



# Maker Lab



## MAKING TO LEARN

What the Chicago Public Library and its patrons are learning as new members of the maker movement



City of Chicago  
Mayor Rahm Emanuel



March 31, 2015

The Chicago Public Library (CPL) launched an Innovation Lab in 2013 within the library's downtown Harold Washington Library Center with funding from the Institute of Museum and Library Services through the Chicago Public Library Foundation to serve as a testing ground for new ideas with high impact potential that may then be replicated — in part, in whole, or in spirit — in the system's 80 branches. The first experimental project in the Innovation Lab is the **CPL Maker Lab**, a hands-on, collaborative learning environment where Chicagoans come together to share knowledge and resources to design and create items. CPL's Maker Lab is Chicago's first free and publicly accessible maker space.

Libraries, programs and services are rapidly evolving to support the needs of 21st-century learners. In particular, libraries can help patrons develop and explore 21st-century skills through self-directed, collaborative, creative, and interactive activities in an informal environment.

In the fall of 2012, Chicago Public Library began a system-wide initiative to increase the organization's focus on defining, measuring and improving its social impact. CPL first defined its purpose as nurturing learning, supporting economic advancement, and strengthening communities for the benefit of all Chicagoans. Then, CPL decided to focus on key outcomes that fulfill this purpose:

- Build Basic Literacy
- Build Digital, Information, and Cultural Literacy
- Advance Critical Thinking and Problem Solving
- Advance Creativity and Innovation
- Foster Communication and Collaboration

These outcomes, rooted in the 21st-century skills literature and evidence base, offer the framework against which CPL aligns each program. The Maker Lab is one of the first brand-new programs that CPL designed to specifically address these outcomes, and the Chicago Public Library is excited to share what it's learned as a result with the broader library community.

While initially designed as a six-month experiment, community response was so positive that the Library and Chicago Public Library Foundation secured support from the Motorola Mobility Foundation allowing CPL to keep the Maker Lab going. As a result of this successful experiment, Chicago Public Library was awarded a Social Innovation Award from the 12th Annual Chicago Innovation Awards and has integrated maker programming into its ongoing services. Additionally, CPL received the National Medal for Museum and Library Services, the highest honor a Library can receive, in part due to the kinds of highly responsive and relevant programming our Maker Lab represents.



# Executive Summary

## *With so many possible ways to support 21st century learners, why did CPL choose “making” as its inaugural Lab project?*

Supporting learners is a big challenge for the American education system and industries thirsty for creative, tech-savvy talent. In response to this challenge, CPL conducted an environmental scan, observing other learning spaces and how people were engaging with them. Hacker/maker spaces stood out as a model that could allow people of all ages to explore and participate in hands-on learning in a collaborative environment. In line with the mission to democratize access, CPL decided that the inaugural Innovation Lab project would be a Maker Lab that introduced existing and new library patrons to the tools, technology, and possibilities in the growing and evolving world of making.

The Maker Lab plays host to multiple types of sessions: “Digital Toolbox” workshops, in which patrons learn how to make a simple object using digital design, “Special Sessions” in which patrons undertake non-digital crafting and art projects, and “Open Shop” where more experienced makers can work on personal projects. The primary purpose of the Lab is to serve as an introductory point for patrons to experience new technologies, test their making skills and learn about further opportunities. By offering introductory-level courses, Chicago Public Library is able to introduce a new segment of the public to the development of 21st-century skills. Additionally, through strong partnerships the library has brought together a growing and diverse community of makers and is able to introduce novice makers to more advanced programs around the city.

## Key Findings

### **The Maker Lab has been wildly popular with patrons.**

Sessions regularly “sell out” weeks in advance and patrons are asking

“I think it’s wonderful that the CPL is able to offer these workshops to the community, for free...I also love the idea of being able to try out a new technology in a community space, and feel comfortable asking questions as a beginner.”

**Toolbox participant  
Woman, 26-35**

for more. The majority of survey respondents first attend a workshop out of curiosity or to try something new, and patron feedback on how to improve the Lab consistently asked for more classes, more time and more topics. When asked to rate their satisfaction with the workshops, 93% of respondents were satisfied or very satisfied with the content, and 94% with the instructor knowledge and quality. Additionally, almost all respondents (96%) said that they were likely to recommend the Lab to another person. In the first six months, the percent of visitors who were new to the Lab leveled off to roughly 50%, with Special Sessions seeing more return visitors than Toolbox or Open Shop visitors.

### **Making has strong potential for building patrons’ digital literacy.**

The aim of the Lab was to test CPL’s hypothesis that making could support 21st century learning. Digital literacy was the outcome that showed the most advancement, as patrons reported gaining knowledge, understanding and hands-on practice with new digital



# Executive Summary

tools. Each patron came out of a Digital Toolbox session having crafted an object using novel technology, and 87% of survey respondents agreed or strongly agreed that they were likely to read or learn more about the session topic or lab tools after this experience.

