



MAKING THE FUTURE

A NEW ASSESSMENT
FRAMEWORK FOR
LOCAL PRODUCTION

Coppin State University
College of Business
Center for Strategic Entrepreneurship

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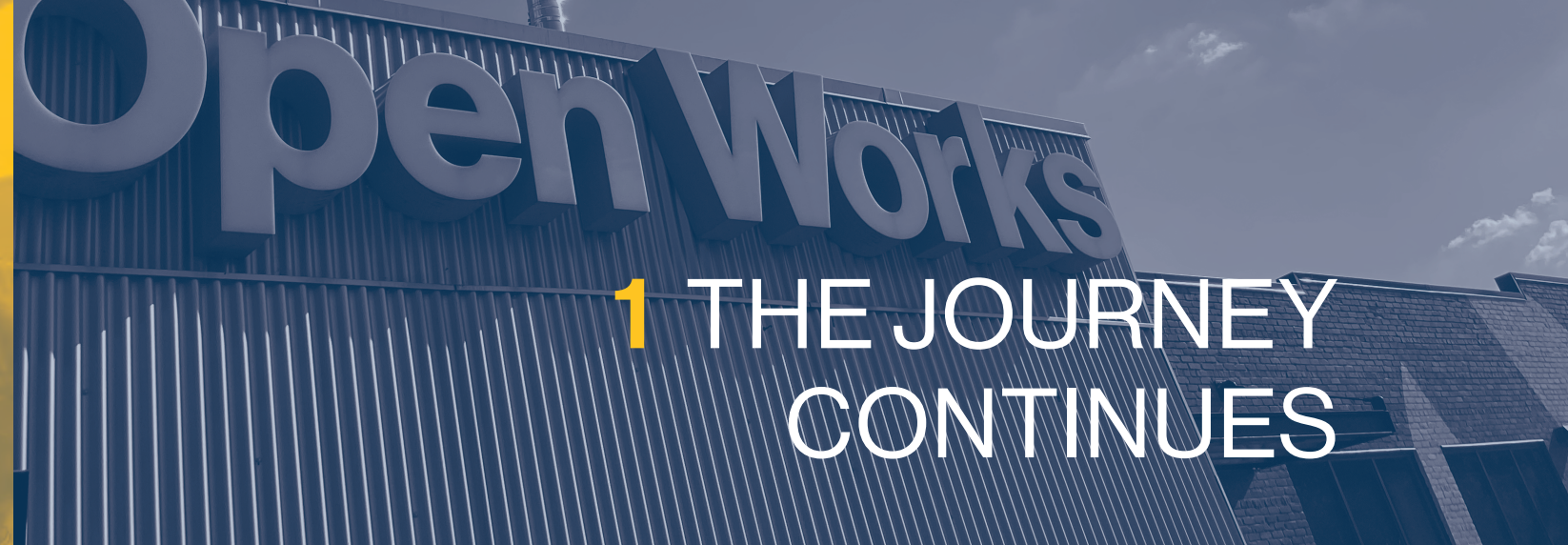
Center for Strategic Entrepreneurship (CSE)

CSE is the epicenter of entrepreneurship research, teaching, and practice activities within Coppin State University and the community. The primary goal of the CSE is to improve entrepreneurial outcomes in our West Baltimore community and contribute to economic growth across the globe. Established in December 2020, the CSE advocates transdisciplinary approaches to business and economic development. Through this advocacy, the CSE provides direction across all areas of study and industry, infusing ingenuity and greater economic velocity and mobility into the broader economy.

MAKING THE FUTURE:

A NEW ASSESSMENT FRAMEWORK FOR LOCAL PRODUCTION

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“The system of *mass production*...presupposes that you are already rich, for a great deal of capital investment is needed to establish one single workplace. The system of *production by the masses* mobilizes the precious resources which are possessed by all human beings, their clever brains and skillful hands, and supports them with first-class tools.”

E.F. Schumaker, “Small is Beautiful” 1973

A Statement from Will Holman
Executive Director,
Open Works Baltimore
Convener, Maryland
Makerspace Association

Open Works was founded in 2016 with a mission to make tools, technology, and the knowledge to use them accessible to all. Up until 2020, that primarily meant two things: providing access to tools and delivering classes on how to use them. When the pandemic struck, we had to cancel all of our public programs, leaving studios vacant and machines silent. But then we realized something: we had an idle factory at our disposal, and we might as well use it! Over the next 3 months, we got to work making face shields. By mid-June, 2020, we had produced 28,270 units of PPE using digital fabrication and a unique crowd-sourced supply chain that leveraged our member community stuck at home.

Open Works was just one of thousands of maker groups across the globe that produced over 42M units of PPE in 2020.¹ A bold combination of open-

¹ “Design, Make, Protect.” Open Source Medical Supplies, 2020. <https://opensourcemedicalsupsupplies.org/impact/>

source collaboration, hyper-local nodes of production, and curious, capable makers remade an entire industry-specific supply chain overnight. This was production by the masses at a global scale and digital pace. As the pandemic receded, we took those learnings and have scaled them up through a combination of on-the-ground community development and high-level policy work.

Since the face shield project, we have produced flat-pack plywood desks for remote learning, built outdoor benches with free wi-fi and solar canopies, and made custom newspaper boxes for the local nonprofit alt-weekly. We've launched new workforce training initiatives in trades new and old, introduced a maker fellowship program, and scaled up our after-school programs for high schoolers. In 2022, we took a leadership position on passing SB453, the Maryland Makerspace Initiative Program (MMIP), which is the first capital appropriation for makerspaces in the United States.

The MMIP wouldn't have passed without a strong impact case. Coppin State University's Center for Strategic Entrepreneurship made that case with their groundbreaking 2019 study *Turning Makerspaces into Greater Places*, which defined both the assessment framework and the policy argument for publicly-

supported community makerspaces as an economic development strategy. *Making the Future* uses the 2019 study as a baseline, evaluating the scale and pace our reemergence from the trials of the pandemic and the new ways we've come to support the local economy. In connection with our work on the MMIP, Open Works is now organizing and incubating the Maryland Makerspace Association (MMA), a statewide coalition of more than 30 makerspaces. As the MMA formalizes, it will provide a rich data set for future analysis of maker economy growth, technical education outputs, and community resilience impacts.

