. 15 U.S.C. § 638(e)(2). The National Geospatial-Intelligence Agency voluntarily participates in conventional topics.

DOD subcomponents have planned a variety of approaches to attract new and diverse applicants to open topics. For example:

- The Air Force has used events, informational webinars, and social media to specifically highlight open topics.
- The Department of the Navy plans to establish an open innovation approach with wider outreach to new networks, according to officials. Navy officials said that outreach will include training and education on proper ways to engage in the programs.
- The Office of the Secretary of Defense (OSD) has collaborated with the Defense Acquisition University and the DOD Office of Small Business Programs to inform federal agencies and industry of open topics, according to officials. For example, OSD officials said they have incorporated information on open topics into the APEX Accelerators program.[39]

Agency Comments and Our Evaluation

We provided a draft of this report to Commerce, DHS, DOD, DOE, Education, EPA, HHS, NASA, NSF, SBA, Transportation, and USDA for review and comment.

DOD, EPA, and HHS provided technical comments, which we incorporated as appropriate. Commerce, DHS, DOE, Education, NASA, NSF, SBA, Transportation, and USDA did not have any comments on the report.

In its technical comments, DOD stated that our analysis does not provide clear evidence that either conventional topics or open topics increase competition. Our report states that open topics may be more competitive based on our analysis of agencies' award data, which showed a smaller number of small businesses received a larger number of conventional topic awards compared to open topics from FY 2019 through FY 2021. We also acknowledge that market concentration is just one indicator of competition. Other indicators include applicant success rates, presence of

[39]The APEX Accelerators program, formally known as the Procurement Technical Assistance Program, was authorized by Congress in 1984 to expand the number of businesses capable of participating in government contracts. Department of Defense Authorization Act, 1985, Pub. L. No. 98-525, § 1241, 98 Stat. 2492, 2605-06 (1984). APEX Accelerators help businesses complete registration and navigate solicitations, and they match small business expertise with relevant agency needs.

new and diverse applicants, and barriers to entry. We did not adjust our report in response to DOD's comment.

In a related comment, DOD suggested clarifying the basis for our statement that businesses receiving conventional topic awards tended to receive multiple awards, which could indicate that open topics promote a more competitive environment. This statement was based on three analyses examining the:

- average number of open and conventional topic awards per unique small business for the period from FY 2019 through FY 2021,
- percentage of awards received by the top 10 businesses that received the most open and conventional topic awards from FY 2019 through FY 2021, and
- number of open and conventional topic awards received from FY 2019 through FY 2021 by businesses that received over 50 Phase II awards during the period from FY 2011 through FY 2020.

Each of these analyses showed a greater concentration of conventional topic awards among small businesses as compared to open topic awards. In response to DOD's comment, we clarified that our statement was based on the multiple analyses we performed.

We are sending copies of this report to the appropriate congressional committees; the Secretaries of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Homeland Security, and Transportation; the Administrators of the SBA, EPA, and NASA; the Director of the NSF; and other interested parties. In addition, the report is available at no charge on the GAO website at http://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 III.

Candice N. Wright
Director, Science, Technology Assessment, and Analytics

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Appendix I: Objectives, Scope, and Methodology

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Extension Act of 2022 includes provisions requiring GAO to issue a series of reports comparing several aspects of open and conventional topics.[1] The act also includes a provision for GAO to report on the Department of Defense's (DOD) efforts to encourage and prepare new small businesses to respond to these solicitations. This report examines: (1) the extent to which participating agencies have used open topics in carrying out their SBIR/STTR programs, (2) how participating agencies' open topics and conventional topics compare in terms of award outcomes and timeliness of awards, (3) factors that participating agencies reported considering in deciding whether to use open or conventional topics, and (4) the extent to which DOD has taken steps to conduct at least one open topic at each component per fiscal year and to attract new and diverse applicants.

The scope of work includes the Small Business Administration (SBA) and the 11 participating agencies, including 30 subcomponents within the 11 agencies (see fig. 2 above).[2] We identified possible subcomponents through our past work and a report from the National Academies of Sciences, Engineering, and Medicine.[3] We then asked agency officials to identify which of those subcomponents, along with any others, developed their own topics in fiscal years (FY) 2019 through 2021.

To address our objectives, we (1) collected information from participating agencies to identify awards that originated from open and conventional topics, (2) analyzed data to summarize and compare open and conventional topic awards, (3) interviewed agency officials and reviewed related agency documentation, and (4) interviewed a non-generalizable selection of knowledgeable stakeholders and reviewed related reports.