## **The Maker Lab engages female patrons to participate in STEAM learning.**

According to survey responses, 66% of the participants in Digital Toolbox sessions were female. These sessions were focused on Science, Technology, Engineering, Arts, and Mathematics (STEAM) learning activities through digital equipment-driven classes that showed participants how to use tools to create a variety of projects. In addition to introducing patrons to the equipment and software, staff spend time in each session sharing how these technologies can have relevance to patrons' hobbies, as well as academic and career paths. Strong interest and attendance by women is an encouraging sign that the library is introducing and encouraging more women to pursue STEAM learning.

## **Making facilitates collaboration between learners.**

Collaboration skills are a key area for growth. Nearly all instructors (87%) reported seeing patrons working together during their Maker Lab classes. Staff similarly reported their enjoyment in seeing patrons encouraging each other and assisting each other in their designs. Return users, the transition of some patrons from workshop attendees to Open Shop attendees, and the growing base of volunteer staff and instructors demonstrated the enthusiasm and energy around this emerging beginner maker community. The Maker Lab supports the library's role as a community convener, and brings together a diverse group of curious patrons to strengthen their knowledge and skills about making.



# Approach and Methodology

In aiming to create a collaborative community space, CPL leveraged many partners to design, build, program, operate, and measure its Maker Lab. CPL received a \$249,999 startup and operations National Leadership Grant from the Institute of Museum and Library Services (IMLS) to create a model for, and share learnings with, other libraries considering Maker Labs. This paper shares CPL findings drawn from the first six months of operation from June 2013 through December 2013.

## Maker Lab Partners

CPL partnered with the Museum of Science and Industry (MSI) to develop programming, design the space, and provide training for library staff. IMLS and the Chicago Public Library Foundation (CPLF) provided critical funding and support to build out the space and procure the needed equipment, software and resources.

CPL assembled a Maker Lab Advisory Board of experts including museum and library staff, leaders in the hacker/maker community in Chicago and beyond, and experts in STEAM and digital learning. These experts met in Chicago for a two-day working session that helped to shape CPL's operations and programming model, determine what role CPL's Maker Lab should play in context of the greater Chicagoland hacker/maker community, and brainstorm how to reach and engage specific patron segments.

To gather data and insights into the patrons who use the Maker Lab and what these patrons are learning, CPL created a research team consisting of CPL staff and external consultants. The team was led by Mission Measurement, a Chicago-based consulting firm experienced with monitoring and evaluation for innovative programs. The analysis presented in this report is based on a mixed-methods approach that combines data collection efforts, such as door count, with qualitative and quantitative research methods, including surveys and on-the-spot interviews. The

## Acknowledgement of Maker Lab Advisory Board Members

### Michael Beltran

Dept. of Mechanical Engineering, Northwestern University

### Michael Davis

Interim President, Wilbur Wright College, City Colleges of Chicago

### Bill Derry

Asst. Director for Innovation and User Experience, Westport Public Library

### Aimee Espiritu

Youth Program and Community Arts Manager, Children's Creativity Museum

### Taylor Hokanson

Asst Professor, Art & Design, Columbia College Chicago

### Rabiah M. Mayas, Ph.D.

Director, Science and Integrated Strategies, Museum of Science and Industry

### Dan Meyer

Fab Lab Manager, Museum of Science and Industry

### Eli Neiburger

Director of IT & Production, Ann Arbor District Library

### Tim Saylor

Former President, Pumping Station: One

### Adrienne Strock

YOUmedia Manager, Chicago Public Library

### Terry Topczwski

FreeGeek Chicago Public Library

### Ben Vershbow

Manger, NYPL Lab, New York Public Library

research team designed the methodology around CPL's operational strategy of public, one-off registration-based sessions. The goal of the research was to arrive at directional findings for the core research questions outlined (see sidebar to the right).



# Approach and Methodology

## Our Guiding Questions

With the help of its Maker Lab Advisory Board and Mission Measurement, CPL defined three underlying research areas to explore through the Maker Lab project.

### Concept Testing

How useful is a maker space in helping library patrons guild 21st century skills? Does the space belong in the library as a way to augment patrons' learning experiences?

### Programming

What kind of programming would maximize the number and progress of people achieving learning objectives? What is most effective, and what is most popular?

### Operations

What are the right equipment, space configuration, and location for a maker space? What is the right staffing model? What is the right way to support such a space financially? What cost-effective measures allow patrons to experience this kind of learning?

## Quantitative Inputs



Mission Measurement designed course-specific electronic surveys and a condensed Maker Week paper survey. Surveys broken out by number of respondents are as follows:

- Digital Toolbox participants: 703
- Special Program participants: 243
- Open Shop participants: 85
- Staff Special Class participants: 159
- Branch Maker Week participants: 32
- Toolbox/Special Program instructors: 47

In total, 1,063 patron surveys were collected from 4,385 attendees.

Survey design was informed by stakeholder interviews and working sessions with the Maker Lab Advisory Board and research team. Many questions were shared across multiple surveys, and each respondent was instructed to enter a unique class code. Survey questions focused on who the patron was (demographics), why they were interested in the Lab (motivation), what they learned (programming and outcomes), what they used (operations), and feedback on their Lab experience (satisfaction). These surveys were administered by Chicago Public Library staff and Maker Lab instructors.

Additional quantitative inputs included web site and blog statistics, Lab door count, Eventbrite registrations, and number of classes.

