



REFORMING THE SBIR APPROACH TOWARDS WOMEN AND MINORITY OWNED PROJECTS

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Disclaimer: The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other entity.

On my honor as a University of Virginia Student, I have neither given nor received any unauthorized aid on this work.

Theodore E. Fergusson

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Definitions

1. SBIR: Small Business Innovation Research Program
2. SBA: Small Business Administration
3. USPTO: United States Patent and Trade Office
4. NIH: National Institutes of Health
5. ECOA: Equal Credit Opportunity Act of 1974
6. FTC: Federal Trade Commission
7. NSF: National Science Foundation
8. DoD: Department of Defense
9. S/ED: Socially and Economically Disadvantaged Individual
10. WS/ED: Women and S/ED
11. STEM: Science, Technology, Engineering, and Mathematics
12. WOSB: Women-Owned Small Business
13. MOSB: Minority-Owned Small Business
14. R&D: Research and Development

Client

My client for this report is Brendan Hart, CEO of Capital Labs. Capital Labs is an organization that designs and develops software for high-tech startups to help solve their enterprise challenges. Headquartered in Brooklyn, New York, Capital Labs works with local, state, and federal legislators to encourage entrepreneurship in areas that do not have traditionally strong innovation markets. We worked together on this report to understand how Capital Labs could partner with the federal government to resolve the funding problem within the SBIR program. We believe that as SBIR moves toward a truly diverse federal innovation portfolio, it will strengthen entrepreneurial ecosystems around the country and bolster small business creation.

Executive Summary

There is a large discrepancy between the amount of SBIR Phase 1 awards received by men and the amount received by WS/ED applicants. According to NSF, women comprise 48.4% of employed scientists and engineers in the US age 75 and under (National Science Foundation, 2017). S/ED individuals comprise 27.1% (National Science Foundation, 2017). However, the maximum percentage of SBIR Phase 1 awards granted to women and S/ED individuals during any year in the last seven years is 14.3% and 6.9%, respectively (SBIR). The SBIR is a federally funded program designed by Congress to, “Foster and encourage participation in innovation and entrepreneurship by women and socially or economically disadvantaged persons” (SBIR, 2018). It is clear that the SBIR is not achieving this Congressional mandate.

The program has awarded over \$42 billion in its 36-year history (United States Congress, 2016). Thus, the observed funding gap has far-reaching impacts for encouraging diversity within entrepreneurial environments like universities. This, in turn, impacts the amount of innovation

produced within the US, since diversity is one of the key factors in creating innovation from an entrepreneurial environment. My client, Brendan Hart, and I worked together on this report to understand how his company, Capital Labs, could partner with the federal government to resolve the funding problem within the SBIR program. We believe that as SBIR moves toward a truly diverse federal innovation portfolio, it will strengthen entrepreneurial ecosystems around the country and bolster small business creation.

This report examines four policy options to address the issue: 1) Let present trends continue, 2) Implement an Identity-Blind Application Evaluation process, 3) Institute a mentorship program between Phase 1 awardees and potential WS/ED applicants, and 4) Expand the Department of Energy Phase 0 program. These policy options will be evaluated according to four evaluative criteria: 1) Effect on the share of awards granted to WS/ED applications, 2) Political Feasibility, 3) Cost-Effectiveness, 4) How sensitive the option is to changes in cost and effect. Per these criteria, this report found that Option 2) Implement an Identity-Blind Application Evaluation process is most likely to succeed. However, recognizing that the conclusions of this report are based on results extrapolated from related experiments and other literature, rather than organizational data, this report concludes that SBIR should implement pilot programs to test the effectiveness of Options 2, 3, and 4. In the proposed program, Capital Labs would serve as the project coordinator, aggregating, analyzing, and publishing the collected data.

Introduction and Problem Statement

Created by the Small Business Act of 1953, the Small Business Administration aids, counsels, assists and protects the interests of the small business community (Small Business Administration, n.d.). In 1958, the Small Business Investment Act allowed the SBA to begin investing in small business ventures (Small Business Administration, n.d.). An important part of this program is the Small Business Innovation Research (SBIR) program.

SBIR's mission is to "support scientific excellence and technological innovation through the investment of Federal research funds in critical American priorities to build a strong national economy" (SBIR, 2018). Agencies with R&D budgets for work done outside the agency that exceed \$100 million are required to allocate 3.2% of their R&D budget to SBIR grant making programs (SBIR, 2018). These agencies include the DoD, NSF, DoE, NIH, NASA, Department of Agriculture, Department of Commerce, Department of Education, Department of Health and Human Services, Department of Homeland Security, Department of Transportation, and the Environmental Protection Agency. SBIR Funding is awarded in two stages (SBIR, 2018).

In Phase I, SBIR attempts to determine the technical merit of the proposal and the ability of the proposer to run their project. These grants usually do not exceed \$150,000. In Phase II, SBIR efforts focus on continuing the work started in Phase I. These awards typically do not exceed \$1,000,000 over two years. Per 2016 Congressional testimony, the SBIR program has awarded a total of over \$42 billion from this funding over its history (United States Congress, 2016). Each partner agency handles the evaluation of Phase I and II applications differently (Small Business

Innovation Research Program). However, there are four broad goals which all SBIR programs have to consider, which are as follows:

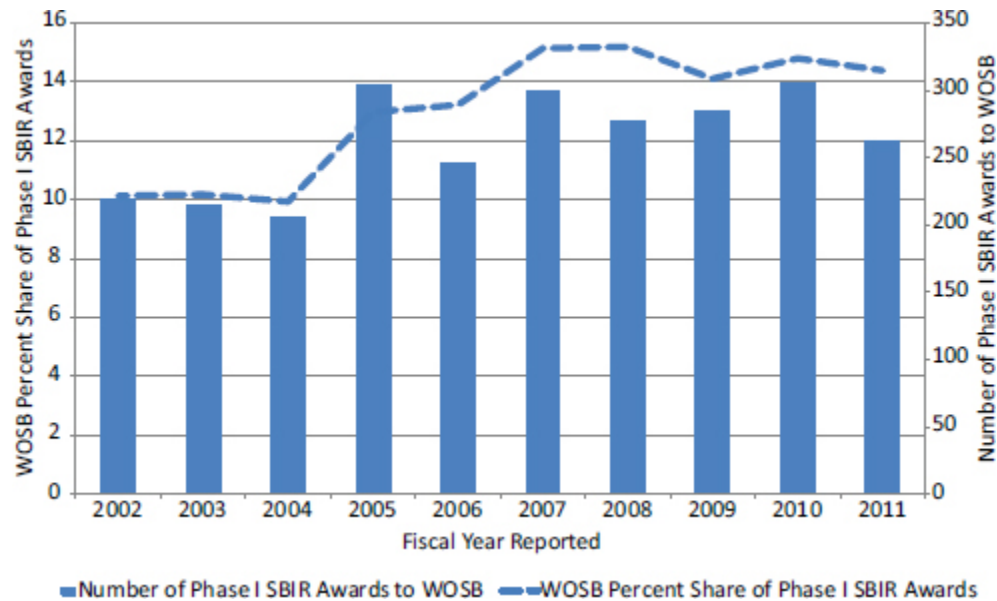
1. Stimulate technological innovation.
2. Meet Federal research and development needs.
3. Foster and encourage participation in innovation and entrepreneurship by women and socially or economically disadvantaged persons.
4. Increase private-sector commercialization of innovations derived from Federal research and development funding. (SBIR, 2018)

This type of broad support is particularly important, since small businesses are one of the primary drivers of job creation within the United States (Hwaltinger, Jarmin, & Miranda, 2010). Researchers have shown that SBIR funding is correlated with positive economic effects, evidenced by the following findings. Research published in the *Journal of Business Venturing* suggests a linkage between receiving a US federal research grant and an increased likelihood of receiving follow on VC funding than those that did not (Islam, Fremeth, & Marcus, 2018). To do so, this study used a dataset of clean energy companies within the United States. The study controlled for past VC funding, past grants received, firm age, total VC investment in a year, and other regional, sectoral, and temporal effects. However, the propensity score methodology used in the experiment yielded weak causal evidence, and so does not conclusively prove causality. Furthermore, the SBIR program supports, on average, five to seven times more early stage technological projects than venture capital (Keller & Block, 2012). While only about 50% of all SBIR-funded projects are commercialized (Link & Scott, 2010), Albert Link and John Scott propose that there may be significant run-on positive effects at other corporations that result from the SBIR program (Link & Scott, 2012).

