

DAY ONE PROJECT

Building Thriving Local Economies by
Leveraging the Maker Movement to
Close the Skills Gap

Megan Brewster
Stephanie Santoso

January 2021

The Day One Project offers a platform for ideas that represent a broad range of perspectives across S&T disciplines. The views and opinions expressed in this proposal are those of the author(s) and do not reflect the views and opinions of the Day One Project or its S&T Leadership Council.

Summary

The Federal Government should further invest in, support and scale four existing approaches to building local skills and vibrant, self-sufficient local economies by coupling localities' needs with workforce development and small-scale manufacturing. This is achieved by scaling local programs and initiatives which harness the Maker Movement, a community-driven, grassroots effort to enable people to design, prototype and manufacture projects, solutions and products.

Specifically, the Federal Government should:

- Leverage makerspaces and Fab Labs as local sites for preparing the current and future workforce through real-world maker-centered learning and Employer Validated Training Programs.
- Build the "MakerNet" to connect employers with skilled talent.
- Cultivate makerspaces as engines for small businesses.
- Launch FabCity America to challenge cities to make what they consume.

By harnessing early successes from across the country, these policy solutions can rapidly stand up localized programs to immediately support more American communities grappling with skills shortages. This need is exponentially more critical in the face of COVID-19, as 80% of U.S. manufacturers have articulated that their business will be financially affected by the pandemic and 53% require a change of operations, including the increased use of automation technologies.

Challenge and Opportunity

A massive skills shortage is eroding our nation's manufacturing capabilities, cutting into our economic prosperity and competitiveness now and into the future. Before the COVID-19 pandemic, the United States' manufacturing sector had a record high of 522,000 unfilled jobs, with an estimated 2.4 million jobs potentially going unfilled between now and 2028 due to a projected skills gap. This equates to more than \$2.5 trillion in manufacturing GDP at risk over the next decade. Global manufacturing executives rank skilled talent as the top driver of manufacturing competitiveness. While some of the nation's largest employers have committed to retraining and upskilling their employees, the majority of working Americans are still without easy access to similar opportunities. Furthermore, employees of small- and medium-sized businesses are particularly vulnerable, as their employers struggle to design and implement retraining and upskilling programs.

The COVID-19 pandemic has resulted in both a health and economic crisis in countries around the world. In the U.S., unemployment rose from 3.8% in February 2020 to 13% in May 2020, or 20.5 million unemployed people. Necessary shelter-in place and social distancing requirements have made it extremely difficult, and in many cases impossible, for companies and manufacturers

to continue operations at full scale. During the second quarter of 2020, the U.S. experienced a 9.1% drop in GDP, the highest since recording began in 1947.

The need to create widely accessible opportunities for individuals to engage in robust training programs is now more urgent than ever in order to ensure that communities are able to reignite and grow their local economies.

Makerspaces, Fab Labs and programs which leverage similar spaces in communities across the country can uniquely and effectively address the massive skills shortage and declines in small business in three key ways. First, personnel shortages in high-demand industries require digital, technical and vocational training that makerspaces foster. Second, COVID-19 has specifically led to closures of small businesses. In the recovery, offering training in skilled crafts and entrepreneurship can help restore the entrepreneurial footprint in many communities. Third, providing a digital infrastructure and platform which further connects makers and the companies, organizations and institutions that need their skills and experiences will enable us to understand what training and reskilling strategies are effective in order to scale best practices and effective models.

We have the opportunity to couple building local skills with building local products. Makerspaces are already operating in more than 2,000 cities across the U.S., where individuals are learning new skills in training programs sponsored by local employers. In parallel, many communities locally make the products that their population consumes, reducing local trade deficits, reinforcing local innovation loops, and capturing entrepreneurial opportunities. To effectively manage this large-scale workforce transition for millions of Americans, we must simultaneously maintain robust economic growth to support local job creation, scale and re-imagine job retraining and workforce skills development, and improve business and labor-market dynamism.

