

How Cities Can Grow

THE MAKER MOVEMENT



ABOUT THIS PUBLICATION

Research for this guide and the original draft of the document were completed by graduate students at the American University Department of Public Administration and Policy. Contributors include Virginia Beckett, Steve Devine, Matthew Henneberger, Katina Kempel and James Parkhurst. These students worked in partnership with Brooks Rainwater and Emily Robbins at the National League of Cities (NLC) to conduct an analysis of the maker movement. The final report was edited by Emily Robbins and Trevor Langan at NLC.

The National League of Cities is the nation's oldest and largest organization devoted to strengthening and promoting cities as centers of opportunity, leadership and governance. NLC is a resource and advocate for more than 1,600 member cities and the 49 state municipal leagues, representing 19,000 cities and towns and more than 218 million Americans. NLC's Center for City Solutions and Applied Research provides research and analysis on key topics and trends important to cities, creative solutions to improve the quality of life in communities, inspiration and ideas for local officials to use in tackling tough issues and opportunities for city leaders to connect with peers, share experiences and learn about innovative approaches in cities.

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FOREWORD



Right now, makers are crafting the next great idea in their homes or one of the many makerspaces growing all around the world. The maker movement is the platform for today's artisans to create, craft and develop new and interesting ideas and products. City leaders are excited by and are supporting the entrepreneurship, increased economic activity, and improved services brought about by small scale manufacturing.

The meteoric growth of micromanufacturers and online platforms like Etsy demonstrates how the maker movement is taking root. One estimate even puts the current number of makerspaces around the world at 2,000. In a recent National League of Cities (NLC) analysis of local economic conditions, we analyzed the growth of the maker movement in cities and found that 26 percent of cities currently have makerspaces and 13 percent have hosted a Maker Faire. These numbers portend the growth and opportunity of this emerging economic space.

The maker movement is centered in cities. And this new, hyperlocal manufacturing environment holds potential not only for individual hobbyists but also for community-wide advances in local entrepreneurship and job creation. Cities have a great opportunity to catalyze this movement as a way to improve our local economies, diversify workforce opportunities, and support the creative economy.

NLC is pleased to share with you *How Cities Can Grow the Maker Movement*, which presents case studies and discusses how the maker movement is being fueled by support from local government. It is our hope that this report will spark conversation and action among city leaders about how to incorporate these strategies into their own communities.

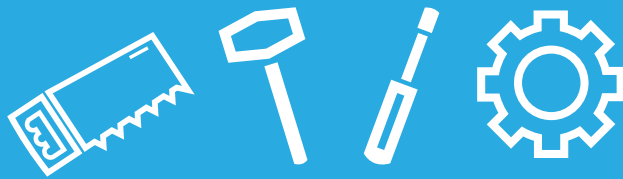
NLC's Center for City Solutions and Applied Research strives to strengthen communities, transform and improve cities, and assist city leaders. We do this by knowing and learning about cities, identifying and sharing promising city practices, fostering effective solutions and innovation, and challenging city leaders to lead.

We wish to thank the cities who participated in this study of the maker movement. Created with our partners at the American University Department of Public Administration and Policy, this guidebook is meant to be a resource for cities as they lead the way forward in this exciting and ever-evolving space.

Brooks Rainwater

Senior Executive and Director,
Center for City Solutions
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EXECUTIVE SUMMARY



This report explores the emergence of the maker movement within a selection of major U.S. cities. The maker movement has developed in a variety of different environments, including makerspaces, hackerspaces, tech workshops and fabrication laboratories.

Data and information fueling this project were derived from interviews with influential points of contact in major cities where the movement is growing. Survey questions focused on four primary sections presented in this report: (1) characteristics, (2) growth, (3) government policies and (4) challenges. Our analysis provides insights into common trends and notable differences examined within the four categories listed above.

The characteristics section focuses on the driving forces behind the movement, the people involved in the movement and the definition of the movement. The section on commercialization aims to establish the scale of involvement in order to determine whether the movement had the potential to increase local U.S. manufacturing. The policy section details the involvement of local governments in implementing program policies that help grow or inhibit the movement. In particular, it was important to determine the policies that were most beneficial to those involved in the movement. Ultimately the goal was to determine how other local governments could implement policies with a proven record of success in their respective cities. City narratives are also provided as individual case studies on the maker movement.