In the coming years, we are also deepening our collaboration with Coppin State University. At the 2023 CSU Economic Inclusion Conference, Open Works launched a capital campaign to build a second location on the west side of Baltimore. That development process is ongoing. In the meantime, a pilot site has opened inside the CSU Center for Strategic Entrepreneurship, providing a platform for classes, workshops, and community meetings. Our growing physical footprint in Baltimore, coupled with the statewide organizing, lays out a bold vision for the future – one where every Marylander can pursue their ambitions with equal access to “first-class tools.”



2 INTRODUCTION

Makerspaces are redefining the landscape of innovation and entrepreneurship globally, revolutionizing how we assess social and economic impact. As these collaborative environments gain prominence, there is a need to understand their influence on technological advancement and social capital. This report explores the evolving assessment methodologies for makerspaces, highlighting their role in shaping the future of relational ecosystems and innovation. Specifically, it delves into the rise of makerspaces in the USA, with a spotlight on Open Works in Maryland, and the pivotal role of Coppin State University in advocating for manufacturing policies. By synthesizing traditional approaches to impact assessment with social network analysis, this report helps to advance a new impact assessment paradigm for local production in the region and beyond.

Present Value, Future Potential, and the Role of Collaboration

Makerspaces provide individuals access to tools, resources, and expertise, fostering

creativity and empowering them to turn their ideas into reality. They have emerged as dynamic hubs of innovation, collaboration, and learning, reshaping traditional notions of manufacturing and entrepreneurship. As the makerspace movement gains momentum globally, it is essential to understand and evaluate its social, economic, and technological impact.

The success of makerspaces over the past decade has led to a paradigm shift in how we assess social and economic impact. Traditional economic frameworks alone often fall short in capturing the multifaceted nature of makerspaces, which encompass not only economic outputs but also social capital, community engagement, and educational outcomes. As such, there is a growing recognition of the need for new assessment models that can integrate, describe, and measure the comprehensive impacts of makerspaces on individuals, communities, and industries.

Exploring makerspaces as economic engines will facilitate the development of innovative assessment models that go beyond traditional economic frameworks. New models will leverage quantitative and qualitative data to assess impact, including job creation, skill development, community

cohesion, and entrepreneurial activity. There are existing frameworks for assessing the impact of makerspaces. A quick search of the internet will reveal many. However, the models are not comprehensive in qualitative, quantitative, social, economic, and technological assessments.

Open Works, located in Baltimore, Maryland, stands as a shining example of the transformative power of makerspaces. Founded in 2016, Open Works provides a 34,000 square foot facility equipped with state-of-the-art tools and machinery for woodworking, metalworking, digital fabrication, and more. In addition to providing access to equipment, Open Works offers a wide range of classes, workshops, and networking events to support makers of all skill levels.

The impact of Open Works extends far beyond its physical footprint. By providing affordable access to tools and training, Open Works empowers individuals from diverse backgrounds to pursue their creative passions and entrepreneurial aspirations. Moreover, Open Works catalyzes economic development in the Baltimore area, creating jobs, supporting local businesses, and attracting investment to the region.

In collaboration with a community-embedded makerspace, the role of Coppin State University as an academic anchor institution advocating for local production and small-scale manufacturing is also at the intersection of change reflected in the “Making the Future” project. The urban, community-centric Historically Black Institution (HBI) plays a crucial role in facilitating the development of policies that support local production and makerspace initiatives. By showcasing the voices of makers and entrepreneurs, Coppin State University helps to advance policies

that create an enabling environment for sustainable growth and equitable access to opportunity through small business coalition and member network opportunities that build awareness and address needs.

The success of using the 2019 Turning Makerspaces into Greater Spaces economic impact study of Open Works to help justify the first investment of public funds in the nation by the Maryland General Assembly for the expansion of makerspaces demonstrates the convergent value of research and economic development policy. As a result, the importance of infusing makerspace impact assessment into policy pursuits is clear. With the resulting formation of the Maryland Makerspace Association and the integration of strategic assessment frameworks into its operations, there exists an opportunity for thought leadership in shaping the internal and external assessment paradigm through the creation of tools and instruments for evaluating impact. By collaborating with stakeholders across sectors, we can develop robust methodologies that capture the full spectrum of makerspaces’ impact on technology, social capital, and economic development as a part of the future of our communities, start-up cultures, and small businesses as the economic drivers.

In this case, “Making the Future” seeks to leverage the collective expertise of makers and key stakeholders in impact assessment and network analysis. This further positions Coppin State University, a community-centric academic anchor institution, as a thought leader within the makerspace community. Through knowledge sharing, capacity building, and advocacy, we have the potential to drive innovation in assessment methodologies and contribute to the growth and sustainability of makerspaces worldwide.

We believe makerspaces represent a transformative force in the global innovation landscape, reshaping how we assess social and economic impact. By embracing new assessment models and leveraging the leadership of organizations like Open Works and Coppin State University, we can unlock the full potential of makerspaces as engines of inclusive growth and community empowerment. The dynamic changes brought about by makerspaces will help secure the opportunity to redefine the assessment paradigm and pave the way for a more equitable and sustainable future.

New Approaches to Assessing the Social and Economic Impact of Makerspaces

Maryland presents a wealth of opportunities for leveraging makerspaces to drive social and economic change. The proliferation of makerspaces not only marks a shift in how we think about innovation and economic development. It is also more apparent that traditional methods for assessing impact are failing to capture the dynamic nature of these collaborative spaces. This report examines the emerging assessment methodologies and makerspace influence on technology, social capital, and economic growth. Through a follow-up case analysis and economic impact study of Open Works in Maryland, we explore the transformative potential of makerspaces and their implications for new assessment frameworks.

Makerspaces foster innovation, entrepreneurship, and community

engagement in ways that defy conventional metrics. Makerspaces serve as hubs for technological experimentation and the cultivation of social capital. Social Capital is “the number of people who can be expected to provide support and the resources those people have at their disposal (Boxman et.al., 1991, p.52).” New ways of describing and measuring impact of makerspaces on society and the economy extend beyond tangible outputs to include knowledge exchange, skill development, and community empowerment.