However, academic research within the last three years suggests that there is an imbalance in how SBIR reaches out to women- and minority-owned small businesses. In 2015, Tanaga Boozer, a former SBIR awardee and employee of the USPTO, indicated that the program was not adequately reaching out to women and minority innovators (Committee on Capitalizing on Science, Technology, and Innovation, 2015). Evidence continued to grow during 2015, where a book published by the NIH found that SBIR definitions of “socially and economically disadvantaged”, inflated S/ED grant numbers, due to an overrepresentation of Asian-Americans in entrepreneurship (National Academies of Sciences, Engineering, and Medicine, 2015). This is at odds with Congressional objectives to generally reach out to women and minorities (National Academies of Sciences, Engineering, and Medicine, 2015). Furthermore, all of the most recent agency-specific reports on SBIR participatory agencies indicate severe agency failure in their outreach to women and minorities. The agencies evaluated include DoD, NASA, NSF, NIH, and DOE, (National Academies of Science, Engineering, and Medicine, 2016) (National Academies of Science, Engineering, and Medicine, 2014) (National Academies of Science, Engineering, and

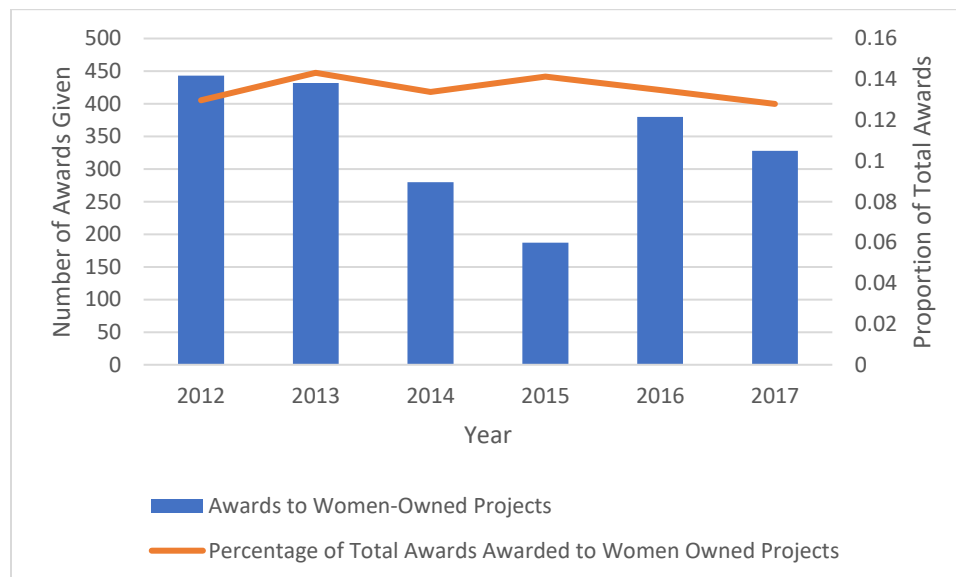
Medicine, 2016) (National Academies of Science, Engineering, and Medicine, 2015) (National Academies of Science, Engineering, and Medicine, 2015). Figures 1 and 2 demonstrate trends for SBIR grants awarded to women over the last 15 years. Figure 3 demonstrate trends for SBIR grants awarded to S/ED projects over the last 5 years.

Figure 1: Women-Owned SBIR Awards 2002-2011



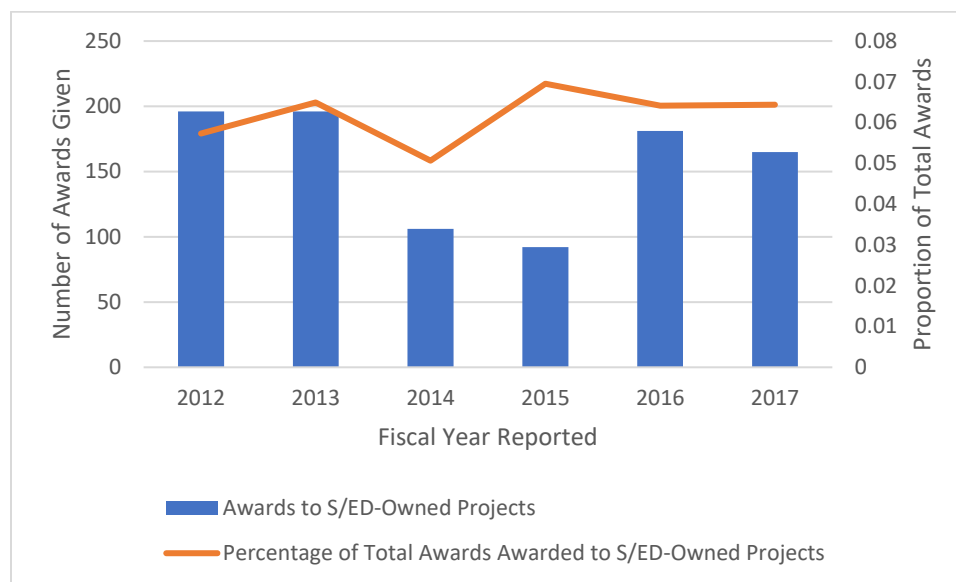
Source: <https://www.nap.edu/read/21738/chapter/12#61>

Figure 2: Women-Owned SBIR Awards 2012-2017



Source: <http://www.sbir.gov>

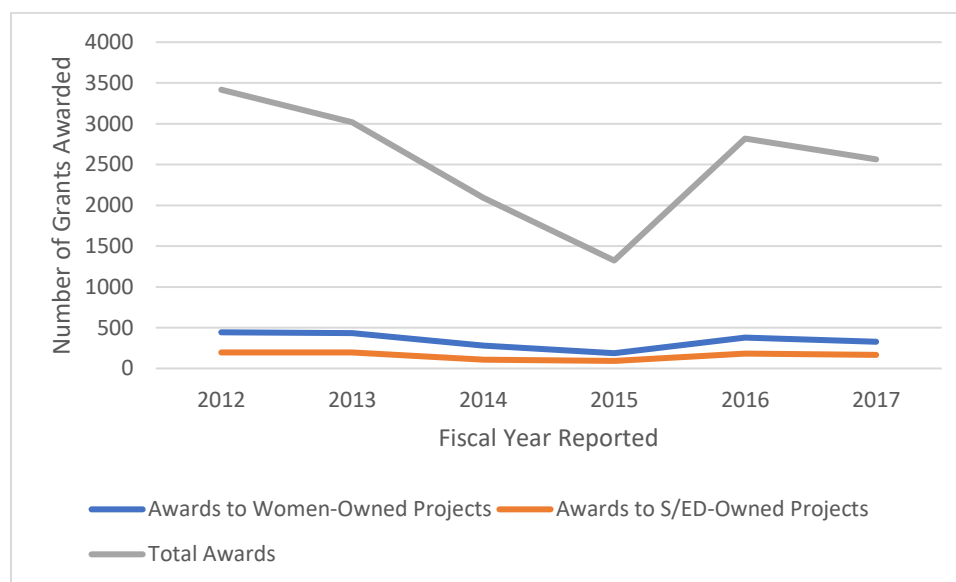
Figure 3: S/ED-Owned SBIR Awards 2012-2017



Source: <http://www.sbir.gov>

This data shows that the percentage of SBIR grants awarded to WS/ED projects has stagnated. Furthermore, as shown in Figure 4, there is a persistent gap between the total amount of grants awarded and the amount awarded to WS/ED-owned projects.

