Current Trends and Goals in the Development of Makerspaces at New England College and Research Libraries

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ABSTRACT

This study investigates why and which types of college and research libraries (CRLs) are currently developing makerspaces (or an equivalent space) for their communities. Based on an online survey and phone interviews with a sample population of CRLs in New England, I found that 26 CRLs had or were in the process of developing a makerspace in this region. In addition, several other CRLs were actively promoting and diffusing the maker ethos. Of these libraries, most were motivated to promote open access to new technologies, literacies, and STEM-related knowledge.

INTRODUCTION AND OVERVIEW

Makerspaces, alternatively known as hackerspaces, tech shops, and fab labs, are trendy new sites where people of all ages and backgrounds gather to experiment and learn. Born of a global community movement, makerspaces bring the do-it-yourself (DIY) approach to communities of tinkerers using technologies including 3D printers, robotics, metal- and woodworking, and arts and crafts.[1] Building on this philosophy of shared discovery, public libraries have been creating free programs and open makerspaces since 2011.[2] Given their potential for community engagement, college and research libraries (CRLs) have also been joining the movement in growing numbers.[3]

In recent years, makerspaces in CRLs have generated positive press in popular and academic journals. Despite the optimism, scholarly research that measures their impact is sparse. For example, current library and information science literature overlooks why and how various CRLs choose to create and maintain their respective makerspace. Likewise, there is scant data on the institutional objectives, frameworks, and experiences that characterize current CRL makerspace initiatives.[4]

This study begins to fill this gap by investigating why and which types of CRLs are creating makerspaces (or an equivalent room or space) for their library communities. Specifically, it focuses on libraries at four-year colleges and research universities in New England. Throughout this study, *makerspace* is used interchangeably with other terms, including maker labs and innovation spaces, to reflect the variation in names and objectives that underlie the current trends. In exploring their motives and experiences, this article provides a snapshot of the current makerspace movement in CRLs.

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The study finds that the number of CRLs actively involved in the makerspace movement is growing. In addition to more than two dozen that have or are in the process of developing a makerspace, another dozen CRLs have staff who support the diffusion of maker technologies, such as 3D printing and crafting tools that support active learning and discovery, in the campus library and beyond.[5] Comprising research and liberal arts schools, public and private, and small and large, the CRLs involved with makerspaces are strikingly diverse. Despite these differences, this population is united by common objectives to promote new literacies, provide open access to new technologies, and foster a cooperative ethos of making.

LITERATURE REVIEW

The body of literature on library makerspaces is brief, descriptive, and often didactic. Given the newness of the maker movement in public and academic libraries, many articles focus on early success stories and defining the movement vis-à-vis the mission of the library. For instance, Laura Britton, known for having created the first makerspace in a public library (The Fayetteville Free Library's Fabulous Laboratory), defines a makerspace as "a place where people come together to create and collaborate, to share resources, knowledge, and stuff."[6] This definition, she determines, is strikingly similar to that of the library.

Most literature on makerspaces appears in academic blogs, professional websites, and popular magazines. Among the most frequently cited is TJ McCue's article, which celebrates Britton's (née Smedley) FabLab while distilling the intellectual underpinnings of the makerspace ethos.[7] Phillip Torrone, editor of *Make:* magazine, supports Smedley's project as an example of "rebuilding" or "retooling" our public spaces.[8] Within this camp, David Lankes, professor of information studies at Syracuse University, applauds such work as activist and community-oriented librarianship.[9]

Many authors emphasize the philosophical "fit," or intersection, of public makerspaces with the principles of librarianship. Building on Torrone's work, J. L. Balas claims that creating access to resources for learning and making is in keeping with the "library's historical role of providing access to the 'tools of knowledge.'"[10] Others emphasize the hands-on, participatory, and inter-generational features of the maker movement, which has the potential to bridge the digital divide.[11] Still others identify areas of literacy, innovation, and STE(A)M skills where library makerspaces can have a broad impact.

While public libraries often focus on early childhood or adult education, CRLs adopt separate frameworks for information literacy. Like public libraries, they aim to build (meta)literacies and STE(A)M skills. Nevertheless, their programs often tailor to curricular goals in the arts and sciences or specialized degrees in engineering, education, and business. This is especially true of CRLs situated within large, research-intensive universities. Considering their specific missions and aims, this study seeks to identify the goals and challenges that reinforce the development of makerspaces in undergraduate and research environments.