New assessment models will emphasize qualitative descriptors alongside quantitative indicators to address the power of social networks and net benefits equated to their impact on individuals and society. Robert Putnam, one of the most prominent social scientists of our times, describes the benefits people gain from their relationships and membership in social networks as social capital that is essential for our well-being and happiness. Such considerations for collaborative networks, knowledge diffusion, and community cohesion are critical in our efforts to evaluate social impact in conjunction with economic and technological considerations.

Coppin State University plays a pivotal role in advocating for local production and supporting the integration of makerspaces into broader manufacturing initiatives. In the past, recommendations in publications like the Maker City Playbook (2016) have provided guidance to policymakers, economic developers, and community leaders about the power of makerspaces in economic development and job creation. Recent Federal and State-level public investments such as the Maryland Makerspace Initiative and the Maryland Manufacturing Act of 2023, reflect a

growing recognition of the importance of makerspaces and manufacturing in driving economic growth and innovation. By investing in workforce development, infrastructure, and technology transfer, Maryland is positioning itself as a national leader in economic growth spawned by local production.

To effectively assess the social and economic impact of makerspaces and return on public investment, it is essential to adopt transdisciplinary approaches that integrate quantitative and qualitative approaches to evaluation. This may include descriptive and experimental evaluations of makerspace users, economic impact, social networks, and case studies of successful projects and businesses that emerge from makerspaces.

By synthesizing transdisciplinary approaches to assessment, policymakers, economic developers, and community leaders can gain a comprehensive understanding of the impact of makerspaces and identify strategies for maximizing their benefits. Moreover, by standardizing transdisciplinary innovation as a part of the assessment process, we can continuously improve assessments across regions, allowing for more informed decision-making and resource allocation.

The Methodology

A mixed-methods approach, synthesizing traditional impact data from questionnaires and interviews with social network analyses, provides an emerging view of the multifaceted impact of makerspaces. Open Works, as a single case, exemplifies the potential of makerspaces as a catalyst for economic revitalization in Baltimore, fostering collaboration among artists, entrepreneurs, innovators, industry, and government. Amid increasing demand for local production space driven by a growing interest in creative outlets, entrepreneurial support, supply chain resilience, and expanding access to the means of production, Open Works has emerged as a national leader in the makerspace movement, advocating for policies that promote innovation, workforce development, and inclusive economic growth in Maryland and beyond. Its success serves as a model for other makerspaces across the nation and internationally.

Recent Public Investment		
Legislation	Date	Emphasis
Maryland Makerspace Initiative (\$5,000,000)	2022	Establishes the Maryland Makerspace Initiative Program in the Maryland Technology Development Corporation to encourage the establishment of makerspaces throughout the State; authorizing the Corporation to partner with a certain entity to provide technical assistance to certain nonprofit entities and to award certain financial assistance to local governments, certain designees of local government, and certain nonprofit entities for the establishment of makerspaces in the State; etc
Maryland Manufacturing 4.0 (\$1,000,000)	2023	Provides grants to small and mid-sized Maryland manufacturers to invest in Industry 4.0-related technologies, machinery and robotics, and digital business practices to remain competitive and drive growth. 20% of the funds will be reserved for small manufacturers with 3-50 employees
Federal funding for the Maryland Manufacturing Extension Partnership (MEP) (\$1,375,686)	2023	An allocation of federal funding that builds on previous investments made by the U.S. Department of Commerce's National Institute of Standards and Technology (NIST) to bolster Maryland's manufacturing sector. The funding will be utilized to expand and develop programs and services that enhance competitiveness, productivity, and technological performance within American manufacturing



3 BUILDING SUSTAINABLE ECONOMIC IMPACT: THE FINDINGS

In 2016, BARCO completed the \$11.5 million renovation of Open Works, a 34,000-square foot nonprofit makerspace serving the greater Baltimore community.

BARCO provides real estate advisory services to the arts community and also develops, owns, and manages spaces tailored to the needs of artists and creatives that are affordable and secure for the long term. To date, BARCO has leveraged more than \$19 million in investment to create 60,000 square feet of space for artists, makers, and performers in Baltimore's Station North Arts & Entertainment District including Open Works, the Motor House, and the Voxel Theater.

Open Works

Open Works is driven to ensure that ideas are not prevented from reaching reality for want of tools. The facility is in a part of Baltimore that has faced many challenges. Open Works provides production space, training, equipment, and other support to those who may be hobbyists, entrepreneurs, makers, or simply curious.

There are several avenues through which Open Works adds to the economy. Through what we may think of as typical daily operations of the facility, it provides direct employment for machine operators, instructors, and support services personnel. It buys goods and services from businesses and individuals, just like any other business enterprise. The scale of each of these activities can be readily modeled within our IMPLAN models to account for the total economic impact that results. Another less typical impact arises through the training and development of individual hobbyists and entrepreneurs. The entrepreneurs are operating businesses that in many cases would not likely exist, if not for the opportunity and nurturing presented by Open Works and therefore, all of the purchases, sales, and other economic activities of these enterprises should also be attributable to Open Works.

In all, there may be anywhere from 400 to 500 individuals who hold rights to be working within the walls of Open Works in any given month. This can include those who are on the Open Works payroll, members who may be renting studio space or other access to resources, people who are only

taking courses, and those who are using day passes. Of those who are actually producing something, many may be simply hobbyists or individuals who occasionally sell something that they have produced but are clearly not reliant on revenues from their Open Works activities.

In order to conduct an economic impact analysis, it is necessary to have reasonable estimates of the revenue streams connected to the activity being evaluated. It is straightforward to collect revenue and expenditure data from Open Works itself, which readily accommodates impact analysis of the operating activities of the entity on its own. However, estimating the economic contributions of those who are not on the payroll of Open Works, but are nonetheless engaged in producing goods or offering other services via its facilities presents many challenges, not the least of which is concern for the privacy of these entrepreneurs. We expect many of the makers – a term we use throughout this report to indicate producers other than Open Works employees – to be unwilling to provide any financial information. The reliability of any data obtained is also a concern. Of those who do voluntarily provide revenue data, some may, for a variety of reasons, give information that is inaccurate. There are also economic benefits generated as a consequence of those who receive training at Open Works which is then transferred to benefit external employers with no obvious link to the makerspace – an economic benefit that we will not attempt to estimate in this study.