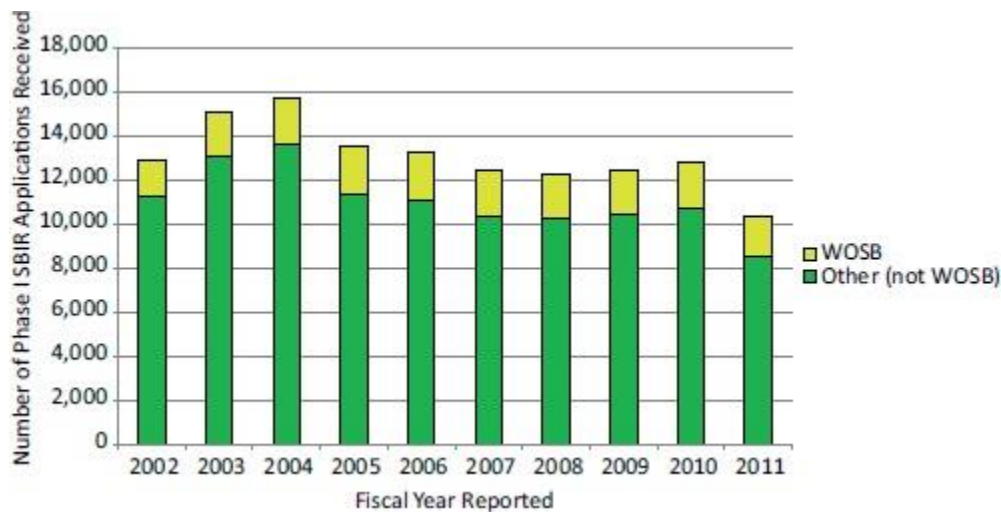
Figure 4: Total SBIR Grants Awarded 2012-2017



Source: <http://www.sbir.gov>

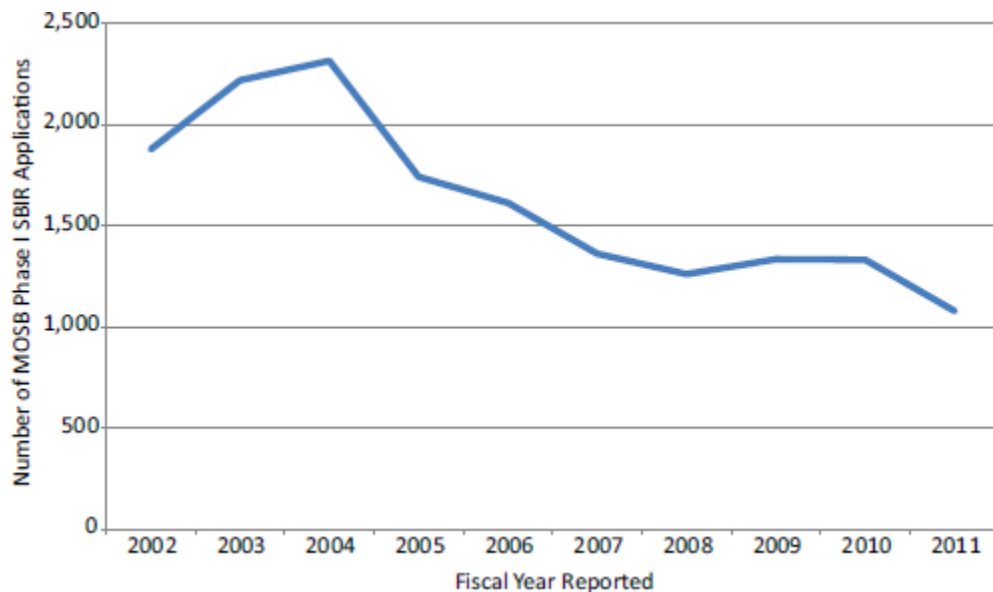
While SBIR does not publicize the number of applications received in any given year, Figures 5 and 6 indicate that the application rate of women to SBIR Phase 1 programs is remaining the same and actually decreasing for S/ED individuals.

Figure 5: Total SBIR Phase 1 Applications



Source: <https://www.nap.edu/read/21738/chapter/12#61>

Figure 6: Total number of SBIR Phase 1 S/ED Applications 2002-2011



Source: <https://www.nap.edu/read/21738/chapter/12#61>

Given the persistent issues surrounding the status quo, the report is not optimistic about the chances for improvement without programmatic change.

Problem Statement. Based on this research, the SBIR program fails at one of its four Congressionally mandated goals. **Too few women- and socially and economically disadvantaged individual-owned projects receive support through the SBIR Phase 1 program.** This failure ultimately hurts the small business sector. A 2009 German study found that cultural diversity of R&D employees within a company was linked to an increase in patent

applications (a measure of innovation) over a cross section of German regions (Niebuhr, 2010). The researcher in this experiment controlled for workplace location, employee nationality, employee educational level, company branch, employee occupation and firm size. These conclusions are supported by a 2013 study published in Economic Geography (Nathan & Lee, 2013). This study used data from two years of the London Annual Business Survey, to compile data on 7,615 firms. The researchers used this data to examine the effects of owner nationality and ethnicity on innovation produced by the business. They define innovation in four ways, where the business has, “(1) introduced a major new product or service, (2) significantly modified its product range or services, (3) introduced major new equipment, or (4) introduced major new ways of working” (Nathan & Lee, 2013). The researchers also differentiate between knowledge-intensive businesses and non-knowledge-intensive firms. The study found that both diverse (mix of UK and foreign-born individuals) and migrant-run firms were more likely to produce innovation relative to businesses solely owned by people born in the UK.

Figure 7: Important Policymakers within SBIR

Mr. John Williams: Director of Innovation and Technology for the Office of Investment and Innovation (OII) within the US Small Business Administration (SBA).

Ms. Brittany Sickler: Outreach, training, and partnership strategist for the SBA’s Office of Investment and Innovation.

Ms. Jenn Gustetic: NASA SBIR Program Executive

NSF SBIR Program Directors: <https://seedfund.nsf.gov/contact/>

Mr. David Sicora: Acting DoD SBIR/STTR Program Administrator

NIH SBIR Specialty Center Coordinators: <https://sbir.nih.gov/engage/ic-contacts>

Mr. Manny Oliver: DoE Director, SBIR/STTR Programs Office

Literature Review

While an important part of the US government’s approach to entrepreneurship, SBIR is a relatively new federal funding mechanism for academic research (founded in 1982). Prior to World War II, private industry, rather than the government, funded basic scientific research and commercialization (Jahnke, n.d.). However, in 1940, President Franklin D. Roosevelt created a new model of federally funded scientific research and development to create innovation to use in the upcoming war (Jahnke, n.d.). In 1950, President Harry S. Truman created the NSF, expanding the government’s research portfolio to all basic scientific research (Jahnke, n.d.). However, researchers were not able to commercialize their innovations until the Bayh-Dole Act of 1980 (Association of University Technology Managers, n.d.). This legislation allowed universities and small businesses to retain ownership over innovations created under federal research programs (Association of University Technology Managers, n.d.).

The effects of the Bayh-Dole Act of 1980 have culminated in a phenomenon known as technology transfer. Technology transfer is the process of converting scientific and technological advances into marketable goods and services (BusinessDictionary.com, n.d.). When this happens, universities are paid a fee for the licensed intellectual property rights, which are then funneled back to the inventors and other research programs (University of Rochester, n.d.). SBIR plays an important role in the technology transfer process by providing the funding and structure for researchers to commercialize their work (SBIR, 2018).

Fixing the gender- and ethnicity-based gap in SBIR funding is key to distributing the benefits of technology transfer to applicants that might not otherwise be able to commercialize their research. While this is a pressing topic, policy interventions have not been implemented across all partner agencies. As such, this review will address the National Academies' solution that the SBA, and thus the SBIR, change its definition of S/ED groups to specifically address the overrepresentation of Asian-Americans in entrepreneurship (National Academies of Science, Engineering, and Medicine, 2014) (National Academies of Science, Engineering, and Medicine, 2016) (National Academies of Science, Engineering, and Medicine, 2015) (National Academies of Science, Engineering, and Medicine, 2016) (National Academies of Science, Engineering, and Medicine, 2015) (National Academies of Science, Engineering, and Medicine, 2016) as well as efforts outlined in the National Academies' report on the DoE (National Academies of Science, Engineering, and Medicine, 2016) and extrapolate solutions from other policy contexts. However, before discussing potential next steps, it is important to emphasize that even if these solutions are implemented and succeed, they will not necessarily solve the problem across all partner agencies. This is due to the structure of SBIR, where each participating agency can customize their own evaluative process. As such, the effects of standardizing practices across SBIR are unknown and practices that prove effective in one agency are not guaranteed to spread.

Defining Disadvantage. The Small Business Act of 1958 defines a socially and economically disadvantaged individual as:

“[I]ndividuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged” (15 USC §637)

The problem with this definition is that it includes Asian-American owners, which are socially and economically disadvantaged in other contexts, but are over-represented in entrepreneurial ventures. Every agency-specific report published by the National Academies of Science, Medicine, and Engineering recommend rewriting this definition to exclude Asian-Americans. This would serve to unmask the worryingly low application rates from other S/ED groups, such as African-Americans, Latin-Americans, and Native Americans. Disaggregating the high rate of Asian-American entrepreneurship from other S/ED data would demonstrate exactly how low the rate of S/ED entrepreneurship actually is. This would improve the quality of available data, allowing for greater accountability and agency action to address the problems within their own process (SBIR at NASA, 2016).

