

Expand Underrepresented Participation in High-Tech Start-Ups

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ASEE

Abstract

When starting small businesses, particularly in high-tech sectors like artificial intelligence (AI), digital twins, or the Internet of Things (IoT), women and underrepresented minority groups face additional hurdles in securing funding and investment. Not only is such a discrepancy in investment socially unjust, but it deprives the US of the advantages in innovation and global competition that could stem from the widening participation of the underrepresented population in innovative sectors. Although targeted support to women and underrepresented minority-owned businesses is being provided by the federal government and the private sector, more remains to be done to close the investment gap.

The US Small Business Administration (SBA, 2013) provides more than \$3.5 billion in funding to over 5,000 startups per year through its Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. Moreover, the Small Business Act provides these programs with a mandate to target women and underrepresented minority groups. Despite this mandate from SBA, only 15% of those funds went to minority-owned companies (SBA, 2013). Funding opportunities from the private sector tell a similar story. Diversity VC, a non-profit partnership promoting diversity in Venture Capital, reported in 2019 that in a comprehensive survey (Azevedo, 2019) of around 10,000 founders receiving venture capital backing, only 9% were women and a mere 1% were Black.

In order to i) accelerate innovation and increase participation of under-represented minorities in start-ups of “new industry”, and ii) to ensure US competitiveness in the global market, in 2010, the National Science Foundation (NSF) introduced the Small Business Postdoctoral Research Diversity Fellowship (SBPRDF) program and selected the American Society of Engineering Education (ASEE) to administer the program.

In recognition of ASEE’s successful performance in meeting the objectives of the SBPRDF program, in 2019 NSF/IIP (Industrial Innovation and Partnerships) program leadership selected ASEE to administer the Innovative Postdoctoral Entrepreneurial Research Fellowship (IPERF) program. The overarching goal of the IPERF program is to emphasize and strengthen the entrepreneurial development of underrepresented fellows. The IPERF program also aims to advance best practices in postdoctoral programs and impart cross-disciplinary expertise in the application of new technologies like AI and IoT in “new industries” based on bioengineering and biochemistry technologies.

Solution on the Horizon

The two programs, past SBPRDF and current IPERF is focusing on selected postdoctoral fellows with high-tech start-up companies, providing the Fellows the opportunity to learn how to collaborate in a multidisciplinary environment and develop an understanding of the expectations and constraints involved in successful entrepreneurship. In return, the fellows applied their AI and IoT expertise and academic knowledge to advance the product realization efforts of the start-ups. Forty percent (40%) of the SBIR host companies decided to hire their fellows as full-time employees. This was largely due to the performance of the Fellows and the commercialization viability of the prototypes developed by the Fellows. Seventy-two percent (72%) of the postdocs noted that the SBPRDF fellowship gave them a competitive edge in the job market, with some further reporting that they gained valuable grant writing skills and business experience. Of all the fellows in the SBPRDF program, forty percent (40%) were women and underrepresented minorities, and forty-three percent (43%) of these participants were offered employment by their host companies, and eighty-four percent (84%) believed that the fellowship experience enhanced their professional qualifications.

ASEE's successful performance in meeting the objectives of the SBPRDF program, contributed to the Innovative Postdoctoral Entrepreneurial Research Fellowship (IPERF) program. The overarching goal of the IPERF program is to emphasize and strengthen the entrepreneurial development of underrepresented fellows. The IPERF program also aims to advance best practices in postdoctoral programs and impart cross-disciplinary expertise in the application of new technologies like AI and IoT in "new industries" based on bioengineering and biochemistry technologies. The IPERF program thus strives to expand the participation of underrepresented scholars in innovative research and technology entrepreneurship in the "new industry." In addition to enhancing the quality of on-the-job training and mentoring provided to the fellow by the host company, ASEE started a new professional development series designed to address the obstacles that have historically limited access to venture capital by underrepresented groups.