Plan of Action

To achieve these ambitious objectives, the United States requires a robust strategy with actionable steps involving several key stakeholders. The next Administration should scale four existing and effective solutions that have proven effective at building local skills and vibrant, self-sufficient local economies. To immediately identify the most relevant agencies to host and support each of these four initiatives, the Office of Science and Technology Policy should rekindle the National Science and Technology Council (NSTC) Interagency Working Group for the Maker Movement.¹ This NSTC Maker Working Group should reconnect with key external partners and local leaders for support and feedback, including:

- Nation of Makers
- Advanced Manufacturing & Transportation Apprenticeships of California (AMTAC)

¹ "NSTC Committee on Technology," White House Office of Science and Technology Policy, Obama Administration, accessed September 1, 2020, <https://obamawhitehouse.archives.gov/administration/eop/ostp/nstc/committees/cot>.

DAY ONE PROJECT

- California Community Colleges Maker (CCC Maker)
- Make: Community
- Citizen Schools
- National Association for Community College Entrepreneurship (NACCE)
- Fab Foundation
- Fab City Global Initiative
- National League of Cities (NLC)
- National Governors Association (NGA)

With the support of the Interagency Working Group for the Maker Movement, the Administration should:

1. Leverage makerspaces and Fab Labs as local sites for preparing the current and future workforce through real-world maker-centered learning and Employer Validated Training Programs.

Makerspaces and Fab Labs are ideal facilities for individuals to acquire the technical skills and experiences in greatest demand among local employers, from manufacturers and technology companies to agricultural businesses. There are makerspaces in more than 2,000 cities across the U.S.² And while the type of technologies and equipment available in these spaces vary by location and community, most makerspaces include technologies such as 3D printers, laser cutters, CNC milling machines, welding and woodworking equipment, sewing machines and in some cases scientific equipment such as micropipettors, tabletop centrifuges and autoclaves. Fab Labs are digital fabrication laboratories which provide access to the environment, skills, materials and advanced technology to enable anyone to make (almost) anything.³ Most spaces offer a variety of classes and workshops that are open to the community and space members.

The Administration should support and grow existing programs which create opportunities for individuals to deepen their skillset and experience through maker-centered learning. This includes programs which expand the capacity for communities to create maker-centered learning experiences in K-12 schooling which then continue in post-secondary education. Makerspaces have developed training programs in partnership with local employers and subsidize individual tuition for individuals who wish to learn skills critical to national competitiveness, such as machining, prototyping, and digital fabrication. Below are three approaches that have been proven to be successful locally and could be scaled to more communities with federal support.

- **Leverage community colleges, Historically Black Colleges and Universities (HBCUs), Tribal Colleges and other minority-serving institutions to create sustainable pathways for**

² Scott Andes and Stephanie Santoso, "Why Maker Economies Need Local Support, Cities Speak, June 24, 2019" <https://cityspeak.org/2019/06/24/why-maker-economies-need-local-support/>.

³ "What is a Fab Lab?" Fab Foundation, accessed October 15, 2020, <https://fabfoundation.org/getting-started/#fablabs-full>.

DAY ONE PROJECT

maker-centered learning which lead to successful careers and economic equity. The Maker Fellows program hosted by the national non-profit organization Citizen Schools leverages support from Corporation for National and Community Service, engaging AmeriCorps VISTA members in growing the capacity for communities to provide high-quality, sustainable maker-centered learning for K-12 students, with a focus on underrepresented students of color.⁴ Maker Fellows are hosted by community colleges, HBCUs and makerspaces. Hosted at post-secondary institutions, Maker Fellows play an important role in creating opportunities for students to develop the types of skills and experiences that will prepare them for the jobs of the future in science, technology, engineering, and mathematics (STEM) and other fields. This model focuses on driving post-secondary enrollment to community colleges, HBCUs and other minority-serving institutions and facilitating local innovation and entrepreneurship via maker-centered learning. The Maker Fellows program could be expanded to 70+ communities in 35+ states in the next 3-5 years, with key support from federal agencies. This would include additional VISTA positions through the Corporation for National and Community Service (CNCS) and additional funding from the National Science Foundation (NSF), the Department of Education and the Department of Defense (which currently supports this program), and be focused on understanding the impact of successful models developed by Maker Fellows and scaling these models across various host sites.