INTRODUCTION

Drawing on the prowess of the robotics engineering programs found at the University of Pittsburgh and Carnegie Mellon, companies like Google and TechShop have set up outposts in Pittsburgh's developing urban core. The city has become one of the most encouraging spots for innovation in the United States, according to Popular Mechanics magazine. The publication even awarded Mayor Bill Peduto the title "Maker Mayor." But what does increased investment in startups, makerspaces and the technology sector mean for cities? In Pittsburgh, revenue from growth translates into protected bike lanes, open spaces, parks and events – projects aimed at making the city a place people want to stay and live active lives. From Rust Belt cities like Pittsburgh to rugged outdoors towns like Burlington, Vermont, the maker movement has shown to have the potential to unlock growth, engage citizens and transform city landscapes.

Perhaps the greatest potential for change comes from the way the maker movement may alter urban landscapes, in terms of both community and spatial relationships. Economic and productive activity obviously plays a large role in urban development. With the growth of the maker movement, which views the consumer as producer, the biggest shift may come in the form of co-location of manufacturing, engineering and design. The movement has the ability to draw production back into the cities where consumption occurs. This can have profound economic and social benefits. In addition to added jobs, proximity means more innovative potential for workers. The untapped skills and knowledge of out-of-work producers become part of the creative economy of the city.

WHAT IS THE MAKER MOVEMENT?

In the 1990s and early 2000s, the United States' technology and manufacturing industries experienced a significant transition. With the advent of the Internet, computers began shrinking in size and price, while global connections grew exponentially and economies became inextricably linked. During this time, the U.S. began outsourcing much of its technological needs. However, the introduction of new technologies, such as the rise of additive manufacturing (commonly known as 3D printing), and non-commercial droids spurred an interest in Do-It-Yourself (DIY) and Do-It-With-Others (DIWO) hobbies.

Faster prototyping and the availability of fabrication tools as well as easier sourcing of parts and direct distribution of physical products online further contributed to the desire to grow community workspaces. In this sense, the maker movement gained momentum from the "increasing participation of all kinds of people in interconnected communities, defined by interests and skills online as well as hyper-local efforts to convene those who share common goals."¹ The increased predominance of makerspaces offers individuals a compelling social experience that is built around interpersonal relationships and, "a chance to participate in communities of makers of all ages by sharing your work and expertise."²

According to Atmel Corporation, the leading manufacturer of microcontrollers and touch technology semiconductors and a major backer of the maker movement, there are an estimated 135 million U.S. adults who are makers. In 2013, Wired magazine reported that the overall market for 3D printing products and similar maker services reached \$2.2 billion in 2012, a compounded annual growth rate of almost 29 percent when compared to the \$1.7 billion the industry recorded in 2011. Projections are expected to reach \$6 billion by 2017 and reach \$8.4 billion by 2020.

Each region of the U.S. and each local community has a slightly varied understanding of what the actual maker movement is, and its definition is often affected by the unique economic environment of each locality. In many cities like Detroit, Pittsburgh and Philadelphia, the maker movement has emerged organically as former manufacturing cities look to diversify by incorporating innovative new technologies into their existing factories. The transition away from generic, mass-produced, made-in-China merchandise and back to local industry seems to encourage entrepreneurs who are looking to share their ideas and innovations with other like-minded people, and build broad-based support for the maker movement.

A person with long, curly hair is working on a project in a workshop. They are wearing a dark long-sleeved shirt and a black wristband. They are holding a small electronic component in their hands. The workshop is filled with various electronic components, tools, and equipment. There is a laptop on the right, a power supply unit in the foreground, and a small robot or device on the left. The background is filled with more equipment and tools. The entire image has a blue tint.

**THERE ARE AN ESTIMATED
135 MILLION U.S. ADULTS
WHO ARE MAKERS.**

THE MAKER MOVEMENT

A TIMELINE OF KEY EVENTS



APR 1998

Etsy launches, providing an online platform for artisans to sell their crafts.

Etsy

JAN 1999

The new DIY Network airs programming on Do-It-Yourself (DIY) home projects like gardening, quilting, and woodworking.

AUG 2000

The Census reports that, for the first time, more than half of American households have a computer and 42 percent have internet access.

JAN 2005

First issue of MAKE magazine, a publication devoted to DIY projects, hits newsstands.



OCT 2006

The first TechShop opens in Menlo Park, California.

APR 2009

MakerBot, one of the first desktop 3D printers, is available for sale.

APR 2009

Kickstarter is formed and entrepreneurs begin to raise capital via crowdfunding.

FEB 2009

Square, Inc., launches, providing crafters and artisans a vehicle to collect credit card payments directly from customers.