In light of these admittedly nontrivial operating phase data concerns, we focused our attention on 82 memberships used by people who are operating businesses out of Open Works as members, studio holders, or

otherwise using Open Works resources, who responded to a survey conducted by Open Works. Some of these core members were interviewed to gather or clarify information about their businesses, including estimates of their annual revenues. There were another 14 respondents whose data was excluded from the study because they identified themselves as hobbyists or there were other exceptional reasons not to include them. These 96 respondents form 50% of the 190 core members who are economically active on a significant scale. The measures of economic impact attributable to Open Works based activities obtained from this study are consequently an understatement of the actual values, even if those who didn't respond to the survey are generally smaller economically than those who provided data.

It is also important to note that some businesses outgrow their space at Open Works. These “graduates” involve successful businesses that are now contributing millions of dollars to the Maryland economy that are not included in this economic impact analysis of Open Works. It is once more emphasized that this impact study will yield a conservative estimate of the overall economic impact.

In each year of operation, as a result of its basic operations and maintenance, Open Works will have the following direct economic effects:

- Payments to employees
- Purchases of goods and services such as equipment, materials, and building services
- Lease payments
- Property and other tax payments

As an absolute lower limit of the impact, expenditures from the income statement of the Open Works entity on its own – ignoring

all of the challenging to measure economic activities of the members – were used as inputs to IMPLAN models of Maryland and Baltimore to obtain the impact in terms of jobs, employment income, output, and taxes. The results of those analyses are included in Appendix B of this report.

There is a host of revenue generating activities conducted by maker/members of Open Works. The activities of these makers include the production of goods and services by: designers, engineers, architects, woodworkers, machinists, artists, apparel makers, insurance brokers, photographers, and various manufacturers of technical products. For confidentiality reasons, it is not possible to publish the revenue details of the 82 significant makers. However, in aggregate those who reported estimated revenues reported \$7.3 million in gross revenues.

On its own, Open Works has annual operating expenditures of more than \$1.5 million. Approximately two thirds of the budget arises as payments to employees which includes technicians, instructors, support personnel and office staff. Rent payments and purchases of materials and supplies are the next largest fractions of the budget.

The expenditures for routine operating activities provide a baseline for the immediate impact of Open Works on the local and state economy, but the effects do not end there. To assist in understanding the distinction between the total, direct, indirect, and induced effects, consider these examples. Consider the hiring of Maryland woodworkers and the money they are paid as a direct effect on the Maryland economy. When a delivery of lumber is made to Open Works and the trucker buys fuel, or a visitor to Open Works buys lunch within Maryland, those purchases create indirect impacts

on Maryland jobs, labor income and output. Finally, the money that was received through the direct and indirect effects does not evaporate, but is in turn spent over and over again, creating additional induced impacts. Adding together all of the direct, indirect, and induced impacts yields a total Maryland impact on jobs, labor income, and economic output. The IMPLAN models base estimates of these effects on the known spending patterns of Maryland workers and businesses. More complete explanations appear in Appendix A.

Economic Contributions to Baltimore and Maryland

To estimate the complete effects of Open Works related activities on the city's economy, an IMPLAN model of Baltimore is used to determine the effects on jobs, labor income, and economic output. An additional multi-regional input-output (MRIO) impact analysis which incorporates the economic data for all Maryland counties into the IMPLAN software is used to estimate the impacts on jobs, labor income, and output within the State of Maryland. The MRIO analysis captures the state-wide economic impacts originated by all Open Works-based activities in Baltimore. It also provides estimates of the local, state, and federal tax effects.

Note that the jobs and labor income gained by Baltimoreans and any output produced by Baltimore enterprises, is a subset of the effects taking place within Maryland. Economic gains and jobs for workers and firms within Maryland, but not occurring within Baltimore will be excluded from the Baltimore estimates, just as any effects outside the state will be excluded from the

Maryland results. We begin by estimating the combined effects of Open Works operations and Open Works based enterprises' activities on the State of Maryland. Discussion of the Baltimore City analyses follows the State analysis.

Economic Effects of Open Works and Open Works Based Enterprises on Maryland

Estimates of the impacts of Open Works operations and Open Works based enterprises are calculated using the multi-regional impact IMPLAN model of the State of Maryland economy. These are annual effects which repeat throughout the operational life of Open Works, so these recurring effects are far more significant than they may seem.

Inputs to the IMPLAN models for Open Works itself, were taken from its income statement and or provided by Open Works. Data for maker enterprises operating within Open Works, were obtained via survey and subsequent verification by Open Works. Because much of the source data contains confidential information, it will not be reported here and in some cases, more detailed information from the IMPLAN results will be presented in aggregated form, or completely suppressed.

In a previous impact analysis of Open Works, only maker data records with full and complete reports of revenues, salaries, and employee headcounts were included. In this study, to gather a more comprehensive picture of the overall economic impacts, some records that did not include all the key

metrics were still included. In such cases, the software infers the missing metrics based on the known expenditure and utilization behaviors of other enterprises in the same industry.

Of the approximately 190 members who operated within Open Works on a regular basis at the time of the survey, there were 96 survey respondents. Of those, 14 records were excluded because they were identified as hobbyists, with no measurable economic impact on employment or output, or the information entered was not verified by Open Works. Even though the usable data sample represents less than half the core makers, the number of responses is much larger than the previous Open Works study, so it is no surprise that economic impacts are substantially larger than those reported previously. The tables that follow display the annual impacts of Open Works on Maryland. A summary of the estimated effects appears in Table 1.

The direct employment impact is estimated to be approximately 277 jobs. Open Works reports that it provided 24 of those jobs itself, with the remainder explained by maker activities. As the effects of Open Works related activities cycle through the economy, this number grows to a total of 351 jobs, accompanied by an addition of more than \$13 million to total labor income each year. Total economic output gains \$37.4 million, which again, repeats year after year.