[1]Pub. L. No. 117-183, §7(b), 136 Stat. 2180, 2188-89.

[2]Within DOD, subcomponents include the military departments as well as other DOD agencies or offices.

[3]GAO-23-105591; and National Academies, *Department of Energy*.

Identification of Open and Conventional Topic Awards

We first developed definitions of open and conventional topics. To inform the definitions, we reviewed example topics from SBA's SBIR/STTR webpage. We also reviewed our past work, the 2021 working paper, and a 2022 report from the Congressional Research Service.[4] We then provided draft definitions to SBA and the 11 agencies for review and comment. We incorporated agency feedback to develop final definitions. All of the agencies concurred with the final definitions for the purposes of categorizing awards issued from FY 2019 through 2021, as follows:[5]

- Open topics present broad categorical focus areas within the agency's mission, without defining a specific technical issue or opportunity to be addressed, and they seek proposals on a wide range of solutions.
- Conventional topics define a specific technical issue or opportunity to be addressed, based on agency requirements or public need, and they seek proposals that address specific predefined parameters or technology areas.

Based on the definitions, we asked agencies to identify awards issued from FY 2019 through 2021 that originated from open and conventional topics. For the Departments of Energy (DOE) and Health and Human Services, we collected additional information on solicitation language and made the determination based on our definitions.

To assess the reliability of these data, we collected written responses from agency and subcomponent officials. For example, we collected data at the DOD level but also asked officials at each DOD subcomponent whether they issued any open topic awards during the time period. We then reconciled any differences. Based on these analyses, we found the data to be sufficiently reliable for our purposes in this report.

[4]For a list of topics on SBA's SBIR/STTR webpage, see *Topic Areas*, accessed July 26, 2023, https://www.sbir.gov/sbirsearch/topic/current. We reviewed GAO-22-105223; the 2021 working paper, Howell et al., *Opening up Military Innovation*; and Congressional Research Service, *Small Business Research Programs: SBIR and STTR*, R43695 (Washington, D.C.: Oct. 21, 2022).

[5]DOD had its own existing definitions of open and conventional topics, but DOD officials agreed that our definitions were appropriate for categorizing open and conventional topic awards issued in the time period.

Summary and Comparison of Open and Conventional Topic Awards

To summarize and compare open topic and conventional topic awards, we obtained data from multiple sources, assessed reliability, cleaned the data as needed, merged the data into a single data set, and compared summary data on award outcomes and timeliness. We used regression analysis to estimate the statistical significance associated with any differences between open and conventional topic awards. Statistically significant differences are defined as $p<0.05$ for the purposes of this report.

SBA award data and registry data. We downloaded publicly available award-level data from SBA's SBIR.gov webpage.[6] We limited these data to FY 2011 through 2021, the most recent year with available data at the time of download. The data include information on each award issued, the agency issuing the award, and the small business receiving the award (e.g., whether the businesses was women-owned at the time of award). We found that many of the awards were missing a unique identifier for the small business (DUNS number). To fill in missing identifiers, we requested data from SBA's company registry. The registry is an SBA database of companies registered to participate in the SBIR and STTR programs. The database includes fields that describe the businesses, including their DUNS number, as of the businesses' most recent SBIR/STTR proposal. We used analytical software to merge the registry data with the award data, matching observations on company name. We then filled in missing DUNS numbers in the award data with DUNS numbers from the registry data.[7] To assess reliability of the merged data set, we conducted tests to identify outliers and invalid values (according to the data dictionary). We collected written responses from agencies on issues we identified. Based on agency responses, we cleaned the data, including updating values or changing invalid values to missing. We also converted award amounts to 2021 dollars using the gross domestic product price index. After cleaning the data, we found the data elements we used for the purposes of our report to be sufficiently reliable.[8] Finally,

[6]SBIR Award Data (accessed Feb. 3, 2023), https://www.sbir.gov/sbirsearch/award/all.

[7]This uses the small business's DUNS number as of its most recent proposal as a proxy for DUNS number at the time of award from FY 2019 through 2021.

[8]We did not assess the reliability of all fields (e.g., number of employees in the small business), because we did not use them for this report.

we identified unique small businesses that won 50 or more Phase II awards from FY 2011 through 2020, based on company name.