RESEARCH DESIGN AND METHOD

Data presented in this study was gathered from library directors (or their designees) through an online survey and oral telephone interviews. After choosing a sampling frame of CRLs in New England, I developed a three-path survey, sent invitations, and collected and analyzed data using the online platform SurveyMonkey. The survey was distributed following review by the

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institutional review board (IRB) at Southern Connecticut State University, where I completed a Master of Library Science (MLS) degree.

Survey Population

To assess generalized findings for the larger population in North America, I chose a cluster-sampling approach that limited the survey population to the CRLs in New England. In generating the sampling frame, I included four-year and advanced-degree institutions based on the assumption that libraries at these schools supported specialized, research, or field-specific degrees. I omitted for-profit and two-year institutions, based on the assumption that they are driven by separate business models. This process generated a contact list of 182 library directors at the designated CRLs in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

Survey Design

The purpose of the survey was to gather basic data about the size and structure of the respondents' institutions and to gain insights on their views and practices regarding makerspaces (the survey is reproduced in the appendix). The first page of the survey contained a statement of consent, including my contact information and that of my IRB. After a short set of preliminary questions, the survey branched into one of three paths based on respondents' answers about makerspaces. The respondents were thus categorized into one of three groups: Path One (P1) for those with no makerspace and no plans to create one, Path Two (P2) for those with plans to develop a makerspace in the near future, and Path Three (P3) for those already running a makerspace in their libraries. P3 was the longest section of the survey, containing several questions about P3 experiences with makerspaces such as staffing, programing, and objectives.

Data Collection

In summer 2015, brief email invitations and two reminders were sent to the targeted population.[12] To increase the participation rate, I sometimes wrote personal emails and made direct phone calls to CRLs known to have makerspace. For cold-call interviews, I developed a script explaining the nature of the online survey. After obtaining informed consent, I proceeded to ask the questions in the online survey and manually enter the participants' responses at the time of the interview. On a few occasions, online respondents followed up with personal emails volunteering to discuss their library's experiences in more detail. I took advantage of these invitations, which often provided unique and welcome insights.

In analyzing the responses, I used tabulated frequencies for quantitative results and sorted qualitative data into two different categories. The first category was identified as "short and objective" and coded and analyzed numerically. The longer, more "subjective and value-driven" data was analyzed for common trends, relationships, and patterns. Within this second category, I also identified outlier responses that suggested possible exceptions to common experiences.

RESULTS

The survey closed after one month of data collection. At this time, 55 of 182 potential respondents had participated, yielding a response rate of 30.2%. Among these participants, the survey achieved a 100.0% response rate (9 completed surveys of 9 targeted CRLs) among libraries that were

currently operating makerspaces. I created a list of all known CRL makerspaces in New England based on an exhaustive website search of all CRLs in this region. Subsequent interviews with the managers of the makerspaces on this list revealed no other hidden or unknown makerspaces in this region. Of the 55 respondents, 29 (52.7%) were in P1, 17 (30.9%) were in P2, and 9 (16.4%) were in P3. (See figure 1.)