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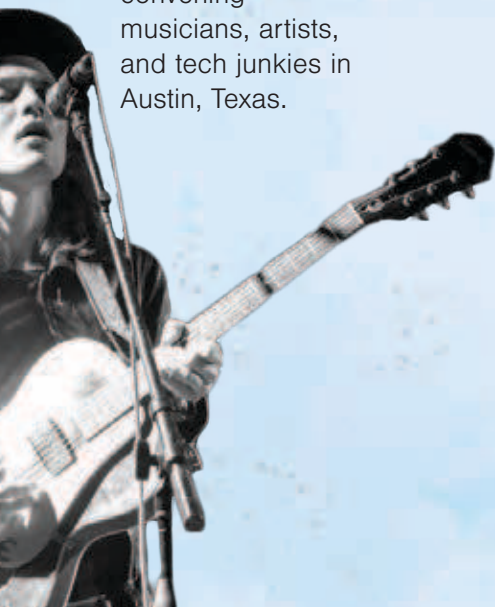
APR 2006

The Bay Area hosts the first Maker Faire, a public annual event celebrating the arts, crafts, engineering, science projects and the DIY community.



MAR 2011

South-by-Southwest (SXSW) celebrates the 25th year of convening musicians, artists, and tech junkies in Austin, Texas.



SEP 2012

The New York Times reports that the “Made in America” label is regaining popularity, with more consumers buying domestic, local goods they feel represent “old-school craftsmanship, even luxury.”

MADE IN USA

MAY 2013

President Obama announces the National Network for Manufacturing Innovation (NNMI), a collaboration between manufacturers and academia to problem-solve and help advance the manufacturing industry.



MAY 2014

White House launches Mayors Maker Challenge to encourage support of Makers at the local level, and hosts the first-ever White House Maker Faire.

CHARACTERISTICS OF THE MAKER MOVEMENT

Given its diverse nature, the maker movement has been difficult to define in a way that is representative of the movement as a whole. A wide variety of people are involved in the maker movement nationwide, embodying a convergence of interests. In this sense, the term “maker” acts as an umbrella term for a range of personalities, from hobbyists and tinkerers to independent inventors and designers.

The most commonly observed theme is the distinction between non-technical hobbyists versus entrepreneurial makers. Hobbyists are those individuals that are interested in the maker movement only for personal enjoyment, whereas technical entrepreneurs seek to prototype products that can be brought to market for commercial production. In many cities, there appeared to be little overlap between these two groups either in membership to certain makerspaces or activity. Overall, the technical entrepreneurs tend to attract more public support due to their more visible potential to boost local economic growth. On the contrary, hobbyists are often left to grow organically without policy intervention. In the future, more hobbyists might seek to become entrepreneurs building the next brilliant idea, as success stories continue to promulgate the media and technological barriers to commercial entry are weakened.

Perhaps the best way to understand the concept of the maker movement is through anecdotes about individuals who are giving momentum to

the movement. Mark Hatch, CEO of TechShop, relies on personal stories to describe the movement. TechShop considers itself “a playground for creativity,” offering access to over \$1 million worth of professional equipment and software while providing comprehensive instruction through expert staff. TechShop members have access to a wide range of tools, including laser cutters, plastics and electronics labs, a machine shop, a wood shop, a metal working shop, a textiles department, welding stations and a waterjet cutter.

Makerspaces are also increasingly being seen as a hotbed for entrepreneurship. Unlike many of the craft makers, the technical entrepreneurs on the other end of the spectrum are interested in moving beyond DIY or DIWO tinkering and into small-scale industrial production. For example, the company that manufactures Square, the mobile credit card reader, created its prototype at TechShop. In addition, a TechShop team recently designed the most efficient data-cooling system to date, which was subsequently bought out and licensed by Emerson Electronics.

The maker movement can also be subcategorized into different areas based on the different types of products being manufactured. Our interviews revealed a clear divide between the artisans, hobbyist tinkerers and serious techies. For example, websites like Etsy offer over one million artisan sellers the opportunity to sell handmade creations. Other workshops appeal more to technological mindsets interested in computer coding, programming or



FORWARD-LOOKING CITIES MIGHT SEEK TO INCORPORATE THE MAKER MOVEMENT INTO THEIR LONG-TERM MUNICIPAL PLANS.

building mobile applications. The maker movement continues to gain momentum as larger corporations become more involved. For example, in Louisville, Kentucky, General Electric (G.E.) has participated in building “G.E. Garages,” where “makers can come and learn modern ways of prototyping and manufacturing new products using devices like laser cutters and 3D printers.”³ Increased support from major companies such as G.E. offers an opportunity for entrepreneurs to showcase their ideas in developing new, more efficient technologies to be mass-produced.