Open and conventional topic data. We then limited the data set to FY 2019 through 2021 and generated a field showing whether each award originated from an open or conventional topic. To populate the field, we either merged in agency data provided (matching on award number) or entered values based on agency information provided. For example, one agency subcomponent stated that all of its grants were from open topics and all of its contracts were from conventional topics. For that subcomponent, we populated the field based on award type (grant or contract). We collected additional data and information from agencies until all awards in the award data were categorized as originating from open or conventional topics. Once the data were complete, we calculated the concentration of awards among small businesses and calculated the proportion of awards given to small businesses owned by women and individuals from socially and economically disadvantaged groups.[9]

Timeliness data. To obtain information on the notification and issuance timeliness of each award, we used award-level data for FY 2019 through 2021 that we collected from the 11 agencies for prior GAO studies on SBIR/STTR award timeliness.[10] As discussed in our prior reports, we took several steps to assess and improve the data's reliability and found the data to be sufficiently reliable for our purpose in those studies. For all awards except the Air Force's FY 2019 and 2020 awards, we used analytical software to merge the timeliness data with SBA's data. We matched observations on award number and program phase. For the Air Force's FY 2019 and 2020 awards, we determined that we needed some additional data beyond what was collected for GAO's prior report on the Air Force's small business research programs. We used data provided by SBA that included metrics equivalent to those used to calculate timeliness in previous GAO studies. Based on interviews with agency officials and data tests, we determined that these data were sufficiently reliable for the purposes of our report. We were able to match 94.0 percent of awards to timeliness data. We calculated notification and issuance times using the

[9]Some awards were missing data on whether the small businesses were women-owned (approximately 0.1 percent missing) and socially and economically disadvantaged (approximately 0.3 percent missing). When calculating the proportion of awards won by women-owned businesses and businesses owned by individuals from socially and economically disadvantaged groups, we did not include awards with missing data.

[10]GAO-23-105591, GAO-22-104677, and GAO-20-693.

solicitation close date, date that agencies notified small businesses of award, and award issuance date.[11] We then compared the calculated number of days with the SBA policy directive's required and recommended timelines for each agency.

System for Award Management (SAM.gov) registry data. To obtain information on whether awards were issued to veteran-owned small businesses, we used the General Services Administration's SAM.gov registration data for FY 2019 through 2021 that we obtained for a prior report, with permission from the General Services Administration. Small businesses are required to register on SAM.gov before submitting a SBIR/STTR or other federal proposal, and registrations are valid for 1 year. We conducted logic tests and found the data to be sufficiently reliable for our purposes. Using analytical software, we merged the SAM.gov data to our data set for FY 2019 through 2021, matching on DUNS number.[12] We then calculated the proportion of awards given to veteran-owned small businesses.

Data on progression through phases. We did not analyze small businesses' progression through program phases, because we were unable to reliably link Phase III awards to Phase II awards or Phase II awards to Phase I awards. In a prior report, we found that Phase III contracts listed in the Federal Procurement Data System could not be reliably matched to awards in the SBA award data.[13] For this report, we were also unable to reliably match Phase II awards to Phase I awards without taking additional steps to improve the data.

Agency Interviews and Documentation

We interviewed officials or collected written responses from the 11 participating agencies on participating agencies' SBIR/STTR program attributes and use of open topics. Regarding program attributes, we collected information on technology areas funded, typical or targeted end users of technologies funded (e.g., consumers, federal agencies), agency

[11]Certain Phase II awards did not have a valid solicitation close date, so we used the date that the agency received the proposal as a proxy. Some awards were missing data on notification (9.2 percent missing) and issuance (6.2 percent missing). When calculating percentage on time, we did not include awards with missing data in denominators.

[12]DUNS number is not a perfect identifier for unique small businesses, and some businesses were missing a DUNS number and were not included in this analysis.

[13]GAO-22-105223.

data on first-time applicants, proposal review processes, and funding mechanisms (e.g., grants, contracts). Regarding use of open topics, we collected information on participating agencies' use of open topics from FY 2019 through 2021, any changes in FY 2022, and any anticipated future changes. We interviewed SBA and participating agency officials to obtain information on the benefits and drawbacks of open topics and, for participating agencies, the factors they consider when deciding whether to use open and conventional topics. For DOD, we also interviewed subcomponents or collected written responses regarding steps DOD has taken to conduct at least one open topic at each subcomponent per fiscal year and to attract new and diverse applicants.