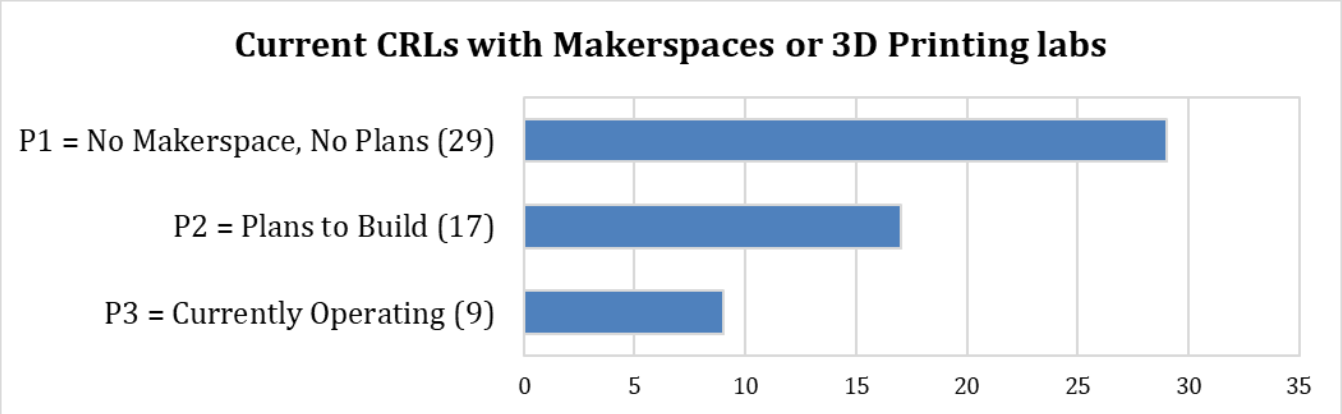

Figure 1. Survey participants' (*n* = 55) current CRL efforts and plans to develop and operate a makerspace.

Among respondents in P2 and P3, the majority (13 of 23) indicated that they were from libraries that served a student population of 4,999 people or fewer, while only one library served a population of 30,000 or more (see figure 2). In terms of sheer numbers, makerspaces might seem to be gaining traction at smaller CRLs, but proportionally, one cannot say that smaller CRLs are adopting makerspaces at a higher rate because the majority of survey participants have student populations of 19,999 or less (51, or 91.1%). The number of institutions with populations over 20,000 were in a clear minority (5, or 8.9%). (See figure 3.)

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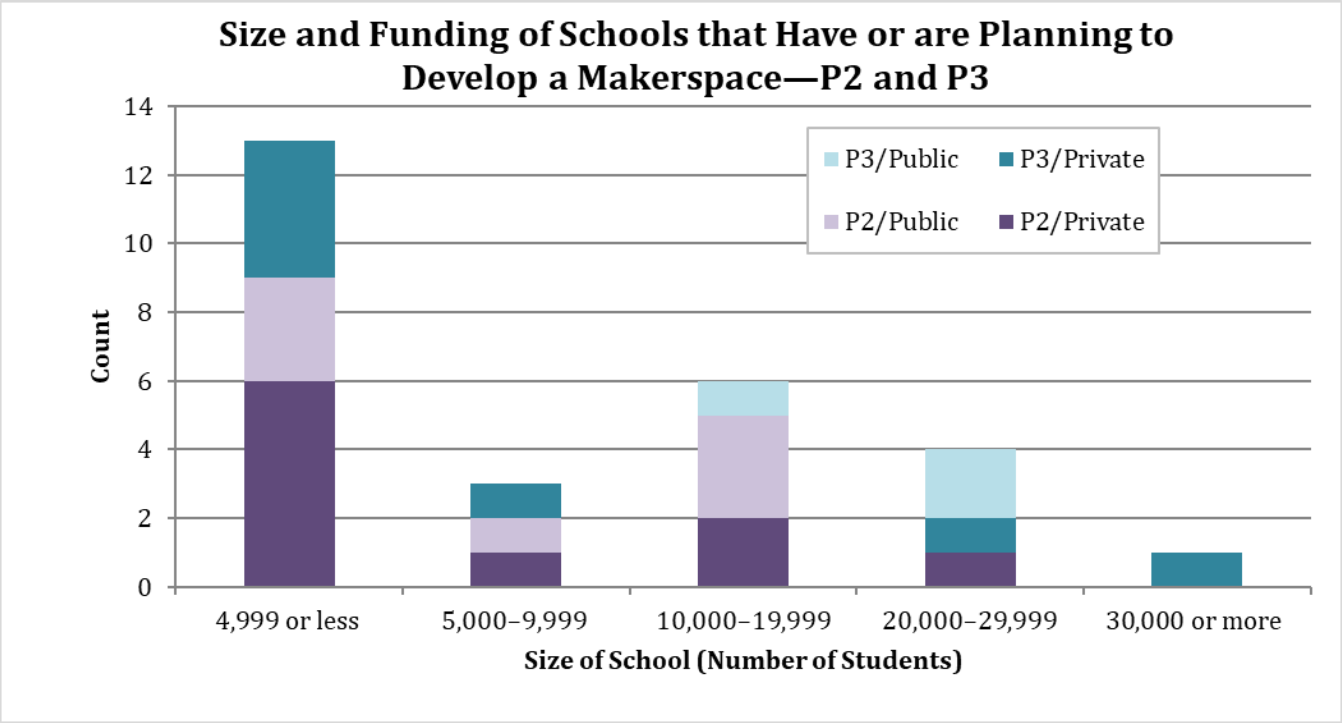

Figure 2. P2 and P3 CRLs with makerspaces or concrete plans to develop a makerspace.