From the Maryland estimates, we identify which sectors of the economy will see the largest gains in jobs, labor income, and output. Table 2 outlines the sectors with the largest gains as measured by employment. The largest job gain is in the sector, training, and other education, with 111 jobs and more than \$2.5 million in labor income. This sector captures the trainers and instructors at

TABLE 1: Summary of Open Works and its Maker Enterprise Impacts on the State of Maryland

Item	Direct Impact	Indirect Impact	Induced Impact	Totals
Output	\$22,073,095	\$8,619,817	\$6,680,494	\$37,373,407
Employment (# of Jobs)	277.0	37.3	36.8	351.1
Labor Income	\$7,646,486	\$3,165,716	\$2,253,062	\$13,065,263
Fiscal Impact Comprised of	State Government Revenues			\$735,563
	Local Government Revenues			\$681,673
	Total State and Local Government Revenues			\$1,417,236

Source: IMPLAN

TABLE 2: Maryland Sectors with the Largest Gains in Employment

Description	Employment	Labor Income	Output
Training and other education	110.6	\$2,575,933	\$4,572,419
Apparel, cut and sew	37.0	\$690,737	\$2,951,652
Woodworking	23.0	\$291,719	\$914,272
Artists, writers, and performers	22.8	\$353,976	\$1,447,708
Food and food service	16.7	\$427,210	\$2,057,292
Medical apparatus manufacturing	15.0	\$777,675	\$3,518,974
Landscape and other design	13.8	\$662,460	\$1,252,690
Business and professional associations	10.6	\$849,457	\$2,725,920
Other real estate	5.5	\$145,868	\$1,341,142
Architectural, engineering, and related	5.4	\$204,080	\$296,567

Source: IMPLAN

TABLE 3: Maryland Sectors with the Largest Gains in Labor Income			
Description	Employment	Labor Income	Output
Training and other education	110.6	\$2,575,933	\$4,572,419
Business and professional associations	10.6	\$849,457	\$2,725,920
Medical apparatus manufacturing	15.0	\$777,675	\$3,518,974
Apparel, cut and sew	37.0	\$690,737	\$2,951,652
Landscape and other design	13.8	\$662,460	\$1,252,690
Management of companies and enterprises	3.4	\$457,002	\$872,851
Food and food service	16.7	\$427,210	\$2,057,292
Consulting services	5.3	\$384,133	\$826,397
Independent artists, writers, performers	22.8	\$353,976	\$1,447,708
Woodworking	23.0	\$291,719	\$914,272

Source: IMPLAN

Open Works, charged with ensuring that equipment and tools are properly and safely used, as well as makers offering training and other educational services. Next, IMPLAN indicates a gain of 37 jobs in the apparel and other cut and sew enterprises, accompanied by a total labor income gain of \$690,737. The combined woodworking sector gains 23 jobs and \$291,719 in labor income. Independent artists, writers, and performers gain 22.8 jobs in Maryland, adding \$353,976 in labor income. A combined food and food service sector adds 16.7 jobs with labor income of \$427,210. The remaining sectors making the list show job gains of 15 or fewer jobs.²

When ranked by labor income, in Table 3, the training and other education sector leads once more, with more than \$2.5 million in labor income. Business and professional associations add \$849,457 to labor income. Medical apparatus manufacturing brings in labor income of \$777,675 and 15 jobs. The apparel sector is followed by the combined landscape and other design sector, with labor income additions of \$690,737 and \$662,460, respectively. The remaining sectors in the list have gains of less than \$500,000. Note that within IMPLAN, labor income includes the dollar amount of salaries plus all employer paid benefits. As with some of the previous tables, some

²Due to confidentiality concerns, some sectors were combined, or entirely omitted from the sectoral ranking tables.

TABLE 4: Maryland Sectors with the Largest Gains in Output			
Description	Employment	Labor Income	Output
Training and other education	110.6	\$2,575,933	\$4,572,419
Medical apparatus manufacturing	15.0	\$777,675	\$3,518,974
Apparel, cut and sew	37.0	\$690,737	\$2,951,652
Business and professional associations	10.6	\$849,457	\$2,725,920
Food and food service	16.7	\$427,210	\$2,057,292
Independent artists, writers, and performers	22.8	\$353,976	\$1,447,708
Other real estate	5.5	\$145,868	\$1,341,142
Landscape and other design	13.8	\$662,460	\$1,252,690
Woodworking	23.0	\$291,719	\$914,272
Management of companies and enterprises	3.4	\$457,002	\$872,851

Source: IMPLAN

sectors with substantial economic impact were either combined with other sectors or entirely omitted to ensure confidential information was not unintentionally disclosed.

Table 4 ranks the sectors by output. The educational sector leads with additional output of almost \$4.6 million each year, while medical apparatus manufacturing gains \$3.5 million in output. The aggregated apparel sector generates output of almost \$3 million, followed by business and professional associations at \$2.7 million. Our combined food sector has an output of \$2.1 million while the other entries on the list, including artists and performers add less than \$1.5 million to Maryland's economic output.

The additions to Maryland's economy contributed by Open Works and the makers operating within it are substantial. The major effects are seen primarily in the training and other education sector, the professional services, including architecture and engineering, and other specialized design services. Not surprisingly, given the number of Open Works-based makers focused on various apparel and other cut and sew processes, as well as woodworking, these sectors also show large gains across Maryland in terms of labor and output metrics. In the next sections of the report, the focus turns to evaluating the economic impact of Open Works on the City of Baltimore.

Effects of Open Works on Baltimore

Baltimore captures most of the economic activity gains from Open Works. Not only are the direct operations located there, but also, since so many Maryland wholesalers, retailers, manufacturers, and other businesses are Baltimore entities, the city captures a large share of the indirect and induced effects as well. Table 5 summarizes the impact of the Open Works related effects on the city. These are annual figures, which continue over the life of the project, as stated previously. The IMPLAN model estimates show that Open Works and its makers directly add: 277 jobs; labor income of \$7.6 million; and output of \$22.1 million within the Baltimore City economy. Once all of the indirect and induced effects are added in, these figures increase to totals of 314 jobs, with a corresponding \$10.6 million in labor income and almost \$30.0 million in economic output. Because the Baltimore economy is a subset of the state economy, these numbers are slightly smaller than the Maryland model results for obvious reasons.

From the perspective of Baltimore residents, the benefits are most likely best measured by the number of jobs and the labor income attributable to Open Works, but the total output of \$30.0 million provides an indicator of the scale of the overall contribution to the city. This table provides a clear demonstration of how the effects of an initial addition to the economy such as that provided by the 277 jobs and \$7.6 million in labor income that is directly provided via Open Works and its makers' operations, ultimately grows into much larger total impacts as the spending works its way through successive rounds of purchases and related job additions.