Among all of the agency reports, the DoE report uniquely demonstrates agency interest and initiative in resolving the funding gap, suggesting several potential paths forward (National Academies of Science, Engineering, and Medicine, 2016). These include gender-blind application evaluation and a required mentorship program wherein awardees mentor potential applicants. The DoE has already engaged in a 2013 independent survey of the pool of potential WS/ED applicants and created an experimental program (Phase 0 grants) that specifically targets this pool. While the program ran out of funding in 2017, NIH has implemented its own Phase 0 program, called the Applicant Assistance Program, which is currently ongoing (National Institutes of Health, 2018).

Interventions. The most commonly agreed on reform across the surveyed National Academies reports is to change the SBIR definition of S/ED to conform to Congressional intent. This change would create better data for agencies and facilitate accountability to the SBIR Congressional mandate. Both the National Academies and Congress believe that collecting and leveraging better quality data is essential for good governance (National Academies of Science, Engineering, and Medicine, 2017) (Commission on Evidence-Based Policymaking, 2017). However, only collecting better data will not change the situation for WS/ED projects. Direct intervention is necessary.

Randomized Controlled Trials on Blind Applications. While gender blind applications can be difficult to execute (Jones & Urban, 2013), one profession has managed to make them very common. From 1970 to 1997, orchestras demonstrated an approximate 25% increase in the number of female players in the top 5 orchestras in the United States. A 1997 NBER working paper found that blind auditions for orchestras explained about 25-46% (approximately 6.25 to 11.5 percentage points) of this increase over the observed period in the proportion of women employed (Goldin & Rouse, 1997). Even though there are differences between the SBIR evaluation process and an orchestra audition, the results shown through a rigorous causal framework are compelling.

Additionally, two other studies, one which simulates a corporate environment (Self, Mitchell, Mellers, Tetlock, & Hildreth, 2015) and one examining race-blind affirmative action (Kapor, 2016) found similar benefits. The study examining corporate application evaluation measured the effect of accountability policy (identity-conscious, identity-blind, and no accountability) on how evaluators rated applications in environments where white men did and did not have a human capital advantage. The study found that both identity-conscious (IC) and identity blind (IB) application processes did prevent gender and racial discrimination. Notwithstanding that finding, the study also found that IC processes created reverse discrimination against white candidates whereas IB did not (Self, Mitchell, Mellers, Tetlock, & Hildreth, 2015). The study on race-blind affirmative action also estimates that removing the Texas Top Ten, an exemplar of this sort of program, would lead to a 10% decrease in college attendance by underrepresented minority students (Kapor, 2016).

Furthermore, findings from a 2017 observational study examining the effects of identity-blind application evaluation on proposal rating in a first-stage peer-review process of biomedical research grants support the above conclusions (Solans-Domenech, et al., 2017). This experiment used a collection of 2,256 proposals, which were evaluated by 1,475 reviewers (average of 2.2 reviews/proposal). These reviewers evaluated the proposals once identity-blind and once identity-conscious. These scores were combined to create a proposal rating of recommended (R), recommended with reservations (RR), questionable (Q), or not recommended (NR) for funding. If there was disagreement between the two reviewers at the end of the second phase, the proposal was sent to a third reviewer, who underwent the same evaluation process. The final ratings were then sent to an identity conscious reviewer committee for final funding decisions. After reviewing the entire sample, 18.5% of all proposals had experienced a rating change between phases 1 and 2. The study used the change between the identity-blind and identity-conscious reviews to create the primary variable of the study. This variable also tracked if the observed change was positive or negative. The researchers then tracked why the reviewers changed their rating between phases 1 and 2. The results indicate that revealing a researcher to be female increased the likelihood of a negative change in rating relative to male researchers between phases 1 and 2. This study represents an area ripe for more research. A 2017 literature review on how to mitigate gender bias in grant applications found only one article that examined a gender-blind grant application process in a pool of 5524 citations and 170 full-text articles (Tricco, Thomas, Antonio, & Straus, 2017).

In contrast, another study very clearly showed the negative effects of gender- and race-aware processes. It did so by demonstrating that resumes with African-American-sounding names were less likely to be contacted for an interview than those with White-sounding name (Bertrand & Mullainathan, 2004). Due to findings like these, companies such as GapJumpers.com are beginning to offer services creating and maintaining blind application processes. Additional research should also be done regarding the effect of identity-blind evaluation of private sector loans on the ability of WS/ED applicants to get loans. It would be useful allegory to use in this sort of policy discussion.

RCTs on Mentorship Programs. This option presents the idea of leveraging awardee capabilities to help mentor potential WS/ED applicants to Phase 1. However, the anticipated effects of such a program are difficult to quantify. The surveyed literature on the topic is unclear on the efficacy of mentoring. One of these studies, conducted by Blau et al, uses an RCT to observe the effects of mentorship programs on obtaining federal research grants and publishing in top journals over a period of longer than year. The study found that mentoring interventions had little effect after one year in the program. However, the treatment group after three years was about 9 percentage points more likely to have published a paper in a top-tier journal, and 20 percentage points more likely to have done so after 5 years (Blau, Currie, Croson, & Ginther, 2010). Smith et al. ran an RCT for an unknown amount of time analyzing the effects of mentorship on affective commitment to an organization. The researchers found that mentoring

and affective commitment to organization were only correlated with regard to white men and women (Smith, Smith, & Markham, 2000). Notwithstanding their findings, the authors caveat their conclusions by noting the small sample size of racial minorities within the overall experimental sample, positing that this could have affected their analysis. Another study over the course of a year found that mentoring relationships had a significant positive impact on mentees' overall psychological need satisfaction at 2 months, but no statistically significant effects at one year (Lewis, et al., 2016). The researchers hypothesize that this demonstrated lack of effect is due to the brevity of the experiment, which supports the findings from the Blau study.

Researchers have also examined this topic within the specific context of entrepreneurship. One such study, published in 2016, examines data gathered from Quebecois entrepreneurs (El Hallam & St. Jean, 2016). In the study, 981 entrepreneurs were invited to take an online survey. These respondents were drawn from a Quebec-based mentoring program, *Fondation de l'entrepreneurship*. This generated a sample size of 314 mentees (162 men, 152 women). The researchers controlled for certain personal characteristics, including mentee age, gender (mentee and mentor), and mentee level of education. After controlling for the specified characteristics, the researchers found that mentee trust in, and perceived similarity with, their mentor explained about 56.5% of the variance related to mentee learning. The researchers concluded by conjecturing that it might be best to let mentees choose their mentors, in order to maximize perceived similarity and trust. Much of the literature specifically involving the impact of mentoring on mentee outcomes in entrepreneurship involves this same dataset. As such, this report omits these studies to avoid redundancy.

Other Literature on Mentorship Programs. Several other papers have studied the correlation between mentorship and organizational diversity. Anecdotal research from the Harvard Business Review supports a positive relationship between mentorship and diversity, showing large observed gains in companies that instituted successful mentorship programs, such as Coca-Cola (Dobbin & Kalev, 2016). A study conducted in Australia (Gardiner, Tiggeman, Kearns, & Marshall, 2007) showed a positive correlation between mentoring and organizational commitment and awards. In this study, mentees were observed to have lower exit rates, a higher likelihood of obtaining at least one promotion, and more success winning research grants, although the sample size in the study was fairly small. These findings support internal analysis of the Sun Microsystems mentoring program (Holincheck, 2006) that observes that mentees were 20 percentage points more likely to have had a salary grade change. Interviews of 30 women in the oil and gas industry (Williams, Kilanski, & Muller, 2014) had a more mixed perspective. The researchers found that while interviewees had positive experiences with formal mentoring programs, mentors were often unable to meaningfully help remove roadblocks caused by organizational discrimination (Williams, Kilanski, & Muller, 2014). Another correlational study found that these formal mentorship relations could serve as a buffer against ambient racial discrimination, but only if they were satisfying and high-quality (Ragins, Ehrhardt, Lyness, Murphy, & Capman, 2017). Additionally, a study of mentorship relationships within the US

Army found that mentorship only boosted mentee outcomes when high achieving mentees were paired with mentors (Carter, Dudley, Lyle, & Smith, 2016).