## Qualitative Inputs

Paul Skeeahan, a recent graduate of Dominican University's Graduate School of Library and Information Science, led the qualitative research including ethnographic observations, interviews and focus groups. He spent 85 hours observing and interviewing patrons during open shop, Digital Toolbox, and Special Programs. Additional qualitative inputs included staff feedback forms administered by CPL.

*What kind of programming would maximize the number and progress of people achieving learning objectives? What is most effective, and what is most popular?*

CPL actively engaged its Maker Lab Advisory Board to determine the most relevant and accessible programming for the Maker Lab. Advisory Board members helped CPL to determine what types of programming to provide, which types of software and equipment to use, and the human resources it would take to run both the classes and the equipment.

Critically, CPL followed the Advisory Board's recommendation to use open-source software, even though it required additional permissions and accommodations to meet city government requirements. Use of open-source software is not only aligned with the hacker/maker movement's philosophy and practice, but also aligned with the library's mission to democratize access to learning. Finally, open-source software allowed the library to reduce the cost of providing this access to patrons and made it more likely patrons could easily access this software when outside the Lab.

## Instructional Content and Self-directed Learning

CPL offers patrons three core types of programs in the Maker Lab: Digital Toolbox, Open Shop, and Special Programs. Additionally, CPL held Lab tours, YOUmedia sessions (for youth involved in CPL's teen programming), and staff-specific workshops to give CPL staff an opportunity to experience the Lab and learn how to enhance programming in their local branches, as appropriate. From pre-opening events held in June 2013 through December 2013, the Maker Lab hosted 328 events with a recorded attendance of 4,385.

"I saw the implications for teaching geometry with patterning in snowflakes. My 8-10 year old students should be doing this."

**Participant  
Woman, 26-35**

## Digital Toolbox

Toolbox classes are the cornerstone Maker Lab sessions, providing patrons with an introduction to design software and lab equipment. Designed by library staff, each workshop starts with a brief overview of the Lab and the Maker movement. Instructional staff then guide patrons step-by-step through the basics of design software and show them how to process the files for the machines to create the final product. Throughout the session, Lab staff facilitate the learning experience through hands-on instruction, fixing files when needed and helping patrons troubleshoot.

Patrons participating in Digital Toolbox sessions most commonly used Inkscape software (75%); the most commonly used equipment was the Laser Cutter (54%) and 3D Printer (27%).

## Special Programs

CPL invited outside instructors to offer non-digital crafting classes with the intention of attracting patrons that may not self-identify as digital makers. By presenting craft programs in the Maker Lab, patrons who may not be initially interested in new technology are exposed to the equipment and resources, increasing their comfort in furthering Lab exploration.



## Open Shop

Through Open Shop, CPL aims to mirror makerspaces by providing opportunities for self-directed, yet staff-supported, learning and exploration. Open Shop patrons work on personally designed projects; the intended audience is not just advanced makers, but also those seeking to progress beyond instructor-led Toolbox workshops. A nominal fee is charged for materials used. The most commonly used tools were the 3D Printer (54%), Laser Cutter (36%) and Inkscape software (31%).

## Patrons Ask for More

Maker Lab classes have been very popular, with majority of sessions being fully booked. Patron surveys show that respondents place high value on the sessions that they have attended. When asked what patrons are looking to do following their Lab experience, respondents reported that they are most likely to want to return to the type of session that they have already attended. For instance, 65% of Open Shop respondents would likely return for a workshop, while 88% would come back for another Open Shop session. The same trend is true of Toolbox and Special Program participants, as 86% would likely return for a workshop, while 69% report they are likely to return for Open Shop.

In general, participants communicated a very strong desire to learn more through a variety of means, including coming back to the Maker Lab, going to a partner space elsewhere in Chicago, or exploring independently. Only 3% of respondents said that they would not come back to the Maker Lab.

Of these few respondents, 30% would be more likely to return if the Lab were closer to home, and 26% said they would be more likely to return if there were different materials or tools available.



## Are Maker Lab Users Satisfied?

When asked, to rate their satisfaction with aspects of the Maker Lab, survey respondents responded with very high levels of satisfaction. This satisfaction was consistently high for all program types. Also, 96% of survey respondents say they are likely to recommend the Lab to another person.

Session Content (Workshops) — 93% satisfied or very satisfied

Instructor Knowledge and Quality (Workshops) — 94% satisfied or very satisfied

Session Length (Workshops) — 89% satisfied or very satisfied

Library Staff Knowledge and Quality (Open Shop) 97% satisfied or very satisfied

*Does a maker space help library patrons advance 21st century skill development? Does the space belong in the library as a way to augment patrons' learning experiences?*

## Testing the Lab as a Driver of Learning Outcomes

CPL hypothesized that the Maker Lab concept could directly advance each of the following outcomes:

- **Build Digital, Information, and Cultural Literacy**
- **Advance Critical Thinking and Problem Solving**
- **Advance Creativity and Innovation**
- **Foster Communication and Collaboration**

The online surveys were designed to capture knowledge or skill gain in a few ways, from qualitative inputs of what patrons learned or did during their session to multiple choice self-ratings on knowledge gained. Open-ended responses were grouped thematically, then mapped to one or more of the outcomes stated above. Through patron and staff surveys, CPL was able to determine which outcomes the Maker Lab is most likely to advance. The first three outcomes will be discussed in this section; see p.9 to understand how the Lab fosters collaboration.