We collected and reviewed related documentation to corroborate information from these interviews, such as DOD guidance and DOD solicitations for FY 2023. We also used this documentation to further explore potential trends. For example, we collected participating agencies' SBIR/STTR program budgets from SBA to identify any trends between budget size and use of open topics.

Knowledgeable Stakeholder Interviews and Reports

We interviewed a non-generalizable selection of five knowledgeable stakeholders regarding the benefits and drawbacks of open and conventional topics for achieving the SBIR/STTR program goals. We identified these knowledgeable stakeholders from among those who had authored relevant reports and articles from four academic, nonprofit, and industry organizations.

We conducted this performance audit from October 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: Technology Areas Funded by Small Business Research Programs

Figure 9: Technology Areas Funded by Small Business Research Programs, FY 2019-2021

Technology areas funded by Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs during fiscal years 2019 through 2021, according to participating agencies	Department of Commerce	Department of Defense[a]	Department of Education	Department of Energy	Department of Health and Human Services[b]	Department of Homeland Security	Department of Transportation	Environmental Protection Agency	National Aeronautics and Space Administration	National Science Foundation	U.S. Department of Agriculture
Advanced manufacturing	✓	✓	—	✓	✓	—	✓	✓	✓	✓	✓
Advanced materials	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓
Advanced systems for scalable analytics	—	✓	✓	✓	✓	✓	✓	—	✓	✓	✓
Agricultural technologies	✓	✓	—	✓	—	—	—	✓	—	✓	✓
Artificial intelligence	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Augmented and virtual reality	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	✓
Biological technologies	✓	✓	—	✓	✓	✓	—	✓	✓	✓	✓
Biomedical technologies	✓	✓	—	✓	✓	✓	—	—	✓	✓	✓
Chemical technologies	—	✓	—	✓	✓	✓	—	✓	✓	✓	✓
Cloud and high-performance computing	✓	✓	—	✓	✓	✓	—	—	✓	✓	✓
Cybersecurity and authentication	✓	✓	—	✓	✓	✓	—	—	—	✓	✓
Digital health	—	✓	—	—	✓	✓	—	—	—	✓	✓
Distributed ledger	—	✓	—	✓	✓	✓	✓	✓	✓	✓	✓
Energy technologies	—	✓	—	✓	✓	✓	✓	✓	✓	✓	✓
Environmental technologies	✓	✓	—	✓	✓	✓	—	✓	✓	✓	✓
Human-computer interaction	—	✓	—	✓	✓	✓	✓	—	✓	✓	✓
Instrumentation and hardware systems	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓
Internet of things	—	✓	—	✓	✓	✓	✓	✓	—	✓	✓
Learning and cognition technologies	—	✓	✓	✓	✓	—	✓	—	—	✓	✓
Medical devices	—	✓	—	✓	✓	✓	✓	—	✓	✓	✓
Mobility	—	✓	✓	✓	✓	✓	—	—	—	✓	—
Nanotechnology	✓	✓	—	✓	✓	✓	—	✓	—	✓	✓
Pharmaceutical technologies	✓	✓	—	—	✓	—	—	—	—	✓	✓
Photonics	✓	✓	—	✓	✓	✓	—	—	✓	✓	✓
Power management	—	✓	—	✓	✓	✓	—	—	✓	✓	✓
Quantum information technologies	—	✓	—	✓	✓	✓	—	—	✓	✓	—
Robotics	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓
Semiconductors	✓	✓	—	✓	✓	✓	—	—	✓	✓	✓
Space	✓	✓	—	—	—	✓	—	—	✓	✓	—
Wireless technologies	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓

Legend: ✓ Agency funded the technology area — Agency did not fund the technology area

Source: GAO analysis of agency information. | GAO-23-106338

Note: GAO asked each participating agency to state whether the agency made SBIR or STTR awards from fiscal years (FY) 2019 through 2021 to fund research and development in each of the technology areas listed.

[a]The Department of Defense also funded a range of technologies related to defense, which may not fit into these technology areas.

[b]Information for the Department of Health and Human Services does not include the Food and Drug Administration, because it did not provide information categorizing its awards into technology areas.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the contact named above, Christopher Murray (Assistant Director), Kelsey L. Kennedy (Analyst-in-Charge), Grant Mallie, Trevor Warner, and Rachel Weingart made key contributions to this report. In addition, Wyatt Anderson, Eric Charles, Patrick Harner, Mark Kuykendall, Curtis R. Martin, and Alec McQuilkin, contributed to the report.

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