The use of 3D printers and robotics has been becoming increasingly popular as a result of the maker movement. 3D printers and the materials required to make use of them are cost-prohibitive, and most of the general public lacks access to such machines. The creation of experimental makerspaces, hackerspaces, tech shops, and fabrication laboratories provides a physical space for like-minded explorers to share ideas and equipment. Such spaces offer “the potential of giving anyone the tools they need to become makers and move

them from passive users to active creators.”⁴ In a sense, these spaces have become social clubs that charge a monthly membership fee similar to a gym. Members pay for access to utilize the area as well as the tools and equipment within. The emergence of makerspaces is effectively lowering the cost of entry for entrepreneurs. Whereas until recently an entrepreneur may have had to spend upwards of \$100,000 to produce a prototype for a new product, the operating terrain has changed, and that cost can now range from as little as \$2,000 to \$4,000. In short, the cost of developing prototypes has quickly become much more affordable for would-be entrepreneurs.

Accordingly, some indicators suggest the maker movement could potentially impact the traditional supply-chain manufacturing paradigm. Forward-looking cities might seek to incorporate the maker movement into their long-term municipal plans, recognizing that the local economy could benefit from the creative and freethinking approach that is often limited in large-scale manufacturing.

HOW ARE CITIES SUPPORTING THE MAKER MOVEMENT?

During the early stages of the maker movement, participants required very little public support. Makerspaces organically emerged as people with similar interests and hobbies sought a place to experiment, tinker and learn. However, in recent years, this mindset has begun to shift, and the considerable growth in the movement has caught the attention of local policymakers, especially those looking to create new jobs that were lost in the recent recession. As internal operations grow and expand outwards, makers are increasingly interacting with local government officials to determine how best to support the movement. To encourage flexible innovation, policies should focus on the long-term sustainability of this emerging industry.

Public-Private Partnerships. A number of cities and municipalities have sought to strengthen the movement through collaborative public-private partnerships (PPPs). Liberal arts colleges and engineering or technology universities in cities where the movement is growing have become leaders in providing financial support for the movement. For example, colleges in Madison, Wisconsin, Burlington, Vermont, and Boulder, Colorado, have provided funding grants or physical space to set-up makerspaces. In an effort to involve more women in the maker movement, a number of universities across the country have partnered with makerspaces to promote technical learning, engineering and mathematics for women. Vocational schooling through public universities offers the unique opportunity to bridge the gap between traditional learning and innovative thinking.

Makerspaces/Incubators/Accelerators.

There is also an increasing prevalence of co-working spaces, incubators and accelerators, both nonprofit and for-profit, to support the entrepreneurial spirit of the movement. Incubator and accelerator models appear to be working successfully in a number of cities, providing valuable technical, marketing and administrative assistance to budding business ventures. In this same vein, active support for networking amongst makers, businesses and the venture capital community is extremely common in most cities we observed. Networking opportunities take many different forms, including online groups, shared workspaces, public seminars and educational events. Interestingly, in many cities these networks serve as feedback loops for businesses to identify product needs and local skillsets, which helps inform the coordinated actions of policymakers.

Maker Faires. A number of cities nationwide host Maker Faires to encourage youth involvement and education in an approachable manner. Such policies and collaborative partnerships prove to be vital building blocks in cities where more dynamic movements are currently underway.

Linkages to Local Manufacturing Growth.

A number of cities are pursuing efforts to link the maker movement directly to local manufacturing growth. For example, local governments could donate unused public buildings for new workspaces or offer low-interest loans or rent-ceiling guarantees for maker startups. Additional policies could involve rezoning areas for industrial use or amending existing

city ordinances to reduce bureaucratic red tape. Local governments could accordingly allow heavy machinery in traditionally non-commercial zones.

Taking the White House's Maker Challenge.

The Mayors Maker Challenge initiative launched by the White House last year requires signatories to hold Maker Faires and commit to engaging in public-private roundtable discussions in an effort to grow each city's respective movement. The challenge underscores larger federal policy initiatives such as the recent establishment of the National Network for Manufacturing Innovation. With such strong momentum and policy support, it appears many levels of government believe the maker movement is an important factor in the revitalization of U.S. manufacturing.

Innovation Districts. For many cities, these policies are part of a larger economic revitalization plan. Strategically grouping makerspaces and entrepreneurial services side-by-side is a potential

option for municipalities hoping to encourage innovative local growth. Many of these projects quickly grow in size and scope as cities try to create "innovation districts." Cities are also pursuing these districts as an attempt to cluster innovation. Innovation districts may require resources from existing institutions, such as a neighboring university or government research facility, to be leveraged towards the overall goal.