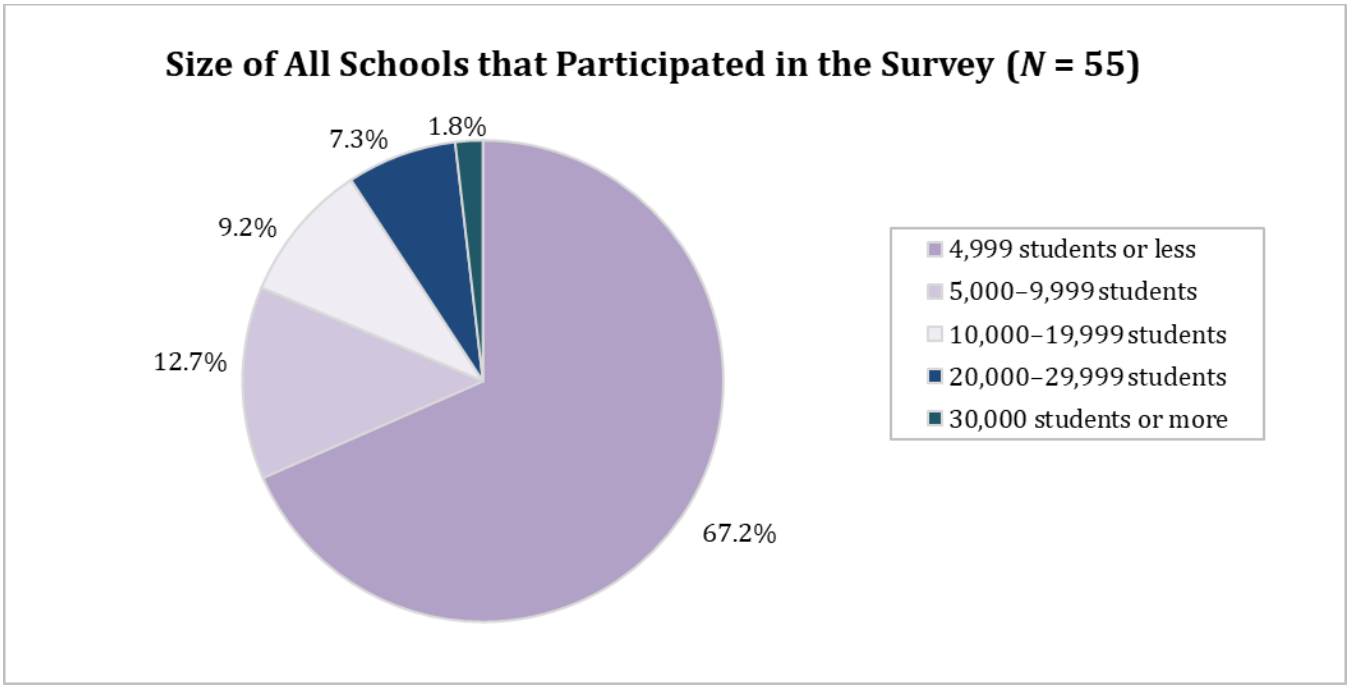

Figure 3. The majority of CRLs (67.2%) that participated in the survey had a population of 4,999 students or less. Only 1.8% of schools that participated had a population of 30,000 students or more.

CRLs with No Makerspace (P1 = 29)

In the first part of the survey, the majority of P1 respondents demonstrated positive views toward makerspaces despite having no plans to create one in the near future. Budgetary and space limitations aside, many were relatively open to the possibility of developing a makerspace in a more distant future. In the words of one respondent, "we have several areas within the library that present a heavy demand on our budget. In [the] future, we would love to consider a makerspace, and whether it would be a sensible and appropriate investment that would benefit our students."

When asked what their reasons were for not having a makerspace, some respondents (8, or 27.6%) said they had not given it much thought, but most (21, or 72.4%) offered specific answers. Among these, the most frequently cited reason (11, or 37.8%) was that a library makerspace would be redundant: such spaces and labs were already offered in other departments within the institution or in the broader community. At one CRL, for example, the respondent said the library did not want to compete with faculty initiatives elsewhere on campus.