Summary of Phase 0 Program. The Phase 0 program was conceived by the Department of Energy in 2014 as a program designed to “enhance the participation of underrepresented groups” (National Academies of Science, Engineering, and Medicine, 2016). DoE went about setting up this program by contracting with a company called Dawnbreaker for an initial sum of \$1,000,000 and around \$750,000 for the two years after that. Unfortunately, this funding came from the SBIR Administrative Fund. The authorization for the Administrative fund expired on September 30, 2017 (Portnoy, 2017). However, the NIH has internally funded a similar program which is currently ongoing.

The structure of Phase 0 followed five criteria. In order to qualify for the program, applicants needed to be:

1. U. S. Women-owned or U.S. SED small businesses, located anywhere in the U.S. and its territories that work with advanced technologies OR Any U.S. small, advanced technology firms currently located in the following under-represented states, districts, and territories: AK, DC, GA, HI, IA, ID, IN, KS, LA, ME, MN, MS, MT ,NC, ND, NE, NY, OK, PA, PR, RI, SC, SD, WA, WI

AND

2. Have NEVER received a DOE SBIR/STTR award. (National Academies of Science, Engineering, and Medicine, 2016)

This limited the applicant pool to about 500 people over 3 years (7 Phase 1 cycles) (O'Gwin, 2018). Once applicants established their eligibility, they were required to submit a Letter of Intent, which outlined the proposed technology and commercialization plan. If the applicants received the Phase 0 grant, Dawnbreaker would provide each candidate with the following services as needed:

1. **Letter of Intent (LOI) review.** DoE is unique among the other agencies in requesting a 500-word LOI, due approximately 1 month after release of the FOA. Dawnbreaker assists applicants in developing a well-developed, two-page description of the technology and its application.
2. **Phase I proposal preparation, review, and submission assistance.** Dawnbreaker provides program applicants with a coach who provides initial advice; helps the company establish and maintain a schedule for proposal preparation; and provides feedback as an independent reviewer of the draft proposal.

3. **Market research assistance.** Although DoE requires only limited commercialization plans for Phase I applications, it requires revenue projections over a 10-year period. A preliminary market assessment may provide companies with insights into different potential applications or identify the existence of strong competing products already in the market. According to Dawnbreaker, eligible applicants may be provided with one relevant Frost and Sullivan report.
4. **Small business development training and mentoring.** The Dawnbreaker business coach can align services with the company's needs. For example, newly formed companies may require assistance with firm structure and initial sources of support. More established firms might require guidance on business models and strategies. Technical leaders of newly formed companies may not yet be experienced in effectively presenting their ideas to investors, and Dawnbreaker's coaching and advice may help.
5. **Technology advice and consultation.** The program provides up to 3 hours of technical consultant time for feedback on the technical work plan or other technical issues.
6. **Intellectual property consultation.** Because even a Phase I proposal requires some attention to intellectual property, the program provides access to legal counsel.
7. **Indirect rates and financials.** To prepare a budget, an applicant must address the issue of indirect rates. The Dawnbreaker consultant helps applicants to understand indirect rates and to develop an appropriate rate structure for the DoE proposal, although the budget itself is prepared by the applicant.
8. **Travel assistance.** Small business can be reimbursed for pre-approved, relevant travel expenses subject to federal travel guidelines. The travel must be germane to securing a Phase I SBIR/STTR award. This component is primarily aimed at supporting travel to meet with staff at DoE or the National Laboratories. (National Academies of Science, Engineering, and Medicine, 2016)

RCTs on the effect of Scholarships on College Matriculation. The most similar policy allegory to the DoE Phase 0 program is the effect of college advising¹ on college matriculation. This is due to the fact that college advising plays a large role prior to the application of a student to college. It is important to note the difference between college advisors and mentors. College advisors have a breadth of knowledge from both within the college application process as well as examining it as from a professional distance.

¹ In education policy, college **counselor** and college **advisor** are relatively interchangeable terms.

Mentors are often near-peers that wish to share their experience with a mentee in order to instruct them or improve the mentee's experience.

Assuming that this is an accurate allegory, the potential effects of the intervention could be large. For example, a 2013 College Board research brief studied the effect of college counselors on the rate of college enrollment at the state level (Hurwitz & Howell, 2013). This study used a regression discontinuity test to find that an additional counselor in a high school increased college enrollment of those students by 10%. Unfortunately, this study was not able to quantify the marginal returns of adding college counselors to high schools that already had more than one. Another study examining the effect of Talent Search, a federal program that provides a variety of college preparatory services, including counseling (United States Department of Education, 2011), on college enrollment found similar results (Constantine, Seftor, Martin, Silva, & Myers, 2006). The researchers' findings suggested that, based on program, state, and federal records, membership in a Talent Search program is linked to increased college attendance. However, given the lack of a random sample, the propensity score method used yields only weak causal evidence to this effect.

In a separate context, a 2009 study used 156 H&R Block offices to conduct a RCT studying the effect of providing low- to medium-income² families aid completing the FAFSA on college enrollment (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2009). The experiment created its sample population out of individuals that used H&R Block to fill out their taxes and had a family member between the ages of 15 and 30 without a bachelor's degree. After these individuals consented to participate in the experiment, they were randomly separated into three groups. The first had the FAFSA pre-populated from their tax forms and completed after an interview. The tax professionals also offered to submit the FAFSA for the family and provide personalized aid estimates and tuition costs for prospective colleges. The second group got a personalized aid and tuition estimate based on the family's tax return and nearby colleges but did not receive personal aid. The last group served as a control, and so only received general information about college tuition and aid. The study found that the first group experienced large relative increases (about 29%) in their likelihood of college enrollment. However, these findings were not statistically significant.

Stakeholder Analysis

As with any policy issue, there are stakeholders that Capital Labs should account for when considering the options presented below. A brief description of the stakeholder's potential policy position is included in their entry.

² less than \$45,000 in annual income

Applicants: These are the stakeholders most effected by the policy options presented in this report, as changes in how the SBIR evaluates potential WS/ED applicants will directly impact their livelihoods. WS/ED applicants stand to gain a greater share of grants awarded pending successful reform of SBIR evaluation practices, and thus would likely support reforms to the SBIR program. Non-WS/ED applicants will likely see their share of grants awarded decrease as a result of programmatic change and might resist reforms to the SBIR program.

SBA/SBIR management: The SBA is the executive agency that oversees the SBIR program. The SBA and SBIR likely have a strong interest in preserving their operating practices and not facing the organizational, administrative, or political costs associated with change. However, SBIR likely has a competing interest in fulfilling its Congressionally-mandated goals. As a result, it is unclear how willing the SBIR would be to adopt reforms to their program.

Partner Agencies: The partner agencies likely have similar interests to the SBIR management teams. However, the National Academies reports indicate that only the NIH and the DoE are making noticeable moves towards fulfilling the Congressionally-mandate goal of reforming their practices towards WS/ED applications. This suggests that most partner agencies have a stronger interest in preserving current operating practices than fulfilling their Congressional mandate.

Private Industry: Per Link & Scott's 2012 paper, private industry often sees positive run-on effects from research started within SBIR-funded projects (Link & Scott, 2012). Coupled with the assertion that having diverse management teams within a business is linked to more frequent innovation (Nathan & Lee, 2013), private industry may have an interest in promoting measures within SBIR to increase outreach to WS/ED individuals.

Universities: One of SBIR's four Congressionally mandated goals is to increase commercialization of innovations derived from federal research and development funding (SBIR, 2018). Universities play an integral part of the federal research and development portfolio. These institutions, particularly STEM focused departments, likely have conflicting interests. They may care about maintaining consistent SBIR policies, so that applicants from those schools can rely on mentorship and experience from faculty that are program veterans. However, STEM departments have also seen a push to improve their own outreach and retention efforts towards the WS/ED community. As such, universities may also have an interest in making the SBIR process more equitable towards WS/ED faculty in order to improve overall faculty prestige and morale.

United States Congress: Given the Republican majority in both the House of Representatives and Senate, it is likely that Congress will have a strong interest in opposing any option which increases SBIR expenditures. Thus, any option which depends on a strong legislative component and requires additional funding may experience implementation difficulties.