The sectoral impacts within Baltimore mirror the results from the state level analysis presented above. Since there are spillovers of all Baltimore economic activities into the Maryland businesses beyond the city, the impacts for nearly all sectors will be larger for the state as a whole. Some industry sectors will experience larger leakages of any revenue they receive into the surrounding regions or entirely beyond Maryland than other sectors. For that reason, it is useful to examine the distribution of any economic impacts in some detail. Tables showing the details of the Baltimore sectoral impacts will be added at a later date but are omitted from this initial draft report.

The next section summarizes the key results of the analyses of the two phases of the Open Works project in terms of impacts via jobs, labor income, and economic output on the economies of Baltimore and Maryland.

Summary of Economic Impacts of Open Works

Overall, a picture has emerged showing that the total impacts on jobs, labor income, and economic output generated by, and as a consequence of Open Works operations are substantial:

- **Maryland Economic Impacts:** 351 jobs; \$13.1 million in labor income and \$37.4 million in output.
- **Baltimore Economic Impacts:** 314 jobs; \$10.6 million in labor income and \$30.0 million in output.

Although the fiscal impacts are more modest, the total effect of Open Works-related activities and any ripple effects generate an estimated \$735,563 per year

TABLE 5: Impact of Open Works on Baltimore City

Item	Direct Impact	Indirect Impact	Induced Impact	Totals
Output	\$22,073,095	\$5,804,898	\$2,091,659	\$29,969,653
Employment (# of Jobs)	277.0	26.1	11.0	314.0
Labor Income	\$7,646,486	\$2,213,951	\$755,037	\$10,615,474

Source: IMPLAN

for the state and \$681,673 per year for local governments – a total of \$1.4 million per year in tax revenue.

We can also see from the analyses that the types of jobs related to Open Works extend beyond manufacturing and in truth, mentoring, training, educational activities, and various professional services are currently demonstrating the largest impacts on all measures.

It is also encouraging to see enterprises becoming too successful to remain at the Open Works site. This is a desirable outcome since such success produces even more jobs and income while making an opening for the next success story to begin life at Open Works.

In closing, we once again emphasize that every possible effort has been made to ensure that the estimates contained in this report are conservative. First, there are known additional activities associated with Open Works that were not included

in this study. First, we captured data from only a fraction of the core group of makers. Secondly, hobbyists using Open Works resources occasionally sell what they produce, and many people improved their skills and consequently their earnings through the training they obtained at Open Works. Neither of these impacts was included in the impact estimates presented. Furthermore, some businesses were developed at Open Works that have since outgrown the space and are now successfully operating as standalone entities. Their large contributions to the Baltimore and Maryland economies are also a consequence of Open Works but are not included in the impacts on jobs, employment, or output. There is a value in the supporting network that a maker center creates: Budding entrepreneurs are mentored and encouraged by the other makers they interact with, which ensures that the success rate of new businesses is higher than it would be without this support network of other entrepreneurs.



4 INNOVATIONS IN ASSESSMENT: THE RECOMMENDATIONS

Makerspace communities such as Open Works play a crucial role in shaping local and national economies by fostering innovation, entrepreneurship, and workforce development. However, assessing their impact requires a nuanced understanding of how makerspaces contribute to economic growth and prosperity. This section explores assessment models and methodologies for measuring the impact of makerspaces on local and national economies that extend beyond traditional economic impact. Traditional approaches to determining economic impact do not lose their value. However, their value is amplified by the integration of social and technological impact determinants.

While quantitative assessment models provide valuable insights into the economic impact of makerspace communities, they do not capture the full range of benefits and outcomes experienced by participants. The integration of social and technological analyses with economic impact analysis offers a complementary approach to understanding the broader impact of makerspaces. By including in-depth interviews, participant observation, and thematic analysis, researchers can explore

the diverse ways in which makerspaces contribute to skill development, creativity, community engagement, and social inclusion. By documenting the stories and experiences of makerspace participants, qualitative analysis can provide rich insights into the transformative power of these spaces and their potential to drive long-term economic and social change.

Traditional Approaches

Economic Impact Analysis

Economic impact analysis serves as a foundational tool for measuring the contribution of makerspace communities to local and national economies. This approach involves quantifying the direct, indirect, and induced effects of makerspaces on key economic indicators such as employment, output, and income.

Direct effects include the economic activity generated within makerspaces themselves, such as membership fees, equipment rentals, and sales of goods produced on-site. Indirect effects capture the ripple effects of this economic activity through supply chain linkages and multiplier effects,

while induced effects reflect the additional spending generated by income earned by makerspace participants and employees. By conducting input-output analyses, economic impact studies can provide policymakers and stakeholders with valuable insights into the economic significance of makerspaces and their potential to stimulate job creation, local investment, and economic diversification.

Social Network Analysis

In addition to traditional economic impact analysis, social network analysis offers a valuable perspective on the interconnectedness and collaboration within makerspace communities. This approach involves mapping and analyzing the relationships and interactions among makerspace participants, stakeholders, and external partners. By visualizing the flow of information, resources, and expertise within makerspace networks, social network analysis can identify key actors, hubs of activity, and areas for collaboration and knowledge exchange. This information can inform strategies for strengthening social capital, facilitating collaboration, and enhancing the overall effectiveness of makerspace communities.

Technological Network Analysis

Assessment of technological impact includes a comprehensive analysis of how expanded access to tools will transform an industry from a market, productivity, employment, and social equity perspective. Barriers to technology adoption and facilitation of adoption by all stakeholders are considered. Long-term trends that develop are also examined through data-informed forecasting. The results are

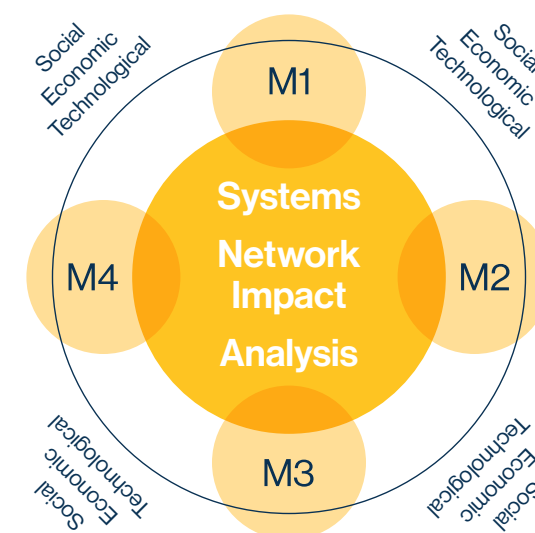
more innovation-centric communities that transcend the traditional social and economic assessments by including technological considerations across disciplines. Supply chain logistics and information exchanges will improve as a result of integrated social, economic, and technological network analyses.