Lessons Learned from SBPRDF and IPERF Programs

During 2021 and 2022, ASEE disseminated a range of surveys. These surveys were completed by postdocs from the previously administered SBPRDF fellowship, as well as IPERF fellows who participated in the program. In addition, the ASEE project team created a survey for participating NSF Phase II host companies. The analysis of those two surveys shows potential differences and commonalities in the goals and outcomes of the two programs, and also the opinions of the Fellows and the host companies about these two programs.

Technical Focus of Companies Participating in the Fellowship Programs

The IPERF team is discovering that most high-tech startup companies participating in the two programs represent the cross-disciplinary industry, see results below. The cross-disciplinarity characterizes nearly all companies that are participating in the IPERF fellowship program. Nearly all of the 80 startups in the IPERF program are identified as being cross-disciplinary startups, i.e., working in parallel in the areas of a few disciplines as per Table 1. These companies are already engaged in activities such as predictive learning (PL), machine learning

(ML), computer vision (CV), neural networks, etc. Moreover, nearly all of these companies either were or already are working on nano/micro or small device level solutions. The trend to multidisciplinary collaboration and solutions seems to be in full swing in the new, high-tech entrepreneurial world.

Table 1. Main research/development discipline of SBIR/STTR startups in IPERF grant.

		IoT Connectivity	Use of AI	Digital twins
Bioengineering	6%	80%	20%	0%
Biomedical	20%	18%	12%	24%
Biochemical Eng.	7%	17%	17%	17%
Chemical Eng.	10%	0%	0%	0%
Information Sciences	5%	0%	75%	0%
Food Engineering	2%	0%	0%	0%
Energy	12%	30%	10%	20%
Geosciences	1%	0%	0%	0%
Ind. and Systems Eng.	4%	33%	0%	0%
Life Sciences	1%	0%	0%	0%
Materials Sciences and Eng.	2%	0%	50%	0%
Mechatronics	10%	25%	25%	0%
Physics and Astronomy	1%	0%	0%	0%
Psychology	4%	0%	33%	0%
Social Sciences	2%	0%	0%	0%
STEM Education and Learning	11%	0%	22%	0%
Additive Manufacturing	1%	0%	0%	0%
	100%			

Number of Fellowships Awarded

The IPERF team awarded fellowships to so far seventy (70) individuals. The original awards were for one-year assignments. Some fellows received an extension with an additional award for year two. To date, the IPERF program received 980 applications, of which 188 were approved by ASEE for placement by NSF Phase II companies.

Ethnic and Racial Distribution of Participating Fellows

As per National Center for Science and Engineering Statistics (NCSES)/NSF, 2019) definition “Underrepresentation and overrepresentation of women and racial or ethnic groups vary by field of study and occupation. Women and underrepresented minorities constituted a substantial portion of the U.S. population ages 18–64 years old in 2017. Women were 51.5% of the

population; Hispanics or Latinos, 14%; blacks or African Americans, 12%; Asians, 5%; and other racial and ethnic groups combined, 2%.”

Table 2 below provides comparative data on participation by various under-represented categories of the population in SBPRDF and IPERF programs. The table also includes the population of the under-represented groups in the U.S. In Table 2, Underrepresented Minority (URMs) are identified as African Americans, Hispanics, American Indians, Alaska Natives, and Pacific Islanders. The columns, URM(M+W) column is the sum of non-URM women and URM men and women in the program, W represents the total of all female participants in the program as of July 2022. Columns URM(W) represents the number of URM women in the program, and URM(M) denotes the number of URM males in the program.

Table 2. Racial distribution in the grants vs. average population in the U.S. (NCSES/NSF, 2019).

	URM(M+W)	W	URM	URM(W)	URM(M)
U.S. population average	67%	52%	33%	17%	16%
SBPRDF	56%	37%	27%	5%	21%
IPERF	75%	56%	31%	12%	17%

The above table illustrates an increase in the total percentage of underrepresented minorities (URM) and women who participated in the IPERF program, to date. The awards are defined as one-year fellowship inclusive of a few fellows who served two (2) years or received an extension/renewal for the second year.