Evaluative Criteria

Unfortunately, there has been very little work done to evaluate policy interventions specifically alleviating the problems found within the SBIR model. As such, the report will use the below criteria to give a framework to evaluate how different policy interventions might affect the issues addressed in the problem justification. These criteria are based off of two assertions. First, WS/ED individuals are not being awarded grants at the same rate as their male, non-S/ED counterparts. Second, implementing any intervention will have costs and the size of these costs may prohibit agency action, regardless of the effectiveness of the solution.

Criteria 1: Share of Funding going to Women and S/ED Individuals

The problem identified in the introduction of this report is a gap between the awards going to non-WS/ED projects and awards that go to WS/ED projects. As such, one of the most important criteria to evaluate for any policy option is how much that intervention would expand the share of total awards granted to WS/ED applicants. Practically, the report will evaluate the impact that each intervention had within its original context and use that to estimate the impact the intervention might have within the SBIR context. In order to execute this evaluation, the report will use publicly available datasets whenever possible, and peer-reviewed academic literature if there are no publicly available datasets.

Criteria 2: Political Feasibility

This evaluative criterion will discuss the political feasibility of policy implementation, qualitatively assessing three key traits on a scale of 1 (None) to 5 (High). The traits assessed under this criterion are 1) whether the program requires new or amended legislation, 2) whether the program would have bipartisan support, and 3) whether the program would likely be implemented. Understanding how involved the legislative or executive branches need to be is important to assessing the viability of an intervention because of the highly polarized political environment in those branches of government.

Criteria 3: Program Cost

This criterion will attempt to estimate how much implementing a given policy option will cost each partner agency. The report will base this metric on publicly available cost information. If no costing information is available, the report will extrapolate costs from similar situations in order to estimate the potential cost of the option.

Criteria 4: Cost-Effectiveness

This criterion would establish the cost effectiveness of a given policy option by dividing the estimated percent point increase of WS/ED individuals receiving SBIR grants (Criterion 1) by the total estimated cost of implementing a gender-blind application process (Criterion 3). The analysis would then qualitatively assess the estimate based on current economic indicators to determine whether the outcome is likely to be higher, lower, or on par with the estimate.

Policy Options

This report considers four potential options: letting present trends continue, implementing a gender-blind application process, creating mentorship programs for potential WS/ED applicants, and instituting the DoE Phase 0 grant program across all SBIR partner agency programs. These options will be evaluated based on four criteria: share of funding awarded to WS/ED projects, political feasibility, cost-effectiveness, and sensitivity to changes in cost and effect. This report proposes that, for all of these options, whichever one is ultimately adopted should be enacted in concert with the National Academy's recommendation of changing the SBA definition of "socially and economically disadvantaged" to more accurately reflect the specific demographic context within entrepreneurship.

Option 1: Let Present Trends Continue

The SBIR represents an important part of the US entrepreneurship economy. While there are funding discrepancies in how SBIR reaches out to and grants awards to WS/ED individuals, drastic change may inhibit the program's work in bridging the gap between research and commercialization. Given the evidence presented in the beginning of this report, this option does not appear to increase the share of awards going to WS/ED applicants.

Option 2: Implement an Identity-Blind Application Evaluation Process

The DoE report suggests that instituting an identity-blind application evaluation process might lead to WS/ED projects having a higher share of total SBIR awards. This expectation has been validated within the context of the orchestra hiring process and by the advent of third party services creating identity-blind application processes.

Option 3: Create Mentorship programs for Potential WS/ED applicants

The DoE report also suggests that creating a mentorship program which pairs Phase 1 awardees with potential WS/ED applicants may increase the share of WS/ED applications received and WS/ED projects receiving a grant. This expectation has its foundations in NSF studies and private industry observations.

Option 4: Expand the DoE Phase 0 Initiative

The DoE report also cites the Phase 0 grant, a program that the Department started in 2014. This grant program, which was specifically designed to prepare WS/ED applicants for Phase I grant evaluation has now been in place for four years. This report will build an estimate from the preliminary data provided by the DoE and studies done on college advising.

Data Analysis

Option 1: Let Present Trends Continue

It is possible for the government to continue running the SBIR program as it is currently structured. This option is the most politically feasible and cheapest option, since 1) the program does not require new or amended legislation, 2) by extension, the program would not need

bipartisan support, and 3) no new program would need to be implemented. Thus, the report rates this option's political feasibility at a 5. However, there are serious concerns with the equity of maintaining current trends. Given the evidence presented in the beginning of this report, this option does not appear to increase the share of awards going to WS/ED applicants. Therefore, this option will form the baseline (no effect) to judge the effect of all of the subsequent options on the share of Phase 1 grants awarded to WS/ED projects, rather than be considered as a recommendation.

Option 2: Implement an Identity-Blind Application Evaluation Process

The cost of implementing such a portal are unclear. GapJumpers does not publish a publicly available cost estimate for their system. As such, this report uses the cost of implementing and maintaining an admissions portal from the Frank Batten School of Leadership and Public Policy at the University of Virginia to establish a baseline for how much a normal system would cost (See Appendix A for the Batten cost breakdown). The report then multiplies this cost by an arbitrary factor of two, in order to account for the novelty and complexity of the GapJumpers system. The fixed costs of implementing the Batten system (TargetX) totaled a one-time fee of \$25,000 to implement the system. There are three types of variable costs imbedded in the Batten system.

First, there is an annual payment to continue to use TargetX, which is calculated based on the anticipated number of applications per month (\$25,000 annually, assuming less than 2,000 applications per month). Second, there is a cost to using a supplementary system (Salesforce) which depends on how many users are on the Batten side of the system (annual payment of \$460/user). Finally, there is a fee for giving applicants access to the Batten application system, which consists of an annual payment of \$4,000 for 2,000 unique logons to the system per month. Thus, the future value of the system is predicated on how many users per month will apply.

According to the SBIR website, the Department of Defense SBIR program has awarded a maximum of 3820 grants in a year in its history (SBIR). Per the NIH SBIR program, the application success rate for Phase 1 grants fluctuates between 11.5% and 27.1% (National Institutes of Health, 2018). Assuming that the DoD and NIH have similar application success rates, variable costs should be predicated on a maximum annual application amount of about 33,217 applications per year. Most agencies will not hit this threshold, since the next largest maximum number of awards given is the Department of Health and Human Services at 2,058 grants awarded in a year (SBIR). However, assuming a linear relation between the fee structure and number of people served, this implies that the Batten costs should account for an increase of about 1.5 times the current annual application amount (assuming equal numbers of applications per month) in order to account for the maximum possible number of applications per year.

As such, the estimate assumes that a system robust enough to cover the Department of Defense's needs, without adjusting for the added novelty and complexity of the GapJumpers process, would require about 15 Salesforce users (\$6,900), an annual payment to TargetX of \$50,000, and

an annual payment of \$8,000 for 4,000 unique logons per month, assuming that applications were evenly spread out over 12 months and that the unique logons payment is a step cost increasing at fixed increments of \$4,000 per 2,000 logons. This yields an initial start-up cost of \$89,900, with payments of \$64,900 every year afterward. Now, assuming that the GapJumpers system would cost about double these estimates, the net present value of a system robust enough to handle the maximum demand from any single SBIR partner agency over 5 years is \$352,405.63. Given that the literature review above estimated that identity blind systems lead to between a 6.25 and 11.5 percentage point increase, this report estimates that, at maximum cost, an SBIR agency would pay between \$30,643.97 and \$56,384.90 per percentage point increase in the number of awards given to WS/ED projects.

However, this is not representative of what all SBIR agencies would have to pay. For example, the Department of Energy has awarded a maximum number of 617 awards in a year, which the Batten system could handle. Assuming the same doubling effect for the GapJumpers system, the net present value of this option is \$158,333.27 over 5 years, giving a cost-effectiveness range of between \$13,768.11 and \$25,333.32 per percentage point increase in the number of awards given to WS/ED projects. These cost-effectiveness estimates also assume that the percentage point increases will remain in the specified range between 6.25 and 11.5 percentage points.

Data from GapJumpers.com gives further credence to these estimates. GapJumpers.com have conducted projects in a variety of industries, including Hi-technology, Media, Finance, Advertising, Data Analytics, Transportation, and Civil Engineering. According to the company, the following results have been shown over 11 projects:

Figure 8: Observed GapJumpers.com Results up to 2017



Source: gapjumpers.com correspondence

As shown by the GapJumpers.com results, there is potential for even greater results than estimated, which would increase the cost-effectiveness of this option. Unfortunately, the political costs are uncertain. While the program would not require new or amended legislation, it is unclear whether the program would have bipartisan support since this is a very new idea with a small sample size. Furthermore, due to current levels of Congressional partisanship, the program would likely have to be attached as a rider to another bill in order to be implemented. As such, this report rates the option as a 2 for political feasibility.