**A majority of Maker Lab respondents reported gains in Digital Literacy.** Surveys asked patrons what they learned in their Toolbox or Special Program workshop; these open-ended questions were then coded by theme. 56% of patrons cited the ability to use new digital tools during their workshop sessions (“Technology Skills” in the table below). An additional 12% of respondents spoke of how they now understood these tools’ purpose and possibilities (“Technology Knowledge”). Novice makers are showing excitement about these new gains in digital literacy. In addition, 16% of respondents spoke to improving their designing or making skills, which maps to the creativity outcome.

Top Learning Codes	Mapped Outcome	Percent of Respondents
Technology Skills	Digital Literacy	56%
Designing/Making Skills	Creativity	16%
Technology Knowledge	Digital Literacy	12%

Qualitative insights are supported by quantitative data: prior to visiting, 44% of respondents had no awareness or low knowledge of the digital software or equipment in the Lab; afterward, this dropped to 9% (the remainder composed of Special Program crafts participants). In addition, respondents entering with low awareness exited on average rating themselves as having “some familiarity” (step 3) with the tools.

Level of Familiarity with Digital Software and/or Equipment	Before	After	Average Step Increase
1. I was not aware of this	19%	4%	2.0
2. I had heard of this, but no knowledge	25%	5%	1.2
3. I had some familiarity with this	20%	30%	0.7
4. I had some knowledge about this	29%	43%	0.2
5. I was very knowledgeable about this	6%	19%	—
n=	940	936	936

## Critical Thinking and Problem Solving are more likely in Open Shop than workshop sessions.

While neither CPL nor its measurement partners administered assessments to test the extent to which patrons increased their skills, the survey responses above show that patrons believe they are improving digital literacy and creativity skills. Critical thinking and problem-solving skills, though complementary, were much more challenging to observe. Given

“It was really interesting to find out the resources that are being made available through this class. This was a really great opportunity to get some of the basics down.”

**Participant  
Man, 26-35**

the template-driven and step-by-step nature of introductory workshops, it is unlikely that any strong growth is taking place. However, it is possible, that were the Lab to explore different workshop formats, such as group projects and more advanced or self-driven sessions.

Problem-solving was more readily observable in Open Shop, where patrons brought in their own projects and designs. Given the generally more advanced skill level of Open Shop patrons, they were almost twice as likely to work independently as were Digital Toolbox and Special Program respondents. Staff observed that attendees ranged from beginners looking to build on the skills they learned in a workshop to advanced users who were creating household, industrial, and laboratory tools. However, despite the self-driven nature of Open Shop projects, 84% of these respondents said that a Lab staff member helped them use a machine, and 62% said that a Lab staff member helped them use software.

### **Collaboration runs rampant among Maker Lab workshop participants.**

One of the key learning outcomes CPL expected the Maker Lab could advance was to foster collaboration, between patrons and their colleagues, classmates and neighbors. To date, the Maker Lab has proven to be ripe for collaboration, both between Lab participants and instructors, staff and participants. The research team believes that the amount of peer

collaboration taking place is a core contributor to the success of the Lab and to patrons' success during their workshops. As the Lab looks to build on its initial success, it may consider ways to increase the collaboration and sense of community that has already taken root.

Digital Toolbox and Special Programs survey respondents reported high levels of collaboration, both in giving and receiving help from other patrons. Forty percent (40%) of Digital Toolbox participants said that someone helped them or they helped someone use a machine, and 45% said that someone helped them or they helped someone use software. Similarly, 36% of Special Program respondents said that someone helped them or they helped someone use a machine, and 20% said that someone helped them or they helped someone use software. In addition, 33% of Special Program participants reported that someone helped them or they helped someone to think through a problem.

Instructors validated patron survey findings; 87% of instructors reported seeing patrons working together during their Maker Lab classes, and 74% of patrons confirmed that someone helped them or they helped someone else (e.g., with a machine, software or thinking through a problem). 91% reported that they observed participants encouraging each other. Staff reported that patrons were eager to see each other's designs, solicit advice and lend a helping hand whenever they could. Anecdotally, instructors observed that patrons expressed more confidence and encouragement when they learned that Lab staff were also in the process of learning new tools and skills.

### **The Lab successfully introduced a wider audience to additional making opportunities.**

Prior to their Lab experiences, 42% of survey respondents had no awareness or very low knowledge of, the maker movement or hacker/maker spaces. That low awareness provided both a barrier as well as a jumping-off point for the Maker Lab launch.

# Concept Testing

To increase access and participation in making, CPL first had to build awareness of the Lab as an available public resource. Most survey respondents found out about the CPL Maker Lab by walking by it (26%), hearing from library staff or library communication (27%), and/or through word of mouth (30%). Others learned about it through local media, social media, and various other connections inside and outside CPL.

In addition to the Lab itself, participants became aware of the maker movement and tools through scheduled classes and the Maker Lab wiki page (<https://sites.google.com/site/cplmakerlab/>). Written on the walls of the lab are lists of relevant resources, including Chicago area maker spaces, names of other maker organizations and materials suppliers. After their Maker Lab experiences, only 12% of survey respondents had low or no awareness of the maker movement or hacker/maker spaces.