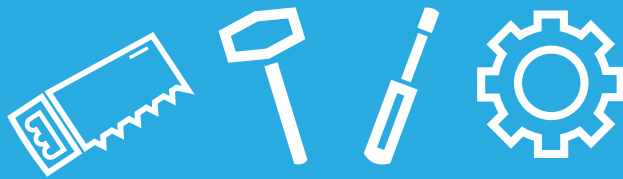
MAK
ER

MOVEMENT



**JUST AS MAKERS FREELY SHARE
IDEAS AND TECHNOLOGY, BUILDING
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CONCLUSION



The maker movement has great potential to alter the very fabric of business and manufacturing in cities across the country. The narratives in this report paint a picture of a selection of the lessons to be learned for those that wish to embrace the maker movement in their own cities. Coordination between the government, the private sector and the community has shown to be effective. Likewise, investment in education and resource sharing will be important to the growth of the maker movement. Finally, as knowledge about this movement is lacking, continued research and development of best practices will be essential. These are the key recommendations to help your city as you move forward:

Share Best Practices. The first recommendation is straightforward: best practices should be shared. Just as makers freely share ideas and technology, building off each other's developments to benefit from recombinant growth, policymakers should share policies that have worked.

Evaluate What Works. Stemming naturally from this first recommendation is a second: policymakers and researchers should invest more in evaluations of what works to develop a body of evidence supporting best practices. These evaluations can take many forms, including surveys, case studies or statistical analyses. In order to properly study the maker movement, it will be helpful to more clearly define it and categorize its many different aspects, ideally using a widely accepted and standardized taxonomy. While the amorphous maker movement certainly defies easy categorization, standardizing the concepts and language surrounding the maker movement would reduce the coordination costs required to share policy information.

Measure the Maker Movement's Development. Another important step for policymakers is to identify and measure the maker movement's development in their cities. While no single measurement is likely able to accurately capture the various components and incarnations of the maker movement in any given city, potentially useful and easy-to-gather measurements include the number of local online maker groups/events and their participants, the number and throughput of local technology incubators or accelerators, the number and size of venture capital firms, and the stock and flow of technology startups, as well as data from surveys of individuals involved in the maker movement, business people and educators.

Publish Market Analyses. Policymakers can also publish market analyses, which serve as a public good for entrepreneurial makers and businesses. Knowing on which sectors of the maker movement local businesses tend to focus can in turn help entrepreneurs focus their efforts. Identifying regional economic clusters can also help policymakers target their support to the most beneficial sectors, since developing and marketing local clusters has positive externalities through knowledge spillovers, shared access to specialized inputs and improved labor matching in thicker markets. Additionally, policymakers can support networking among entrepreneurial makers, businesses, venture capitalists and educators by convening events to facilitate information spillovers.

Financially Support Educational Opportunities in Science, Math and Technology. Policymakers should also actively pursue state and federal financial support for education in science, math and technology. Since investments in human capital are positive externalities – particularly because highly educated students often go on to relocate to other cities – local, state and federal governments are better able to internalize the externalities and thus have the incentives to invest optimally. Streamlining regulatory and administrative burdens can also significantly reduce the barriers to commercial entry for entrepreneurial makers looking to form a startup business.

ALBUQUERQUE, NM

Albuquerque's maker movement was quite small when it began to receive substantial support from local government, which has provided the impetus for strong public and private involvement. The growth in Albuquerque's movement can be linked to the opening of Quelab in 2010. Quelab is Albuquerque's first nonprofit maker- and hacker-space, offering local members 24-hour access to facilities for a small monthly fee. Quelab maintains a creative presence by sponsoring booths at the Albuquerque Mini Maker Faire and hosting regular open-house events to the public.

In addition, "Innovate ABQ" is a collaborative city initiative between the University of New Mexico (UNM), the Science & Technology Corporation (STC) at UNM, city and county government, and the business community. Innovate ABQ is an integrated community plan that seeks to put, "research and commercial labs, science and technology companies, educational programs, business services, support services, and commercial and retail businesses [into a] share[d] space and a business incubator in a way that allows people to work together as they wish and be an essential part of the community that is connected to UNM."⁵ The plan hopes that local investment and public-private partnerships with the UNM will promote a cluster of innovation in the heart of Albuquerque.