Other reasons included that makerspaces were expensive and not a priority. Some (5, or 17.2%) libraries preferred to allocate their funds to different types of spaces such as "a very good book arts studio/workshop" or "simulation labs." Some (6, or 20.6%) shared concerns about a lack of space, staff, or simply "a good culture of collaboration [on campus]." Merging these sentiments, one respondent concluded, "People still need the library to be fairly quiet. . . . Having makerspace equipment in our library would be too distracting."

While some were skeptical (sharing concerns about potential hazards or that makerspaces were simply "the flavor of the month"), the majority (roughly 60%) were open and enthusiastic. One respondent, in fact, held a leadership position in a community makerspace beyond campus. According to this librarian, 3D printers, scanners, and laser cutters were sure to become more common, and CRLs would no doubt eventually develop "a formal space for making stuff."

CRLs with Plans for a Makerspace in the Near Future (P2 = 17)

The second section of the survey (P2) focused primarily on the motivations and means by which this cohort planned to develop a makerspace. When asked why they were creating a makerspace, the most common response was to promote learning and literacy (15 respondents, or 88.2%). In addition, a large majority (12 respondents, or 70.6%) felt that makerspaces helped to promote the library as relevant, particularly in the digital age. Three more reasons that earned top scores (10 respondents each, or 58.2%) were being inspired by the ethos of making, creating a complement to digital repositories and scholarship initiatives, and providing access to expensive machines or tools. Additional reasons included building outreach and responding to community requests.[13] (See figure 4.)

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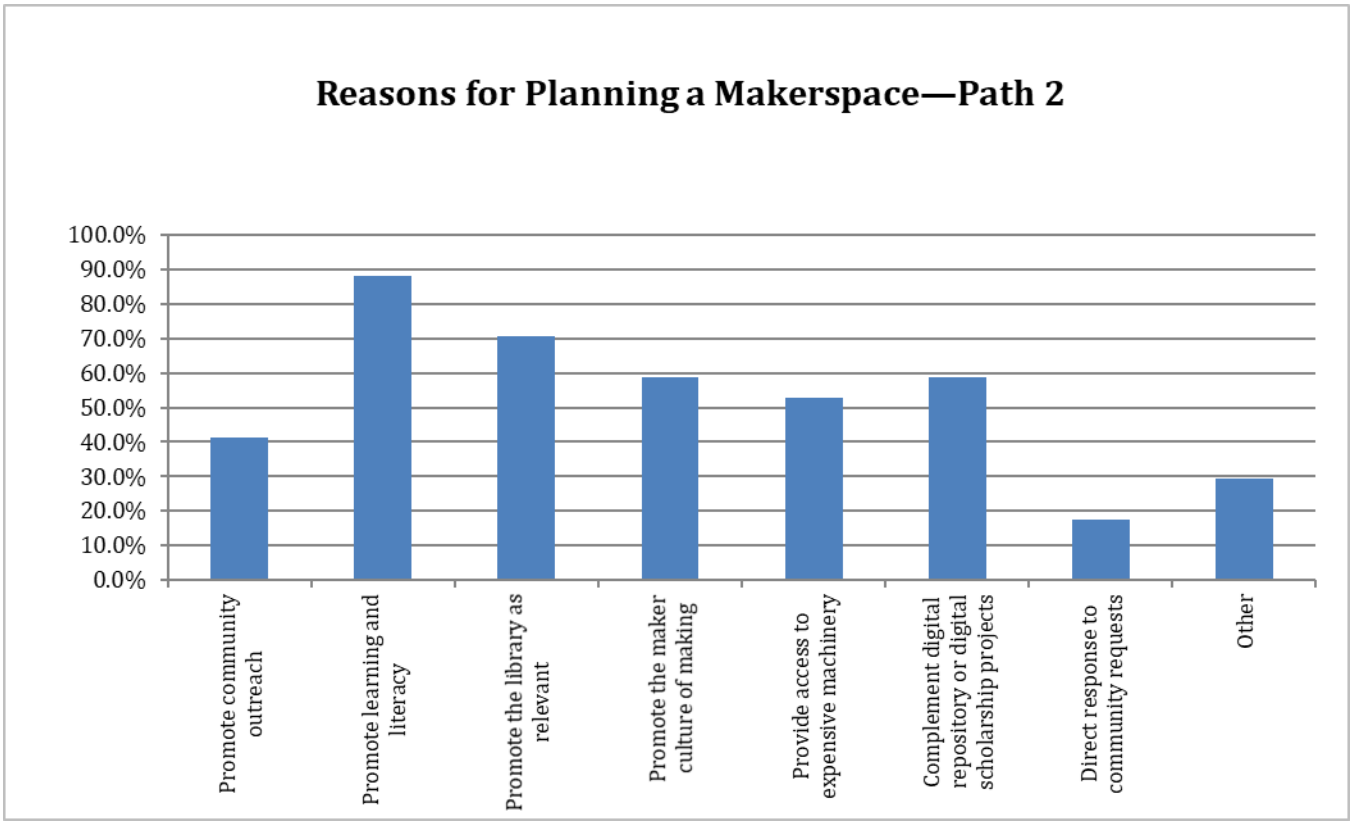