Lab attendance was driven by novice makers. When asked to assess the overall skill levels of attendees represented in their classes, 89% of Maker Lab class instructors selected “Novice” or “Beginner”. These introductory sessions successfully built interest and confidence in exploring making, whether digital or non-digital: in post-session surveys, 87% agreed that they would read or learn more about the session topic or lab tools, and 71% agreed that they would download software they used that day onto their personal computers.

## **Lab participants have greater confidence in themselves to become makers.**

The first part of learning is discovery, and the library engaged a broad new audience in making and learning about maker spaces. Perhaps one of the most encouraging results is that patrons emerge believing that anyone can make and be a part of the maker movement. Through low-risk, low-barrier workshops, patrons walk away from their first experience with a concrete object of their own creation. Their initial experiences also introduce them to the community aspect of making, the backbone of which

## **Why do patrons come to the lab?**

When asked, “Why did you visit the Maker Lab today?” survey respondents were prompted to choose all reasons that applied, and they responded as follows:

- 70% Out of curiosity or to try something new
- 56% To explore my interests
- 39% Specific interest in this session’s content
- 20% To work on a personal project
- 16% To work with others in the Lab
- 9% For my work/job
- 4% For class/school
- 12% Other

is mutual encouragement. Post-session, 86% of respondents agreed or strongly agreed that they would make something else on their own, and 81% agreed or strongly agreed that they would visit another maker space or crafts space in Chicago.



*What are the right equipment, space configuration, and location for a maker space? What is the right staffing model? What is the right way to support such a space financially? What cost-effective measures allow patrons to experience this kind of learning?*

## Location and Space

CPL set up the Maker Lab in the system's main branch, the Harold Washington Library Center (HWLC). HWLC is centrally located in Chicago's downtown area and easily accessible by public transportation, with several bus and train lines stopping right outside. The Lab's third-floor location is on a high-traffic path heading to the main bank of public access computers and circulating collection, and survey data confirmed that many participants (26% of respondents) found out about the Maker Lab when walking by.

The space itself was designed with the help of a consultant, Luci Creative. To maximize the space, the layout separated computers from a worktable in the center of the room. Tables were made out of lightweight materials for easy movement and reconfiguration. Finally, the walls were finished in whiteboard paint in order to facilitate additional creativity, diagramming, and information-sharing.

## Registration and Hours



Lab users registered for sessions online via Eventbrite, a free event-scheduling website, which was linked from the main Maker Lab webpage. The formal registration tool helped to manage classroom size and instructor-

student ratio. Sessions filled up quickly and staff would “overbook” each session by 3-5 seats in order to account for no-shows, which is a common occurrence for free, public events. However, accurately estimating the number of no-shows remained a challenge throughout. One possible model to adopt from the Ann Arbor Public Library would be to guarantee just a few seats and set aside the rest for a walk-in, first-come first-serve basis. During the pilot, the Maker Lab was open seven days a week. The Lab opened one hour after the building opened to allow staff to warm up the equipment and prepare for classes, and closed one hour before the building closed so that staff could clean up while any pending projects were completed. It was found that afternoon hours and uninterrupted shifts are most effective and manageable.

When asked to make suggestions for what would improve the likelihood of return visits, respondents overwhelmingly suggested that they would like CPL to offer more sessions. Some voiced frustration with how quickly the classes fill up. In regard to class times, 42% of respondents asked for more weekend hours and 31% asked for more evening hours.

“I love that this equipment is now more available to the public. Maker spaces are great, but it doesn't make sense to join when I would only be using the equipment from time to time. The CPL Maker Lab allows me to work on short term projects.”

**Toolbox Participant,  
Woman, 18-25**

## Equipment and Software

In observance of federal guidelines, and with an eye towards testing a sustainable model that other libraries may adopt, CPL chose to purchase lower-cost, hobbyist-level equipment and to utilize open-source design software.

### Equipment Used:

**Full Spectrum Laser Cutter:** To cut, engrave, bore, and trim materials

**MakerBot Replicator 2 3D Printer:** To manufacture 3D objects from a digital design

**Cameo Vinyl Cutter:** To cut intricate/contoured designs for cards, decals, etc.

**CNC Milling Machine:** Computer-controlled tool to engrave, etch, and sculpt foam, wood, plastic and other materials

**Laptop Computers:** To use design software and administer surveys

**Camera:** To document process steps and final projects for sharing

### Software Used:

**Inkscape:** Graphics editor, digital drawing tool, free and open source

**Trimble SketchUp:** Digital drawing tool for 3D printing and woodworking, etc.

**Autodesk 123D:** Free software for 3D design and fabrication

The 3D printers and laser cutters generated the most media coverage, and patrons were enthusiastic about the opportunity to try these unique tools. In Open Shop, the 3D printer was the most commonly used (54% of

respondents), followed by the laser cutter. In Toolbox sessions, the laser cutter was most frequently used, followed by 3D printers and vinyl cutters.