Program Impact Survey Results

Interdisciplinary experience gained during the postdoc assignment was a major factor in influencing a postdoc’s decision to either seek an industry/entrepreneurship path vs. return to the academic environment. Even though all the postdoc assignments are not completed yet, the initial survey results already show their inclination to stay within the high-tech industry. As of June 2022, forty (40) fellows have finished the program, thirty (30) are currently active and will finish by September 2023, and eight (8) fellows are defined as attrition cases. These attrition cases are the fellows who prematurely left the program within one to five months of the start of the fellowship. These attritions are due to several factors, such as attractive job offers, the startup company deciding to cease operations, or in a few cases, the company’s dissatisfaction with the performance of the fellows.

Rather than seek a job within academia or some other fellowship program, the entrepreneurial interest of fifty percent (50%) and interdisciplinary research topics of thirty percent (30%) were two major factors driving the postdocs’ decision to join the IPERF program. Financial

considerations made up nine percent (9%) and curiosity about a particular company made up the remaining five percent (5%). Eighty-five percent (85%) of fellows claimed to have received enough training by the host company to perform their jobs, and ninety-four (94%) claimed webinars delivered by ASEE were of high value to them. Eighty-eight percent (88%) stated their work environment was adequate to complete their research or developmental work.

The post-fellowship life of the fellows is of great interest to the IPERF team. In the survey, fifty-five percent (55%) of the survey respondents listed “Other” as the primary reason to leave the program; the project team intends to dig deeper into understanding this. Twenty-eight percent (28%) claimed completion of the program as specified by the host company, and as finding a new job, ten percent (10%) were listed as reasons for leaving the program.

Over forty-one percent (41%) of fellows stated that they intended to stay at the company, which is similar in scope to the former SBPRDF grant (Fig. 1), thirty-seven percent (37%) of IPERF fellows will stay within the same industry and five percent (5%), will go back to academia or create their own startup. Also, seventy-seven percent (77%) stated that they will return to the host company in the future if positions or funding became available. Ninety-one percent (91%) stated that IPERF was a great opportunity to receive extensive experience in learning about the industry and the high-tech startup environment; about nine percent (9%) disagreed with that statement. Ninety percent (90%) of the IPERF fellows stated that the program provided them with a great opportunity to join the modern industry, whereas only seventy-two (72%) percent of the SBPRDF fellows reported satisfaction with their fellowship program. This success can be attributed partially to a variety of cross-disciplinary professional development webinars with various experts. IPERF Fellows stated these training opportunities were extremely advantageous to them.