- **Expand initiatives which enable individuals to upskill efficiently and receive industry-recognized credentials.** The Santa Fe Community College Fab Lab is working with Fab Lab Hub to provide training and apprenticeships focused on digital fabrication. The Community College is implementing a digital badging system for technical skills required for smart manufacturing based on research conducted by manufacturing expert and Fab Lab Hub founder, Sarah Boisvert.⁵ Fab Lab Hub is currently working with America Makes and the National Additive Manufacturing Innovation Institute as part of a partnership to expand opportunities for careers in the 3D Printing industry. This collaboration is focused on developing digital badges that prepare operators and technicians to use and service Fused Deposition Modeling (FDM) and Stereolithography (SLA) 3D Printers. The \$70,000 in funding for the project was provided by the U.S. Office of the Secretary of Defense through the Air Force Research Laboratory (AFRL). Training to receive the badges range in duration from 4 to 8 weeks, and the average cost is \$250 per person, with lab fees in

⁴ "Makers Fellows," Makers + Mentors Network, accessed October 15, 2020, <https://makersandmentors.org/makerfellows>.

⁵ "SFCC's Innovation Center announces grand opening of Fab Lab Santa Fe on Feb. 12," Santa Fe Community College, January 29, 2018, <https://www.sfcc.edu/press/sfccc-innovation-center-announces-grand-opening-fab-lab-santa-fe-feb-12/>.

the \$50 – \$100 range.⁶ In addition to scaling this program to other communities, other federal agencies such as the Department of Energy, Health and Human Services, and the Department of Agriculture could provide support to seed similar programs that are field-specific and leverage other institutes within the National Network for Manufacturing Innovation. For example, Health and Human Services could support an apprenticeship program focused on upskilling individuals to design and produce PPE domestically for future needs, in collaboration with the Advanced Functional Fabrics of America.

- **Create more opportunities for non-traditional students to work with potential employers and gain real-world work experience.** The Makermatic (CA) program is focused on leveraging makerspaces located across California community colleges as sites where companies can work with teams of students to develop tangible solutions to real-world business problems. California Community Colleges (CCC) Maker developed the Makermatic Team Internship model as a way to streamline the typical internship model of matching one student to one employer. In the CCC Maker Makermatic team internship, 20-25 students work with one employer, and Makermatic is less time consuming than traditional internships. The program has been successfully piloted at 6 of the 23 community college makerspaces that are part of the CCC Maker initiative supported by the California Community College Chancellor's Office. Businesses that participated in the pilot indicated that they found value in the solutions proposed by the students.⁷ For example, Cabrillo College students in Santa Cruz, CA worked with Calfee Design on the challenge of bringing the Calfee Streamliner electric trike vehicle prototype to market. College of Alameda collaborated with Elder Care Alliance, where the participating students developed art and maker projects for seniors. Federal agencies and the National Labs can tap into this previously underleveraged group of individuals who have developed technical skills in digital design, fabrication and prototyping, experience in open-ended and collaborative problem solving.

2. Build the "MakerNet" to connect employers with skilled talent.

The Administration should develop a digital platform that connects makerspaces with manufacturing job vacancies, un- and under-employed people, and specific skills-development available at the makerspace in order to qualify for each vacancy. With such a system, employers could, for example, define a role by the level of skill or experience required across various tools,

⁶ "Fab Lab Hub, LLC Receives America Makes Contract to Create Additive Manufacturing Digital Badge Partnership," America Makes, February 22, 2019, <https://www.americamakes.us/fab-lab-hub-llc-receives-america-makes-contract-to-create-additive-manufacturing-digital-badge-partnership/>.

⁷ "Workbook for Makermatic Team Internships," CCC Maker, May 30, 2019, <https://cccmaker.com/workbook-for-makermatic-team-internships/>.