Special consideration had to be given to fumes and debris from operating the equipment. The Innovation Lab space in the library is enclosed with no outside ventilation; thus, CPL purchased self-contained air filtration systems for the laser cutters, which worked well. However, attempts to modify the CNC milling machine for safety, debris, or noise reduction hindered the machine's performance. Due to challenges with operating the milling machine, it was not frequently used. Without a well-ventilated and sound-proof or removed area to use the CNC milling machine, other libraries may run into similar challenges.

Overall, Lab staff found the vinyl cutter to be the most reliable equipment, as it was the simplest to operate and required little to no maintenance. The laser cutter, which operated from the same design software, was similarly simple to operate and since users could view the design being cut, was even more engaging. The 3D printer was most exciting, but required a lot of maintenance. Due to frequent malfunctions and the time it took to layer and produce each object, patrons often had to pick up their product at a later date. Deeper training on maintenance and troubleshooting, coupled with dedicated technical staff with a routine maintenance schedule, would improve functionality.



# Instructional Model and Staff

## Instructional Model

The Lab is configured for 10 workstations, with one student per station. With a goal of a 3:1 student to instructor ratio, staff found that a 6:1 ratio was manageable and still allowed for individualized attention. Typically, one instructor would lead the lesson while another one or two would circulate to answer questions and set up equipment. Multiple instructors also allowed for a better cutting/printing process at the end of the class so that patrons were able to take home their finished objects.

For Digital Toolbox, staff demonstrate step by step how to use the open-source software to open and manipulate a template design. Patrons are then allowed time to personalize their designs, for instance changing color or words. Setting constraints through the template and limiting the number of choices allowed patrons to explore their creativity without getting overwhelmed about doing everything “just right.” Halfway through the session, instructors demonstrate how to process digital files, then spend the rest of the time troubleshooting and printing/cutting so that each patron is able to leave with a finished product of their own design and making.

## Staffing and Training

Staffing was one of the most challenging, yet professionally rewarding aspects of the Maker Lab. CPL was unable to hire additional staff or move staff to focus on the Maker Lab; however, it was able to “detail” one librarian to play a nearly full-time role at the Maker Lab throughout the six-month period. In order to cover all hours of operations, 1 other trained librarians rotated shifts for 1-2 days per week. Later on, the Lab staff also recruited eager volunteers and interns to assist with operations. Finally, CPL was able to allocate three additional staff members to spend some time each week supporting the Lab through programming, marketing, financial oversight, procedural, and procurement.



# Instructional Model and Staff

The MSI Fab Lab staff led two four-hour trainings for the core 12 Maker Lab instructors. Trainings included mock lessons and coaching around leading efficient and effective classes. In addition, MSI staff were available for phone call consultations throughout. Finally, though only core staff underwent this more intensive training, over 150 additional staff participated in special Toolbox sessions to learn about the software and equipment.

Working at the Lab had a very positive effect on staff development. In addition to technical skills, Lab staff developed new leadership and mentorship skills from developing programming, curriculums, and the volunteer program. They valued the opportunity to collaborate as a team to continuously improve the Lab. There is great demand among CPL librarians to bring mini-Labs into the neighborhood branches so that more staff can learn more from offering this service.

## Financial Model and Operational Efficiency

CPL and IMLS developed a cost-sharing model to launch the Lab. The initial \$249,999 grant was used for start-up costs including equipment, furniture, materials, travel, advertising, and evaluation. Staffing, the most significant expense, was covered by CPL. The library also identified additional funds to upgrade the electrical, cable, and Wi-Fi capabilities, add a door for security and noise containment, and to purchase laptops.

In the first six months, CPL only used one-third of the IMLS funds. This was in part due to the publicity and strong word-of-mouth buzz surrounding the Lab, which eliminated advertising costs. Secondly, CPL found that the cost of materials could be lowered through careful monitoring of patron work, which reduces waste from design mistakes. Finally, workshops remained at the introductory level, which reduced programming costs. The budget was then revised to include funding for additional interns.

## Patron Spotlight: Meet Beth

Beth is an occupational therapist from Boston, MA, who works with children with disabilities, helping them to participate more fully in school activities. Currently on sabbatical in Chicago, she collects experiences and information from the Maker Lab experiment in order to put this knowledge to use in her own programs.

Beth started with Toolbox and Special Programs classes, then started attending Open Shop. She has downloaded the open-source software to work from at home, but finds herself more productive and motivated in the company of other makers.

She says, “Sometimes schools restrict learning by placing emphasis on reading, writing and other traditional skills development while neglecting expansion of manual skills...The use of hands and minds for designing and creating is not encouraged enough in many schools.”

With the popularity and success of the Maker Lab firmly established, CPL and the Chicago Public Library Foundation have secured private support from the Motorola Mobility Foundation for a second year of operation after the IMLS grant expires.

## External Partnerships and Maker Community

Through its Maker Lab Advisory Board and partnership with the Museum of Science and Industry, CPL built collaborative relationships with other maker spaces in Chicago including Pumping Station: One and South Side Hackers. In service of growing the local maker



# Instructional Model and Staff

community, CPL decided early on that their contribution would be to increase public access and exposure, then refer patrons on to other maker resources and spaces. In fact, when CPL held open houses to introduce these other local spaces, the events were standing-room only.