Social Innovation Systems Approach: A Systems Framework for Makerspace Community Impact Assessment

To comprehensively assess the impact of makerspace communities on local and national economies, it is essential to adopt a systems framework that integrates quantitative and qualitative data from multiple sources. This framework should consider the complex interactions and feedback loops between economic, social, and environmental factors, as well as the dynamic nature of makerspace ecosystems.

Key components of a systems framework for impact assessment may include:

- Input-output modeling to quantify economic linkages and multiplier effects.
- Social network analysis to map and analyze collaboration networks within makerspace communities.
- Technological network analysis to assess the availability, required competencies, and socioeconomic impact resulting from broadening access and utilization of production tools.



- Stakeholder engagement and participatory approaches to ensure that assessment methods are inclusive, transparent, and responsive to the needs and priorities of makerspace communities.

By adopting a systems approach to impact assessment, policymakers, researchers, and practitioners can gain a holistic understanding of the economic significance of makerspace communities and develop strategies for maximizing their positive contributions to local and national economies.

Challenges and Considerations

While assessment models offer valuable tools for measuring the impact of makerspace communities on local and national economies, they are not without challenges and limitations. Key considerations include:

- **Data availability and quality:** Limited data on makerspace activities and outcomes can hinder accurate assessment of their economic impact.
- **Attribution and causality:** It can be challenging to attribute economic outcomes directly to makerspaces, given the complex and multifaceted nature of economic development.
- **Contextual factors:** The impact of makerspace communities may vary depending on factors such as location, industry focus, and community demographics, requiring tailored assessment approaches.
- **Long-term outcomes:** The full economic impact of makerspaces may unfold over time, making it essential to adopt longitudinal research designs and follow-up studies to capture evolving trends and trajectories.
- **Philosophical differences regarding science and technology:** Transdisciplinary approaches to assessment require the development of research protocols that are acceptable to scientists and technologists who have different perspectives on knowledge discovery and tool development.

Addressing these challenges requires collaboration and partnership between makerspace operators, researchers, policymakers, and other stakeholders to develop robust assessment methodologies and data collection strategies that capture the diverse dimensions of makerspace impact.

By combining economic impact analysis, social network analysis, mixed methods research methodologies, and systems thinking, policymakers, researchers, and practitioners can gain a comprehensive

understanding of the economic significance of makerspaces and develop strategies for maximizing their positive contributions to economic growth, innovation, and prosperity. Continuous improvement in efforts to overcome potential challenges includes:

- **Exploring and embracing the Opportunity for Future Impact**

The makerspace movement represents a transformative opportunity to drive social and economic progress in Maryland and beyond. By embracing new approaches to impact assessment and supporting policies that foster innovation, collaboration, and entrepreneurship, we can unlock the full potential of makerspaces to create a brighter future for all.

- **Fostering Creativity and Innovation**

Makerspaces provide a supportive environment for individuals to explore their creativity and bring their ideas to life. By offering access to tools, materials, and expertise, makerspaces empower people to experiment, prototype, and innovate across diverse fields, from technology and engineering to art and design.

- **Promoting Lifelong Learning**

Makerspaces serve as informal learning spaces where people of all ages can acquire new skills, knowledge, and competencies. Through hands-on experimentation and collaboration, individuals develop problem-solving skills, critical thinking abilities, and a growth mindset that are essential for success in the 21st-century economy.

- **Encouraging Collaboration and Community Building**

Makerspaces bring together people from diverse backgrounds, disciplines, and perspectives, fostering a sense

of belonging and community. Through collaborative projects, workshops, and events, makerspaces promote social cohesion, networking, and mutual support, creating opportunities for interdisciplinary collaboration and knowledge sharing.

- **Empowering Entrepreneurship and Small-Scale Manufacturing**

Makerspaces provide aspiring entrepreneurs and small-scale manufacturers with the resources, support, and infrastructure needed to launch and grow their businesses. By offering access to prototyping equipment, business incubation services, and mentorship programs, makerspaces lower the barriers to entry for new ventures and catalyze economic development in local communities.

- **Increasing Access to Technology and Tools**

Makerspaces democratize access to technology and tools that may otherwise be out of reach for many individuals, particularly those from underserved communities. By providing affordable access to 3D printers, laser cutters, CNC machines, and other advanced equipment, makerspaces empower people to turn their ideas into tangible products and prototypes.

- **Promoting Sustainability and Environmental Consciousness**

Makerspaces promote sustainable practices and environmental consciousness through initiatives such as upcycling, recycling, and waste reduction. By encouraging resourcefulness, creativity, and DIY culture, makerspaces contribute to a more sustainable and resilient society, reducing consumption and waste while fostering innovation in sustainable design and manufacturing.

- **Supporting Education and Workforce Development**

Makerspaces play a vital role in education and workforce development, providing hands-on learning experiences and real-world skills that are relevant to the needs of employers and industries. By integrating makerspace activities into school curricula, vocational training programs, and continuing education initiatives, makerspaces prepare individuals for careers in STEM fields, manufacturing, and the creative industries.

- **Driving Economic Growth and Revitalization**

Makerspaces stimulate economic growth and revitalization by supporting local entrepreneurship, small-scale manufacturing, and job creation. By attracting investment, talent, and innovation to communities, makerspaces contribute to the diversification and resilience of local economies, fostering prosperity and opportunity for all residents.



5 CONCLUSIONS

Overall, makerspaces offer a wealth of benefits to society, empowering individuals, strengthening communities, and driving innovation and economic development. As makerspaces continue to evolve and expand, their positive impact on society is poised to grow, shaping the future of work, education, and entrepreneurship for generations to come.