AUSTIN, TX

There is a city-wide sense of pride in Austin for local small businesses, and as the live music capital of the world, Austin has always attracted creative and artistic individuals. This creative presence has led Austin to become one of the most innovative cities in America, with 2,900 new patents issued — the second-most per-capita of any metro area in the U.S. Austin's culture of innovation may be boosted by well-known tech credentials like the South by Southwest web startup and music festival held annually in March, the nearby headquarters of Dell, IBM's Austin research lab and the University of Texas's Cockrell School of Engineering. Austin's growth into a tech city combined with its artistic roots creates a strong base for a maker movement that has been present in the city for years.

The city has seen a growth in makerspaces after the University of Texas opened its own makerspace called Innovation Station. Additionally, the Austin Chamber of Commerce started the Innovate Austin initiative, which supports the maker movement and provides opportunities for community individuals to get involved with the movement. Innovate Austin is an economic development initiative that is focused on making Austin the premier region to start and grow technology and innovation-based businesses. Beyond makerspaces such as TechShop, the maker movement has seen expansion and growth through the opening of more public makerspaces, education programs that include making, and school-sponsored makerspaces.

BOULDER, CO

The proximity of three national laboratories within Boulder's city boundaries plays an important role in the city's maker movement. The impact of having such a concentration of researchers is hard to measure, but can be clearly seen in the community. The University of Colorado-Boulder, where students have access to the "Idea Forge", has also been an important part of the growing innovation culture in Boulder. Boulder's movement is so much a part of its DNA that it might be difficult for policymakers to even characterize its nature or point to its beginnings. The citizen ownership of the movement is also very high, pushing it further out of the local government's purview.

Understanding the maker movement in Boulder cannot be done without understanding the maker ecosystem in the greater Denver area. Boulder's immediate neighbor to the east is the city of Brighton, where residents now enjoy a public makerspace in their library. Brighton is part of Adams County, which recently increased public funding for all libraries to grow its "Anythink" initiative. The program is designed to promote creativity in the community. If you travel immediately north of Boulder you will arrive in Longmont, a city that recently renovated one of its high schools to include an award-winning innovation center. Longmont is also home to the "Tinkermill," Colorado's largest makerspace, which can be accessed for as little as \$25 a month. Boulder itself offers free maker services for teens in its central library, in a space called "The Foundry."

BURLINGTON, VT

The emergence of the maker movement in Burlington capitalizes on the rugged independence and self-reliance that has historically existed in Vermont culture. In many ways, the growth of the maker movement is an organic extension of Vermont life, which consists of a unique population of artists and creative mindsets. Given the rural nature of Vermont, maker programs are implemented at the municipal level, with local libraries offering maker movement learning experiences. Throughout the summer of 2015, fourteen libraries in the Burlington area are offering maker workshops for K-12 students. The initiative is part of a large collaborative effort between the Vermont Department of Libraries, Vermont makers, University of Vermont College of Engineering and Mathematical Sciences (UVM CEMS), the Vermont Library Association and CMF Innovations. For many Burlington makers, the essential pipeline to expanding the movement is through education for kindergarteners through high school. Children of all ages are encouraged to participate in do-it-yourself-with-others learning experiences that promote "outside the box" thought processes and analysis.

Nearby institutions like the University of Vermont (UVM), Champlain College, Burlington College and Trinity College create a breeding ground for a hands-on college population. In addition to the traditional four-year universities, there are a number of vocational schools, such as Burlington Technical Center and the Woodbury Institute at Champlain College that contribute to the creative environment. These local universities and research institutions are largely responsible for supporting the natural growth of the maker movement in Burlington.

CHATTANOOGA, TN

Chattanooga has been nicknamed the “gig city” by city officials, analysts and tech professionals because it has the fastest and least expensive broadband speeds in the U.S. The fiber optic network that resulted after an update to the city’s power system four years ago is referred to as “the gig.” This publicly owned system has attracted capital, talent and industry to the community that never would have been present otherwise. Chattanooga has welcomed a new population of computer programmers, entrepreneurs, investors and techies that is not commonly found in eastern Tennessee.

In 2012, The Chattanooga Public Library transformed a floor of the previously rundown library into a makerspace, and the space not only revamped the library but also largely contributed to the spread of the maker movement. Prior to the library space opening, ChattLab was the only makerspace in the city and was used mostly by tinkerers. There are now six public makerspaces in the city. Chattanooga also held their first Maker Faire in 2013, and the interest and popularity by both participants and attendees made the Maker Faire an instant annual event.