Option 3: Create Mentorship Programs for Potential WS/ED applicants

The cost of this option is also uncertain. A potential breakdown of costs from managementmentors.com suggests that there are three potential routes to take when setting up a mentor-mentee matching system (managementmentors.com, 2016). First, the organization could hire a consultant, costing about \$30,000-\$50,000. Second, the organization could buy an online software package, costing as low as \$3,000 a year, depending on the number of users. Third, the organization could produce the system in-house, which costs the equivalent of the hours of time invested in making the system multiplied by the value of that time. The website estimates that setting up the system could take 100 hours for an employee whose time is worth \$75 an hour, leading to a total cost of \$7,500. However, these are all fixed costs. Managementmentors.com quotes a final annual price of about \$7,500 to set up a matching system and monitor it for the

duration of the mentoring program. Assuming that this price is for the software package, that means that about 40% of the total cost of the program is fixed.

Using the Sun Microsystems cost of \$695 invested per mentor-mentee pair in a 95-pair program (Dickinson, Jankot, & Gracon, 2009), each mentor-mentee pair costs the organization about \$417 after accounting for fixed costs. Furthermore, according to Figures 2 and 3, the maximum number of women-owned projects given awards across all SBIR partner agencies is around 450 and the maximum number of S/ED owned project given awards is around 200. Therefore, the maximum number of pairs across SBIR is around 650, assuming no double counting between women and S/ED populations in order to establish a maximum. As such, the maximum total variable cost across SBIR is about \$271,050 per year. The fixed costs of setting up the matching software is a one-time payment of \$36,000 for all 12 partner agencies. As such, the net present value over 5 years of a SBIR-wide mentoring program is about \$804,308.52, or \$67,025.71 per agency if costs are shared equally. Taking the range of effect from the literature review of a 0 to a 20-percentage point increase as a result of the mentoring program, the cost effectiveness of this option ranges from no effect to costing each agency \$3,351.29 per percentage point increase. This option is cheaper than Option 2 but less predictable. Since the program would not require new or amended legislation and is easier to explain to legislators than Option 2, this report rates the option's political feasibility at a 3, even with the current levels of Congressional partisanship.

Option 4: Expand the DoE Phase 0 initiative

The DoE is currently analyzing the data gathered during the Phase 0 program in order to release a full report through the National Academies Press. However, preliminary findings about the effect of the program seem promising. According to Figure 9, Phase 1 applicants that received the Phase 0 treatment were observed to be four percentage points more likely to receive a Phase 1 grant.

Figure 9: **Overall FY 2015 – FY 2017 (324 Phase 0 Participants)**

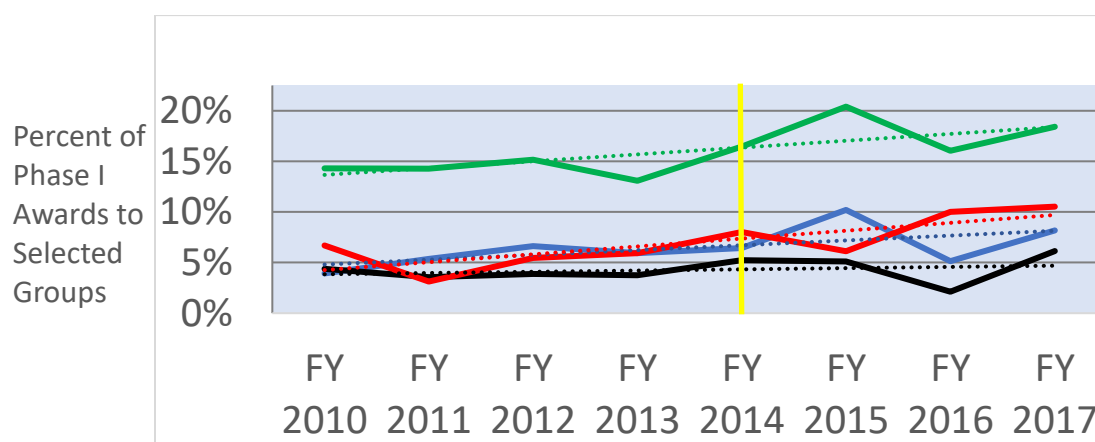
	Phase I Applications	Phase I Awards	Phase I Award Rate
1. All Phase 0 (P0) UR Participants	218	32	15%
2. P0-1st Grant Application	171	22	13%
3. Non P0 UR-1st Grant Application	296	27	9%
4. All DOE SBIR/STTR Applicants	4,195	830	20%

Notes:
Line #1: 67% (218) of all Phase 0 (P0) participants submitted a Phase I application following DOE support. Of this number 32 (15%) received a Phase I award/grant.
Line #2: To be eligible for Phase 0 support, one must have never received a DOE SBIR/STTR award. So, this means, many, but not all Phase 0 participants may have never submitted a DOE Phase I grant application. During this period, 171 or 78% of the Phase 0 participants had never submitted a DOE Phase I grant application. Of the 171 first-time grant application submitters, 22 Phase 0 participants or 13% received a Phase I grant.
Line #3: Now compare this line to Line #3. Of the 296 Non-Phase 0 UR applicants (those UR Phase I applicants not in the Phase 0 program) submitting their first DOE Phase I grant application, 27 or just 9% received a Phase I award. This means those UR applicants in the Phase 0 program are more likely to win an award.

Source: (O'Gwin, 2018)

However, the results for women and S/ED individuals is more mixed. According to Figure 10, WS/ED individuals have seen slight improvements since 2010. It is unclear that the Phase 0 program has pronounced, positive effect on the percent of women and S/ED individuals that won a Phase 1 award.

Figure 10: **Proportion of Phase 1 Awards to Select Groups Pre/Post DoE Phase 0**



small businesses from under-represented states

historically underutilized business zone small businesses

women-owned small businesses

socially and economically disadvantaged small businesses

Source: (O'Gwin, 2018)

Per this graph, the Phase 0 program contributed about an approximate 2 percentage point decrease to an approximate 3 percentage point increase to the share of awards granted to WS/ED projects. Based on the information above, this report assumes that \$750,000 represents the total annual variable costs for a Phase 0 program and \$250,000 represents the total fixed costs. Therefore, at 2 cycles per year, a DoE size program will award roughly 143 grants, yielding an average per candidate variable cost of \$5,244.75. As such, assuming a discount rate of 7% over the three years the program was active, the net present value of the program is about \$356,013.63. This means that SBIR agencies could be spending between \$178,006.81 per percentage point decrease and \$118,671.21 per percentage point increase. Since the program has been implemented before, it likely would enjoy bipartisan legislative support, since it would likely be perceived as non-risky. Coupled with the fact that this option would not need new legislation to get implemented, this report rates its political feasibility at 4.

Assessment and Recommendations

Outcomes Matrix

Option	Share of Awards	Political Feasibility	Cost	Cost Effectiveness
Let Present Trends Continue	0	5	0	0
Identity-Blind Application Evaluation Process	6.25 – 11.5 percentage point increase	2	\$158,333.27 - \$352,405.90 over 5 years	\$13,768.11 - \$56,384.90 per percentage point increase
Mentorship Program	0 – 20 percentage point increase	3	\$67,025.71 per agency over 5 years	No effect - \$3,351.29 per percentage point increase
DoE Phase 0 Program	-2 to 3 percentage point increase	4	\$356,013.63 over 3 years	\$178,006.81 per percentage point decrease - \$118,671.21 per percentage point increase

This report suggests that Option 2: Implement an Identity-Blind Application Evaluation Process is the most likely to succeed. This option is likely to create a 6.25 to 11.5 percentage point increase in the number of awards given to WS/ED projects, with potential for even larger increases. This option also incurs costs of the that are relatively small for a US government agency. While this option is neither the cheapest nor the most cost-effective, it is ultimately the most realistic.