DAY ONE PROJECT

materials, and types of projects, and instantly be matched to anyone who either already meets those criteria or could do so with some training at their local makerspace.

Platform development should be led by the Department of Commerce, given its deep experience with the manufacturing sector and the maker movement, in close collaboration with the Department of Education, Department of Labor, and the U.S. Digital Service. The platform could leverage two existing platforms: first, MakerNet.work, which is currently fielding a working beta version with approximately 3,500 users as of September 2019; and second, FabLabs.io, which is a partial deployment that lacks the whole-of-nation approach proposed above.

MakerNet remains in its beta phase likely because it requires broad grassroots adoption across a multitude of small organizations, many of which are already struggling financially. Broad platform adoption, along with strategic partnerships within regional and local manufacturing, will be required to generate the critical mass of data needed to realize a network effect (alternatively, existing datasets are available for purchase). Furthermore, data modeling of a generalized skills framework will require a strong data science engineering team.

Employer-validated training programs in local makerspaces will require the development of sustainable long-term partnerships with employers who are invested in co-designing and implementing training programs that meet their needs in the non-traditional setting of a makerspace. Standard metrics and evaluation processes must be developed to measure the effectiveness of these programs. Trade-offs that may lead institutions and organizations not to establish these programs must also be identified; for example, when more importance is placed on the transfer of community college students to 4-year colleges over student job placement rates and these metrics are tied to funding opportunities.

3. Cultivate Makerspaces as engines for small businesses.

Makerspaces can also provide the resources and environment to enable individuals to develop their own small businesses and become local entrepreneurs. This is another way in which these spaces significantly contribute to a city's local economy. Makerspaces can support burgeoning and existing entrepreneurs in numerous ways including access to technologies and resources for early-stage prototyping and small batch manufacturing as well as access to individuals with the skills, experiences and backgrounds needed to help build out startup teams. Through existing programs and new initiatives developed by the Small Business Administration (SBA), the Federal Government should continue to support the entrepreneurial ecosystem being developed within makerspaces as well as between makerspaces and other key institutions such as accelerators and incubators. Due to the COVID-19 pandemic, makerspaces around the country have been operating at reduced capacity and observing social distancing requirements, but have developed creative initiatives to continue to support local entrepreneurs during this time.

Entrepreneurial programs which leverage makerspaces can vary in their initial size and scope and then be scaled based on learnings and best practices. Fostering entrepreneurship and

DAY ONE PROJECT

supporting the development of small businesses around the country has been a priority for the Federal Government since the creation of the SBA in 1953. In the last six years, the SBA has introduced two specific programs which recognize the unique and critical ways that makerspaces are making it possible for entrepreneurs to develop, prototype and in some cases manufacture their products locally and regionally. These programs have been proven to have a significant positive return on investment as measured by metrics such as job creation and additional capital raised. The SBA should continue to offer these programs, increase the amount of funding and in-kind resources and technical support they provide, and develop competitions to support specific underserved groups such as the BIPOC community or female makers.

In 2014, the SBA launched the Accelerator Growth Fund competition “to engage with and support organizations whose sole purpose is to help start-ups grow, become commercially viable and have a real and sustained economic impact.”⁸ The program was launched in 2014 with \$2.5 million in appropriated funds. In 2015, it distributed \$50,000 grants to accelerators, makerspaces and other entrepreneurial ecosystem models, totaling \$4.4 million. Support from the SBA through this program led to 14,158 jobs being created or sustained and \$850.5 million in capital being raised by startups served by these organizations just two years into the Accelerator Growth Fund competition program.

In 2019, the SBA launched the Makerspace Training, Collaboration, and Hiring (MaTCH) Pilot Competition which “seeks to address the job skills and placement gap faced by U.S. businesses by providing funding to create or expand programs within existing makerspaces that offer job-specific and soft skills training.”⁹ The competition awarded up to \$1 million in funding across three categories: seed (\$25,000), proof of principle (\$100,000) and scale (\$200,000). Finally, SBA’s Match Program has \$1 million in funding to support makerspaces focusing on workforce development initiatives.