EUGENE, OR

The city of Eugene has experienced a wide diversity of maker movement activity. In broad terms, there are two types of makers in Eugene: the hobbyists and the entrepreneurs. The two groups are not mutually exclusive, but at the present time there seems to be relatively little overlap, interaction or transition between the two groups. The hobbyists tend to be highly-educated engineers, about 30-50 years old on average, who are joining the maker movement purely for fun and are not interested in commercialization; some are even actively opposed to efforts toward commercialization. The entrepreneurs, on the other hand, tend to be younger than the hobbyists. They are about 20-40 years old on average, and are highly educated engineers and programmers who are deliberately seeking to create products to sell commercially.

The Eugene Office of Business and Economic Development plays an active role in helping foster the movement by coordinating among entrepreneurs, incubators, schools, businesses and the state government. Most notably, in 2014, the city sold an unused building for \$1, which will be renovated and converted into a co-working space, an incubator and a fabrication workshop. Eugene also provides targeted loans to support the maker movement, like their subsidized low-interest loan to Fertilabs, a nonprofit business incubator. Another major role for the city’s Office of Business and Economic Development is to coordinate information and activities with regional economic development partners, like the Chamber of Commerce, Oregon’s Economic Development Districts and the state government. In 2014, the city published the Manufacturing Cluster Report in collaboration with the Lane Council of Governments, which outlined the key manufacturing growth areas in Eugene to help businesses plan and invest smarter. Additionally, the city coordinated efforts to be part of the Pacific Northwest Manufacturing Partnership, which submitted an application to the national Investing in Manufacturing Communities Partnership (IMCP) program run by the Department of Commerce’s Economic Development Administration. If accepted, this IMCP application will allow the region to receive special preference in applying for federal grants from multiple agencies targeting innovative manufacturing projects and regional clusters.

LOUISVILLE, KY

Louisville has a strong manufacturing history. GE Appliances as well as Toyota and Ford manufacturing plants are present in the city, and there exists a whole ecosystem of small businesses that feed the overall supply chain economy. The traditional supply chain design is being threatened by an increase in additive manufacturing and the use of 3D printers. The need to buy products from large-scale production companies is becoming increasingly unnecessary. Localized economies of one allow individuals to create whatever they need for themselves, changing the dynamic of the competitive nature of the manufacturing industry. At this time, the movement is just beginning and has not really impacted these companies – but it is a paradigm shift to which these companies should pay attention.

Created in 2010, LVL1 was one of the first official makerspaces in Louisville. This nonprofit organization started with only six members and now has upwards of 80 paying members, along with a community of about 100 engineers who are either members of the club or known to frequent the space. The space that LVL1 provides is open to the public as long as a member accompanies them. Greg Fischer, the mayor of Louisville, is a paying member at LVL1, and his office shows strong support for the growing community of makers.

Businesses in the Louisville area have also been extremely welcoming to the maker movement. GE Appliances created what they call a “hackerspace” referred to as FirstBuild. It was inspired by LVL1 and launched with help from some of the biggest names in the maker movement, including Local Motors, makerBot and TechShop. FirstBuild is designed to bridge the gap between the hacker/maker movement and the mass market. As ideas and concepts are developed in the hackerspace, creators can team up with GE designers to build prototypes. FirstBuild then helps to facilitate a limited production run. Depending on the success of the product, GE then chooses whether or not to move it into mass production.

MADISON, WI

Madison is home to a well-rounded maker movement. The nonprofit makerspace Sector 67 and the complementary Bodgery are the heart of the movement. Meanwhile, the University of Wisconsin-Madison feeds creativity into the community and contributes a research testing facility of its own. The fabrication lab, or Fab Lab, is housed in the University's Institute for Discovery and has historically been a biotech testing facility.

The city is not idly standing by while this rapid expansion of innovation is underway. Efforts to grow the movement, or at least provide the tools for commercial growth, are also underway. The city recently announced a plan for its Starting Block facility. This new facility will move the Sector 67 makerspace into a larger home while also pairing it with important entrepreneurial and incubation services. The collaborative effort is based on a multitude of public and private partnerships. The city government is committing at least \$1.5 million to the project. While this contribution is generous, officials are careful to explain that this is a citizen-led initiative; the city government is simply responding by providing the tools needed to complete the job. The Starting Block facility will be located a few blocks from the Capital in an old industrial lot.

PHILADELPHIA, PA

The emergence of the maker movement in Philadelphia presents an anomaly. On one hand, the movement has emerged organically, driven by a few citizens in the same way as movements in other cities have begun. However, unlike many smaller cities, Philadelphia is unique insofar as it has the robust urban manufacturing core of a large city.