While the other options presented are either a) cheaper or b) more tested, they are too unpredictable to ultimately recommend as definitive courses of action. In the case of Option 3: Establish a Mentorship program, academic literature seems to point to the conclusion that

mentorship relationships create the most value when they persist about 3-5 years. Given that the DoE has two Phase 1 cycles in a year, it is unlikely that potential mentors would be able to interact with their mentees for even a full year. Therefore, this report indicates that Option 3 is more likely to trend toward the lower end of its range (no effect) than the higher end of its range (20 percentage point increase). However, the argument could still be made that the amount of investment in such a program is small enough that the investment might still be justified by any percentage point increase in the number of awards granted to WS/ED projects. This report contends that mentoring relationships of less than one year where both parties are working on intensive projects of their own might lead to low quality, unfulfilling mentor-mentee relationships on average. If that were the case, mentoring programs would likely have a negative effect on the number of WS/ED applicants to the SBIR program due to negative word of mouth about SBIR outreach, further diminishing the case for Option 3: Establish a Mentoring Program.

Similarly, while Option 4: Expand the DoE Phase 0 Program is more tested, it is the only option that has a potentially negative effect on the number of awards given to S/ED projects. While Option 4 is also the only one that has been implemented within the SBIR context, Option 2: Implement an Identity-Blind Application Evaluation Process has been implemented in a corporate setting. The evidence gathered from gapjumpers.com during those auditions suggests that the theoretical gains found in the RCT's on identity-blind auditions are likely to translate to interventions done in non-laboratory circumstances. Furthermore, Option 2, at its maximum, costs slightly less than the Phase 0 program over more time (five years vs. three years) and is likely to cost significantly less for smaller agencies. As such, Option 2 represents the least-risky option at a total cost that is less than Option 4, which has already been implemented by two government agencies (DoE, NIH).

Recommendation and Implementation

However, this recommendation is based on highly theoretical estimates of the effects of each option. In order to better understand the true effects of each option, it is recommended that each option be implemented at a different agency over a period of three years under the SBA Pilot to Allow for Funding of Administrative, Oversight, and Contract Processing Costs (Small Business Administration, 2014). This fund is specifically aimed at increasing WS/ED participation in the SBIR program. Establishing these pilot programs would allow for the creation of a longitudinal dataset over all three options to understand the actual costs and effects of each. While this program has not been renewed by the SBA yet, this report assumes that there is a good chance that it will be in the near future, based on an interview with the manager of the DoE Phase 0 program, Chris O'Gwin (O'Gwin, 2018). Even if the program does not get renewed immediately, agencies should still comply with the rules set out in the 2014 Policy Directive (described below) so that they can transfer their pilot programs to the SBA funding program if it does get renewed.

Per the 2014 SBA Policy Directive, each of these programs should cost no more than 3% of the implementing agency's total SBIR budget and the agency should draft a working plan for each

fiscal year (Small Business Administration, 2014). This working plan must comply with the SBA's agency-specific performance metrics for that fiscal year, and agencies must submit this plan 30 days before the start of the fiscal year. At that point, SBA has 30 calendar days to provide comment on the program. If SBA doesn't return comments in that time period, the program is approved. If they do, the agency has to change or supplement and resubmit the work plan to SBA. After the plan is approved and metrics are set, the agency can begin with the program. Any material changes to the work plan after this point by the agency need to be reported to SBA.

The general structure of the program would proceed as follows. Three different agencies would each implement a different option. Each agency would report data measuring pre-selected characteristics about proposals to Capital Labs, which would serve as a data aggregator and analyst, at 0, 18, and 36 months. Capital Labs would then publish these results with a definitive policy recommendation. The data that agencies should collect about the proposals are as follows:

1. The share of awards received by WS/ED candidates
2. The racial group (African-, Asian-, Latin-, Native American, etc.) of S/ED candidates
3. The annual cost of the program

Agencies should also require that awardees report the following about their projects:

1. Size of the project team
2. Any non-monetary awards received by the team from non-SBIR sources
3. Any additional private sector funding secured during or immediately after Phase 1
4. Any SBIR Phase 2 awards secured after Phase 1

It is recommended that the following agencies implement the corresponding option. The DoD should implement Option 2: Identity-Blind Application Evaluation Process. The National Science Foundation should implement Option 3: Mentoring Process. The NIH have already begun to implement a DoE-style Phase 0 program called the Applicant Assistance Program (Dawnbreaker, 2017). This should be folded into the pilot program in order to measure the sustained effects of a Phase 0 program. Program-specific descriptions are as follows:

Identity-Blind Application Evaluation Process. DoD should implement this pilot program. It is the single largest SBIR partner agency and awards more money than the next two partner agencies combined (SBIR). As such, DoD represents the highest traffic area within SBIR. Therefore, most of the bugs in a new application portal that would come from scaling up the system and high volumes of traffic will be found by implementing the system at DoD. This program should take place in two stages.

The first stage should be to work with gapjumpers.com or a similar service to implement a hybrid system that requires applicants to submit a standard DoD proposal form and a gapjumpers.com audition. The applications should then be randomly divided into three groups for review. In the first group, reviewers would receive just the gapjumpers.com audition results

and rate them based on the results. In the second group, reviewers would receive identity-blinded copies of the standard DoD applications, rate them, then receive the un-blinded copies of the proposals, and rate them. These ratings would be combined to create a proposal score for program director(s) to use in funding decisions. Finally, the third group would serve as a control and reviewers would receive just the normal DoD proposal form to rate. Reviewers would then be asked to rate their experience as a reviewer.

This structure is fairly expansive. If DoD cannot implement the full extent of the program due to budgetary constraints, it should implement an RCT with either just the gapjumpers.com section or the blinded-revealed approach and a control. If fully implemented, this experiment would serve to examine several factors. First, it would measure the effect of two different types of identity-blind application evaluation processes on the share of awards granted to WS/ED projects. It would also gather data on how reviewers viewed each process, which could be helpful for making future structural decisions if the program became permanent.

Mentoring Program. NSF is the most suited to implement this pilot program. The agency has already funded an RCT studying the effects of mentorship on researchers (National Science Foundation, 2006). Furthermore, NSF works exclusively with basic researchers from universities, where mentorship programs are more established (National Science Foundation, 2018). This means that it is likely that NSF SBIR awardees are more likely to have experience mentoring and can establish the best-case scenario for a SBIR mentorship program. an RCT studying the effects of mentorship on researchers (National Science Foundation, 2006). Furthermore, NSF works exclusively with basic researchers from universities, where mentorship programs are more established (National Science Foundation, 2018). This means that it is likely that NSF SBIR awardees are more likely to have experience mentoring and can establish the best-case scenario for a SBIR mentorship program.

The agency should structure their pilot program to test as many permutations of a mentoring program as possible. NSF should conduct a series of workshops at universities and incubators around the country and compile a sample of potential WS/ED applicants. At the same time, NSF should ask its current class of SBIR Phase 1 awardees for their interest in mentoring WS/ED applicants. If there is room in the budget, this request could be supplemented by monetary compensation if additional incentive is needed to get grant recipients to consent. The sample of potential applicants and the sample of potential mentors should then be randomly sorted into three groups. The first group of mentees and mentors should be paired via a software matching program. The second group of mentees should receive a packet of descriptions regarding the second group of mentors. Mentees would then choose their mentors. The final group of mentees would serve as a control group and not receive mentors.

Similar to the DoD pilot, if NSF does not have the budget to implement the full scope of the intervention, the agency should implement one for the pilot program. At its full extent, this program will assess two phenomena. First, the program should quantify the effect of mentorship

on the share of awards granted to WS/ED applicants. However, it should also determine which pairing system is the most effective at increasing the share of awards granted to WS/ED applicants. This data should be useful for the implementation of a full-scale version of the mentoring program, were it to become permanent.

Phase 0 Program. Since NIH has already started a Phase 0 program, and DoE's funding expired in 2017, it makes sense to leverage the program that is already in progress. As such, under this study structure, the NIH should proceed with the program and report the requested data back to Capital Labs. Since the Phase 0 is unique to federal programs, the NIH program does not have to compare between different potential structures to determine the best way to run a Phase 0 program.

Appendix A

Annual \$25000 for TargetX based on user numbers of less than 2000 application per month

\$25000 implementation Target X.

10 Salesforce Users at an annual payment of \$460 per user.

\$4000 annually for 2000 unique logons/month

Annual Sums

First Year: $\$(25000+25000+4600+4000) = \58600

Each Subsequent Year (forecasted for the next 5 years): $\$(25000+4600+4000) = 33600$

GapJumpers Estimate:

First Year: $\$58600 \times 2 = \$117,200$

Subsequent Year: \$67,200

Discounted at 7% over 5 years: \$ 158,333.27

Total Value: \$246,220.65

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