As we look toward the future of makerspaces, it is clear that these dynamic hubs of creativity, collaboration, and innovation will continue to play a transformative role in society. Here are some trends to watch include:

- **Trend #1. Expansion and Diversification:** Makerspaces will continue to expand and diversify, catering to a wide range of interests, industries, and communities. From traditional woodworking and metalworking to emerging fields like biotechnology and digital fabrication, makerspaces will evolve to meet the evolving needs and interests of makers around the world.
- **Trend #2. Integration with Education:** Makerspaces will become increasingly integrated into formal and informal education systems, providing hands-on learning experiences and real-world

skills to students of all ages. By bridging the gap between theory and practice, makerspaces will empower the next generation of innovators, problem solvers, and lifelong learners.

- **Trend #3. Global Collaboration:** Makerspaces will foster greater collaboration and knowledge sharing across geographic boundaries, enabling makers from different countries and cultures to connect, collaborate, and co-create on projects of mutual interest. By leveraging digital platforms and networks, makerspaces will transcend traditional barriers to collaboration and innovation, driving global progress and prosperity.
- **Trend #4. Sustainable Design and Manufacturing:** Makerspaces will play a key role in promoting sustainable design and manufacturing practices, fostering creativity, resourcefulness, and environmental consciousness. By championing principles of upcycling, recycling, and waste reduction, makerspaces will contribute to a more sustainable and resilient society, driving innovation in green technologies and circular economies.

- **Trend #5. Trans-regional and Transcultural Empowerment of Marginalized Communities:**

Makerspaces will continue to empower marginalized communities, providing access to technology, tools, and training that may otherwise be out of reach. By fostering inclusivity, diversity, and social equity, makerspaces will serve as catalysts for positive social change, helping to address systemic inequalities and empower individuals to realize their full potential.

- **Bonus Trend. Policy and Advocacy:**

Makerspaces will increasingly become the focus of policy and advocacy efforts aimed at supporting innovation, entrepreneurship, and workforce development. By advocating for policies that promote makerspace access, funding, and support, stakeholders can ensure that makerspaces remain vibrant and sustainable engines of economic and social progress.

In conclusion, the future of makerspaces is bright and full of promise. As these dynamic spaces continue to evolve and expand, they will play an increasingly important role in driving creativity, collaboration, and innovation across diverse fields and communities. By embracing the principles of inclusivity, sustainability, and social responsibility, makerspaces have the potential to shape a more equitable, resilient, and prosperous future for all.

6 APPENDICES

Appendix A: Economic Impact Methodology and Terms

This analysis of the economic contributions of Open Works on the Maryland and Baltimore economies was prepared using the IMPLAN (multi-region) input-output models for the State of Maryland and the City of Baltimore. IMPLAN is one of the most widely used models in the nation and can be used to analyze the impacts of companies, projects, or of entire industries. An input-output analysis examines the relationships among businesses and among businesses and final consumers. Input-output analysis is based on the use of multipliers, which describe the response of an economy to a change in demand or production. Multipliers measure the effects on an economy from a source of economic activity, in this case the jobs and revenues associated with the construction and subsequent operation of Open Works.

The economic activity generated in a city, county, region, or state is greater than the simple total of spending associated with the event or activity being studied. This

is because as this money is earned it is, in turn, spent, earned, and re-spent by other businesses and workers in the local economy through successive cycles of spending, earning, and spending. However, the spending in each successive cycle is less than in the preceding cycle because a certain portion of spending “leaks” out of the economy in each round of spending. Leakages occur through purchases of goods or services from outside of the region and via federal taxation. The IMPLAN multipliers used in this analysis capture the effects of these multiple rounds of spending based on observed spending patterns within the region of study. This analysis focuses on three measures of economic impact:

- **Output.** The total value of production or sales in all industries.
- **Employment.** The total number of full and part-time jobs in all industries.
- **Labor Income.** The wages and salaries, including benefits, and other labor income earned by the workers holding the jobs created.

Four measures of the economic activity and impact of the construction spending and operating expenditures of Open Works are included in this report:

- **Direct effects.** The change in economic activity being analyzed – in this case the jobs and revenues directly associated with Open Works.
- **Indirect effects.** The changes in inter-industry purchases, for example the purchase of goods or services to support the construction and production activities, in response to the change in demand from the directly affected industry.

- **Induced effects.** The changes in spending from households as income and population increase due to changes in production.
- **Total effects.** The combined total of direct, indirect, and induced effects.

Appendix B: Economic Impact of Open Works Excluding Maker/Member Activities

To benchmark the models of Open Works, we employed State of Maryland and Baltimore City IMPLAN models, using only the immediate activities of Open Works itself, since we had very reliable financial information for those activities. Although we have considerable confidence in the validity of the estimates presented in the main report, it is still of interest to measure

the impact of the Open Works entity on its own, to firmly establish a lower bound of the maker space’s impact. Tables B.1 and B.2 are presented below, showing the impacts at the state and city levels. It is of note that those immediate activities on their own ultimately generate \$4.1 million of output per year within Maryland and \$3.2 million for the city each year. Further, even though Open Works is a nonprofit, once all of the revenues generated by its activities work their way through the economy, state and local governments gain \$134,510 per year in additional revenue. It also supports 36.6 Maryland jobs, of which 32 are within Baltimore City.

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TABLE B.1: Impact of Open Works (Excluding Maker Activities) on the State of Maryland

Item	Direct Impact	Indirect Impact	Induced Impact	Totals
Output	\$2,129,768	\$1,105,935	\$901,103	\$4,136,806
Employment (# of Jobs)	26.9	4.7	5.0	36.6
Labor Income	\$1,110,965	\$365,766	\$303,829	\$1,780,560
Fiscal Impact Comprised of	State Government Revenues			\$71,85
	Local Government Revenues			\$62,659
	Total State and Local Government Revenues			\$134,510

Source: IMPLAN

TABLE B.2: Impact of Open Works (Excluding Maker Activities) on Baltimore City

Item	Direct Impact	Indirect Impact	Induced Impact	Totals
Output	\$2,129,768	\$826,120	\$282,326	\$3,238,214
Employment (# of Jobs)	26.9	3.6	1.5	32.0
Labor Income	\$1,110,965	\$279,408	\$101,863	\$1,492,236

Source: IMPLAN



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