These partnerships drove traffic to the CPL Maker Lab and gave patrons additional avenues to explore beyond the Lab. 81% of survey respondents said they were likely to visit another maker space or arts and crafts space in the Chicago area. Subsequently, CPL began organizing bus field trips for patrons from the central library to these maker spaces.

## Internal Partnerships and Lab Promotion

CPL integrated the Maker Lab with other aspects of the library system and programs, including YOUmedia, which set aside dedicated time for teens in private sessions. CPL wanted to explore if the Maker Lab might function as a natural bridge to technical education for graduating teens; however, they found that those teens generally ended up going on to college.

CPL also hosted Maker Weeks in neighborhood branches to broaden patron outreach. However, due to logistical concerns the Maker Week activities were non-digital in nature. CPL is currently considering how to bring more digital making activities, in temporary and/or permanent sites within neighborhoods.

CPL developed Maker Lab content for:

- **CPL web site** ([chipublib.org/maker-lab/](http://chipublib.org/maker-lab/)) and Online Events Calendar
- **Maker Lab wiki** ([sites.google.com/site/cplmakerlab/](https://sites.google.com/site/cplmakerlab/))
- **Maker Lab Flickr** ([flickr.com/photos/cpl\\_makerspace/](https://www.flickr.com/photos/cpl_makerspace/))
- **Chicago Maker Page** ([makersinchicago.org](http://makersinchicago.org))
- CPL social media platforms including Twitter (@chipublib) and Facebook (<https://www.facebook.com/pages/Chicago-Public-Library/35447572453>)

The Maker Lab blog saw at least 1,000 visitors each month from July through December, peaking at 2,056 visitors in October. The top referral sources to the blog were the CPL web site and Google Search.



# Participant Demographics

*What segments of patrons are most represented among Maker Lab participants? Which types of programming are most attractive to certain patron demographic groups?*

## Gender

Overall, 68% of all Maker Lab survey respondents identified themselves as female, while just 32% identified themselves as male. (See “Who Comes to the Lab?” sidebar on p. 17.) However, Open Shop participation skewed more male as 61% of Open Shop survey respondents were male and 39% female. Special Program participants were more likely to be female with 77% of survey respondents identifying as female and 23% male.

## Age

The most represented age groups were 26-35 (32%) and 36-45 (23%), which is a much larger percentage than the city’s demographics (33% are 26-44 year olds).\* (See “Who Comes to the Lab?” sidebar on p. 17.) Open Shop survey respondents tended to be younger, with 68% identifying as 35 or under. Also, a higher percentage (22%) of Open Shop participants consisted of 18-25 year-olds than any other Maker Lab program.

## Ethnicity

The most represented ethnicity was White (48%), followed by Black/African-American (19%). (See “Who Comes to the Lab?” sidebar on p. 17.) Given that 32% of Chicago residents are Black/African-American and 28% are Hispanic\*, CPL and other libraries might consider how to improve outreach so that the participant demographics are more consistent with a city’s overall population.

## Employment Status/Type

The most represented employment status/type was Employed, followed by Unemployed. (See table on p. 17.) 13% identified themselves as Entrepreneurs/Small Business Owners, compared with U.S. Census Bureau American Community Survey data that says that 4.6% are self-employed.\* As one might expect given the demographic profiles of inventors and start-up entrepreneurs, both Entrepreneurs/Small Business Owners and Students were more likely to attend Open Shop than other Maker Lab offerings.

## Neighborhood of Origin

Patrons came from all over Chicago to visit the Maker Lab. The heat map on page 17 based on survey responses shows that, while some areas drew more patrons than others, patrons came to the Maker Lab from a wide variety of neighborhoods. This reach includes Maker Week participants, where CPL designed outreach activities in neighborhood branches. Further outreach will be necessary before determining which neighborhood populations have the highest interest in making.

The most where CPL drew more than 25 patrons included: New City/Jackson Park (Hyde Park), Lakeview, Lower West Side/Armour Square, Near South Side, Edgewater, South Side, Logan Square, Ukrainian Village, Lincoln Park, Uptown, Berwyn, Ravenswood, and North Center/Irving Park/Avondale.

CPL has now created an outreach strategy to underrepresented neighborhoods that includes pop-up and short term maker programs in branches serving those communities.

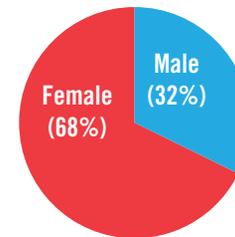
# Map of Where Patrons Come From and Demographics



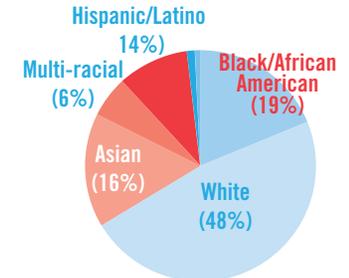
Employment Status/Type	Total	Toolbox	Special Program	Open Shop	Maker Week
Retired	4%	4%	4%	1%	10%
Entrepreneur/ Small Business Owner	13%	13%	13%	19%	0%
<b>Employed</b>	<b>40%</b>	<b>42%</b>	<b>32%</b>	<b>42%</b>	<b>66%</b>
Unemployed	18%	19%	19%	8%	7%
Student	14%	13%	16%	23%	7%
Other	11%	10%	16%	6%	10%
n=	986	655	224	78	29

## Who Comes to the Lab?

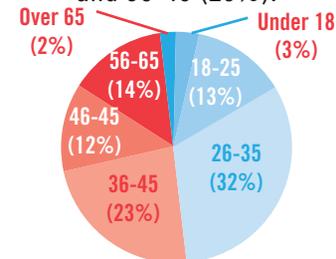
**Gender:** 68% of Maker Lab survey respondents are female.