Philadelphia's diverse neighborhoods offer a hotbed for emerging artisans and craftsmen. Nearby institutions such as the Moore College of Art and Design, the Art Institute of Philadelphia, and the University of Pennsylvania encourage a vibrant college population. Many of these art and design schools offer programs specializing in different aspects of Do-It-Yourself (DIY) techniques. In this respect, many of the universities are pumping out prime candidates to join the maker movement.

To facilitate the growth of Philadelphia's industrial sector and address barriers that inhibit growth, the Mayor's Manufacturing Task Force was created in 2013 with the goal of providing the city with an industry-led roadmap to increasing Philadelphia's competitiveness. The result is the Manufacturing Growth Strategy for Philadelphia, an actionable document providing recommendations for improving Philadelphia's strategic plan for industrial development. The report's key findings are that the city should address tax barriers for businesses, help increase access to capital and fund research and development.

SAN FRANCISCO, CA

San Francisco, which bills itself as the Innovation Capital of the World, has a thriving maker movement. The first Maker Faire, now a global ambassador of the maker movement, was hosted in San Francisco in 2006, and the city government is dedicated to actively promoting and fostering the maker movement. San Francisco's makers tend to be highly-educated engineers and programmers, about 20-40 years old on average, who are very focused on creating designs and products for commercial sale, though there is also a significant amount of hobbyist maker activity.

The city of San Francisco is very engaged in its maker movement, and has implemented numerous policies to promote and support the Movement's growth. San Francisco's Mayor Ed Lee, a prominent member of the Maker Mayor Challenge, has staff dedicated to the maker movement. In addition to grants and tax incentives, the Mayor's Office of Civic Innovation and the Office of Economic and Workforce Development help coordinate several innovative programs to build the "connective tissue" that feeds San Francisco's maker movement cluster. These programs range from the Mayor's Innovation Roundtable series of events, which convenes entrepreneurs, venture capitalists and others, to the SF Open Law project, which seeks to lower the administrative barriers of entry for new startup businesses. The mayor's office has also created a new Make-to-Manufacture Fellowship, focused on growing the maker movement by gathering and publishing consolidated information on maker organizations, building partnerships with incubators, identifying workforce training needs, compiling and distributing educational resources, and developing networks of business-to-business sub-contractors to facilitate the transition from product design to manufacture.

The nonprofit organization SFMade, which is partly funded by city grants, also supports the city's maker movement policies, with a focus on encouraging local manufacturing and equitable growth among underserved communities. SFMade provides makers and entrepreneurs with information on how to secure financing and manufacture locally. As part of this mission, they conduct educational seminars, host networking events, and provide expert knowledge of local resources. SFMade also helps match underserved employees, such as skilled immigrant craftsmen, with startup employers looking to manufacture locally.

Methodology

The National League of Cities asked the American University Master of Public Policy (M.P.P.) team to provide research and analysis related to the maker movement taking place in many of America's cities in the form of city-by-city case studies. The focus of the team's research and analysis was uncovering similarities in cities with existing maker movements in order to identify trends and formulate recommendations for cities to use when working to cultivate the maker movement and enhance growth within the movement that would lead to economic growth within their jurisdictions.

With the help of NLC, the American University M.P.P. team identified specific cities to use in its study. While some base-line research was completed in order to establish an understanding of the current maker movement, little research exists that analyzes the economic impacts of the movement on cities. Therefore, the bulk of the research was anecdotal in nature, and was obtained through interviews with individuals familiar with the maker movement in each city. These individuals ranged from makers, owners and volunteers of makerspaces, city government officials, nonprofit participants, Maker Faire coordinators and other on-the-ground stakeholders.

With NLC's input, the American University MPP team formulated a survey questionnaire that would be used in the interviews and allowed each group member to obtain answers to the four sections identified as most important: characteristics of the movement, commercialization and growth of the movement, policies that support or inhibit the movement and challenges facing the movement. Once the interviews were complete, the team compiled findings in order to identify and analyze trends.

Endnotes

1 Dougherty, D. The Maker Mindset. MIT. Retrieved from <https://llk.media.mit.edu/courses/readings/maker-mindset.pdf>

2 Ibid

3 Morin, Brit. "What Is the Maker Movement and Why Should You Care?" The Huffington Post, 2 May 2013. Web.

4 Bjarin, Tim. "Why the Maker Movement Is Important to America's Future." Time. Time, n.d. Web.

5 <https://stc.unm.edu/econdev/innovateabq.php>