The following three models demonstrate how makerspaces can be leveraged to foster local entrepreneurship based on the specific needs of communities such as supporting entrepreneurs of color, revitalizing neglected and underutilized areas and providing training and technical assistance to help maker entrepreneurs further develop their businesses and contribute to their local economies.

During the height of the COVID-19 pandemic, Hacker Lab, Sacramento’s 15,000 square foot makerspace and coworking space was forced to close to the public, but played a critical role in the production and distribution of PPE to frontline healthcare and essential workers.¹⁰ Hacker Lab also pivoted to develop online courses to support local maker entrepreneurs and introduced a Small Business Recovery Program focused on providing free one-on-one business mentorship

⁸ “The Growth Accelerator Fund Competition,” Small Business Administration, last updated March 16, 2015, https://www.sba.gov/sites/default/files/growth_accelerator_competition_1Pager.pdf.

⁹ The Makerspace Training, Collaboration, and Hiring (MaTCH) Pilot Competition, Small Business Administration, accessed October 15, 2020, <https://www.sba.gov/match>.

¹⁰ HackerLab. <https://hackerlab.org/en>.

through a partnership with Sac Inclusive Economic Development Collaborative.¹¹ It also developed a no-cost, two-month rapid design training program aimed at enabling individual upskilling during the pandemic, with a focus on marginalized groups and farm workers. Program participants also received \$1,000. This program was funded by the CARES Act and several local sponsors, including Kaiser Permanente and Sutter Health.¹²

Arts organization AS220 in Providence, RI offers artists opportunities to live, work, exhibit and/or perform in its facilities. AS220 was launched by artist Bert Crenca in a one-room rental above the Providence Performing Arts Center in 1985, with a budget of just \$800. Today, the non-profit owns – and enlivens – three mixed-use buildings, totaling over 100,000 square feet, in the heart of Providence’s downtown and represents a \$25 million investment in downtown Providence. This complex includes rotating gallery spaces, a print shop, a darkroom and media arts lab, a fabrication and electronics lab and a youth program focusing on youth under state care and in the juvenile detention facilities. It also features four dozen affordable live/work studios for professional artists and maker entrepreneurs.¹³

BLDG 61 in Boulder, CO is Boulder Public Library’s free makerspace. In 2019, BLDG 61 launched a series of new initiatives with the Boulder Small Business Development Center empowering entrepreneurs to design, prototype and manufacture their physical products. This program was expected to engage a minimum of 12 maker-entrepreneurs over the first year of this collaborative accelerator program. BLDG 61 has already been offering entrepreneurs enrolled in Boulder SBDC courses vouchers which they can use to spend time designing, prototyping and working with BLDG 61 staff members in the makerspace on their product ideas.¹⁴

4. Launch FabCity America to challenge cities to make what they consume.

The Office of Science and Technology Policy, in concert with the NSTC Interagency Working Group for the Maker Movement, should launch FabCity America to challenge American cities to make what they consume by revitalizing manufacturing infrastructure and incentivizing a new economy. Instead of importing products and exporting trash, cities striving to meet this challenge would be encouraged to produce their own consumables and recycle their own waste within the cities’ boundaries. In this way, a city’s imports and exports then become information, knowledge, design, and code.

This moonshot aims to inspire action and leadership, showcase best practices, and create a national network of cities working towards this goal. Commitments for action to support this moonshot may be made by the Federal Government, city governments, and other organizations.

¹¹ “One-On-One Business Mentorship,” Hacker Lab, accessed September 20, 2020, <https://hackerlab.org/en/page/iedc>

¹² “Level Up Your Skills! The Pathways Program” Hacker Lab, accessed October 21, 2020, https://hackerlab.org/en/page/pathways?utm_source=Hacker+Lab&utm_campaign=b5a5dcb37b-NEWSLETTER_10_21_20&utm_medium=email&utm_term=0_f9f50abb60-b5a5dcb37b-134717115&mc_cid=b5a5dcb37b&mc_eid=95c4efc641.