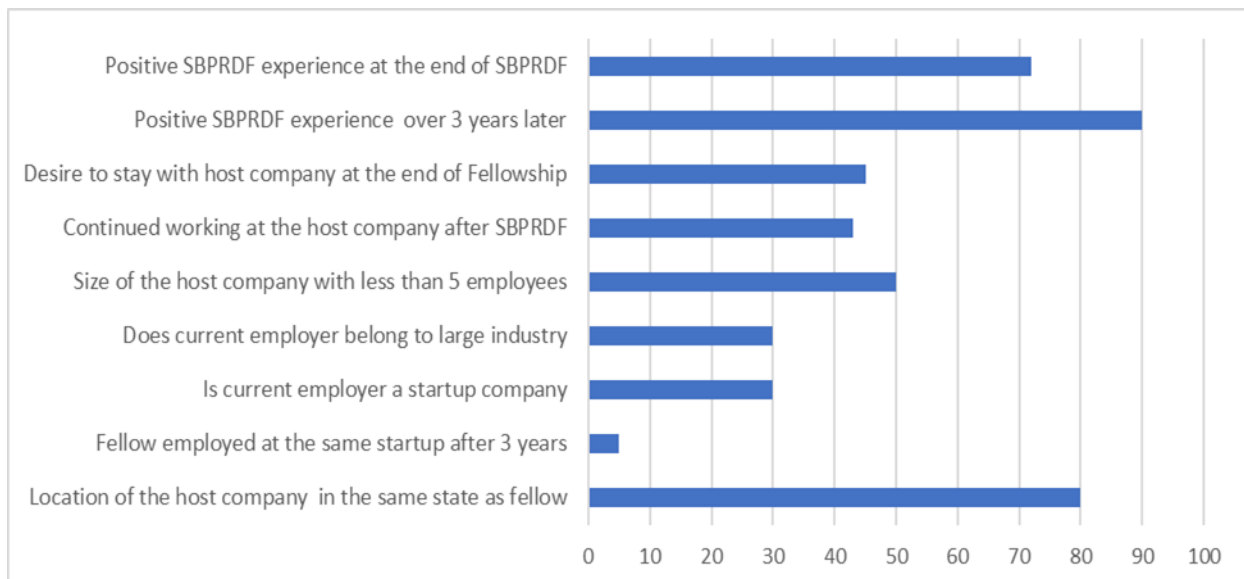


Fig. 1. SBPRDF longevity survey, three (3) years after the SBPRDF fellowship and direct exit surveys of SBPRDF fellows, (Ivanitzki, Johnson, 2022).

Professional Development Opportunities for the Fellows

As part of the program's professional development offerings, each fellow was able to access up to fifteen hours of one-on-one consultation with experts in venture capitalism and seed funding. Topics of these consultations included mentoring and commercialization aspects, interdisciplinary collaboration, transitioning from academia to a start-up, time management/prioritization, and how to manage work-life balance, during a pandemic.

As a condition of participating in the program, the IPERF host companies have to assign a mentor from their companies to closely monitor fellow's progress during their postdoctoral appointment. Additionally, every six months, the mentor delivers a report summarizing the interaction with the fellow. The progress report usually entails, assessing the research project, a list of joint publications, and areas for possible future collaboration with the fellow. ASEE has been evaluating these reports and giving informal feedback to the fellows, especially if they are seeking a second-year award extension.

Through the IPERF grant program, ASEE is committed to providing professional experiences for African Americans, Hispanic Americans, American Indians, and Hawaiian/Pacific Islanders in innovative start-ups and more industry-oriented research to encourage their own entrepreneurship. However, for the U.S. to maintain its global competitiveness in the innovative and high-tech industry, the need for continued support to prepare and engage the underrepresented population must remain a national priority.

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Biographies

TEDDY IVANITZKI is one of ASEE's directors within the Fellowships and Research Opportunities Department. He has more than 25 years of experience in managing the commercialization of technologies within IT industries and as the CTO/CEO of multiple high-tech startups in Europe and the United States. Prior to joining ASEE, Dr.

Ivanitzki was managing director of the Ethiopian Institute of Technology in Mekelle, Ethiopia; previously, he served as dean of the College of Engineering and IT at DeVry University in Houston, Texas.

RASHIDA JOHNSON has more than twelve years of experience managing government grants and contracts awarded to the American Society for Engineering Education. Ms. Johnson has expertise in contract administration, budget tracking and management, proposal development, financial reporting, the monitoring and evaluation of project goals, and the general administration of the grant life cycle. Ms. Johnson has also been integral to developing outreach strategies for attracting the highest and most uniquely qualified postdoctoral talent. Ms. Johnson holds a master's degree in public policy from Georgetown University and Bachelor of Arts degree in government and international relations from Smith College.

ASHOK AGRAWAL recently retired from managing director for professional services and director of external affairs and outreach at the American Society for Engineering Education. At ASEE, Agrawal supervised NSF-funded Graduate Research Fellowship Program, Small Business Postdoctoral Research Diversity Fellowship, and Innovative Postdoctoral Entrepreneurial Research Fellowship programs. He has served as a program officer at the Division of Undergraduate Education at the National Science Foundation and continues to assist NSF on special projects. Agrawal has also served on the National Academy of Engineering Committee to Advance Engineering Studies at Tribal Colleges, the NAE Committee on Community Colleges Role in Engineering and Education, and the National Research Council Board on Engineering Education. Dr. Agrawal has also served on NSF's Committee on Equal Opportunities in Science and Engineering.

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