**Ethnicity:** the most represented ethnicities are White (48%) and African-American (19%).



**Age:** most represented age groups are 26-35 (32%) and 36-45 (23%).



American Indian/Alaskan Native (1%)  
Native Hawaiian/ Other Pacific Islander (1%)

# Conclusions and Lessons Learned

## Patron Demand

The Maker Lab has been extremely popular with a widely diverse patron base, especially women. Further outreach and programming in underrepresented neighborhoods has been put in place through pop up and mini labs to reach even more diverse use. While female-heavy participation in Toolbox and Special Programs is promising, the Lab will continue to bridge the male-female gap in Open Shop through a variety of collaborations with women-led organizations.

Patrons are already asking for, and staff are starting to consider how to increase the variety and skill level of classes offered, including sequenced offerings. These more advanced classes will require more planning, expertise and training for staff, and the registration process will need to continue to be refined to ensure a quality experience for patrons while maximizing access.

## Operations

While the 3D printer has been the best driver for marketing, the staff's favorite tools are the Laser Cutter and Vinyl Cutter. Additional training or an on-site maintenance expert would increase the effectiveness of using the 3D printer and CNC milling machine. The cost of materials was well-managed through the use of open-source software, hobbyist-level equipment, and careful oversight of patrons' design.

Staffing is the biggest logistical challenge and expense for a successful Maker Lab. Ideally, there should be at least one full-time manager who has oversight over all activities, ensuring continuity, expertise, knowledge-sharing, and continuous improvement. Staff with an interest in making, willingness to take risks, and high resilience and curiosity will be successful instructors. Finally, shift-based hours of operation ensured that staff had enough time to set up and maintain equipment between classes, as well as keep their skills sharp.

## Learning Outcomes

The Maker Lab has high potential to deliver 21st century learning outcomes. At its root, the Lab increases access to new tools and methods. Directionally, collaboration, digital literacy, and creativity are the outcomes that are most achievable across session types. While some degree of critical thinking and problem-solving is likely taking place, given that most patrons participate in guided sessions rather than Open Shop, the Lab is less able to directly influence this last outcome.

The Maker Lab has generated positive press, branding and buzz for CPL which allows the library an opportunity to engage patrons in a new and exciting way. In order to continue expanding learning opportunities, the Lab is growing its existing partnerships with institutions like City Colleges of Chicago to demonstrate how making can create a pathway into advanced manufacturing and advance economic outcomes.

“Your program is so much more accessible than an outside Hacker Space... You're expected to already know how to use everything. At the library, you're assuming we're starting from zero, which is great.”

**Toolbox Participant,  
Woman, 36-45**

# Acknowledgements

## Final Thoughts

The CPL Maker Lab has been a successful experiment at Chicago Public Library and brought positive attention to the way that libraries are innovating to better serve patrons. This preliminary assessment shows that patrons are very interested in this offering, and are gaining important exposure to digital technologies. CPL and other libraries should continue to explore the extent to which these resources and models best support patron learning and experimentation.

With a robust and diverse maker ecosystem in Chicago, the Lab has created a natural and complementary role as the introductory and entry point for makers; patrons have a low-barrier way to try new tools and techniques and are referred to other maker spaces for further, more in-depth exploration. Libraries considering joining the maker movement should conduct an environmental scan of their local ecosystem to plug into the learning network. The Chicago Public Library looks forward to continuing to build on this early success and continue to offer exciting opportunities for its patrons to practice 21st century skills.

CPL wishes to thank Mission Measurement researchers Nancy Cao, Diane Knoepke and Brian Slivnick, and Paul Skeehan, a recent graduate of Dominican University's Graduate School of Library and Information Science, for the data analysis and written work that undergirds this report. We also want to recognize Chicago Public Library staff members Mark Andersen, Jeremy Dunn, Diane Marshbank-Murphy and Sasha Neri for their time, ongoing assistance, and dedication to this initial study of the Maker Lab's first six months.

We thank the Chicago Public Library Foundation for providing critical support to both the Maker Lab project and this research. We owe a tremendous gratitude to the generous support from the Motorola Mobility Foundation, whose grant has allowed us to continue offering high quality making and learning experiences throughout Chicago.

This project was made possible in part by the Institute of Museum and Library Services Grant Number LG-00-13-0122. The views, findings, conclusions or recommendations expressed in this publication do not necessarily represent those of the Institute of Museum and Library Services.

Finally, we would like to extend a special acknowledgement to the Maker Lab Advisory Board members who volunteered their time, energy and counsel to shape our maker experience.



City of Chicago  
Mayor Rahm Emanuel









This project was made possible in part by the Institute of Museum and Library Services  
Grant Number LG-00-13-0122.