¹³ “About,” AS220, accessed September 1, 2020, <https://as220.org/>.

¹⁴ BLDG 61: Boulder Library Makerspace, accessed October 20, 2020, <https://boulderlibrary.org/bldg61/>.

DAY ONE PROJECT

For example, the Federal Government (specifically, the Departments of Defense and Energy) could establish research and development facilities focused on sustainability at local universities. The Department of Commerce could set up a program or Federal Advisory Council for community manufacturing clusters to share best practices and provide external advice. The SBA could connect the local Small Business Development Center in participating cities to local entrepreneurs.

Local governments and communities can also commit to actions in support of the Fabcity moonshot. For example, city leaders might commit to improving a key metric in their locality's consumption, such as reducing the annual tonnage of waste exported from their city. City leaders can also look to convert dormant lots into small farming spaces for food production and harvesting or subsidize locally made products that are built from a significant fraction of recycled raw materials. Communities might develop and deploy localized systems to distribute energy, water, and waste production and consumption, such as microgrids. Makerspaces might connect regional innovations to real local problems, providing business and education opportunities.

The Fabcity America Moonshot has limited budget implications, as the program sets an ambitious goal for localities to aim for as they build their own making ecosystems. A modest budget of \$1-10M could provide additional incentive, perhaps in the form of a prize competition run by the Department of Commerce or the SBA to develop data systems that capture and analyze data and monitor local progress.¹⁵ Other incentives could include local vouchers, so that cities can conduct the necessary research to establish the baseline for their current status in order to define appropriate local goals, or events that convene leaders to showcase and share best practices across participating cities.

The Fab City Global Initiative is an existing international initiative started by the Institute for Advanced Architecture of Catalonia, MIT's Center for Bits and Atoms, the Barcelona City Council, and the Fab Foundation to develop locally productive and globally connected self-sufficient cities. As of November 2020, the Fab City Global Initiative is comprised of a network of 34 cities and a core collective and is governed by a foundation. Five American cities are current participants: Sacramento, Oakland, Boston, Somerville, and Detroit.

¹⁵ Adie Tomer, Joseph W. Kane, and Robert Puente, "Metro freight series: Global goods trade and metropolitan economies," Brookings, June 16, 2015, <https://www.brookings.edu/research/metro-freight-series-global-goods-trade-and-metropolitan-economies-2/>.

DAY ONE PROJECT

About the Authors



Megan Brewster is a technologist who has worked at the forefront of innovation over the last 15 years across industry, government, and academia. As VP of Advanced Technology, Dr. Brewster is delivering the Internet of Every_Thing with passive RFID technology by bringing clarity and strategy to next-generation capabilities through technology development and partnerships, as well as international standards. Previously, Dr. Brewster served as the Senior Policy Analyst for Advanced Manufacturing at the White House Office of Science and Technology Policy, where she supported the stand-up and sustainable transition of a \$3B national network of R&D hubs and coordinated numerous priority technology areas across 13 Federal agencies. Dr. Brewster earned BS from the University of Washington and PhD from MIT, both in Materials Science and Engineering, with a PhD minor in Technology and Public Policy.



Stephanie Santoso is the Director of Strategic Initiatives for Makers + Mentors Network, an initiative of the national non-profit organization, Citizen Schools. As a Senior Program Fellow at Infosys Foundation USA, she supports the Foundation's maker education portfolio. Stephanie is a founding Board Member of Nation of Makers and received her Ph.D. in Information Science at Cornell University where her dissertation research explored the IP issues related to 3D printing. From 2014-2016, she served as the first Senior Advisor for Making at the White House, where she helped develop President Obama's Nation of Makers initiative to broaden access to the Maker Movement. This included planning the first-ever White House Maker Faire and the National Week of Making.

About the Day One Project



The Day One Project is dedicated to democratizing the policymaking process by working with new and expert voices across the science and technology community, helping to develop actionable policies that can improve the lives of all Americans, and readying them for Day One of the next presidential term. For more about the Day One Project, visit dayoneproject.org.