Figure 4. Rationale behind P2 respondents' decision to plan a makerspace (*n* = 17).

While P2 respondents indicated a clear decision to create a makerspace, their timeframes were noticeably different. I categorized their open responses into one of six timeframes: "within six months," "within one year," "within two years," "within four years," "within six years," and "unknown." The result presented a clear trimodal distribution with three subgroups: six CRLs with plans to open within 18 months, five with plans to open within the next two years, and six with plans to open after three or more years (see figure 5).

In addition to their timeframe, P2 respondents were also asked about their plans for financing their future makerspaces. Based on their open responses, the following six funding sources emerged:

- the library budget, including surplus moneys or capital project funds
- internal funding, including from campus constituents
- donations and gifts
- external grants
- cost recovery plans, including small charges to users
- not sure/in progress

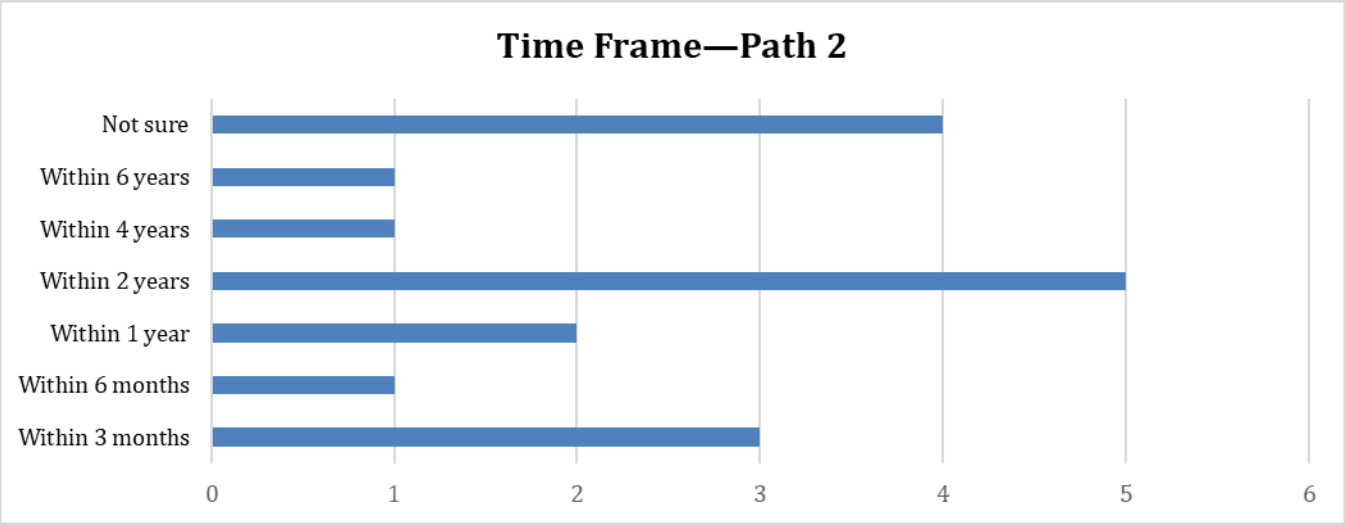

Figure 5. P2 respondents' timeframe for developing the makerspace (*n* = 17).

With seven mentions, the most common of the above funding was the "library budget." With two mentions each, the least common sources were "cost recovery" and "not sure/in progress." Among those who mentioned external grant applications, one respondent mentioned a focus on Women and STEM opportunities, and another specifically discussed attempts at grants from the Institute of Museum and Library Services. (See figure 6.)

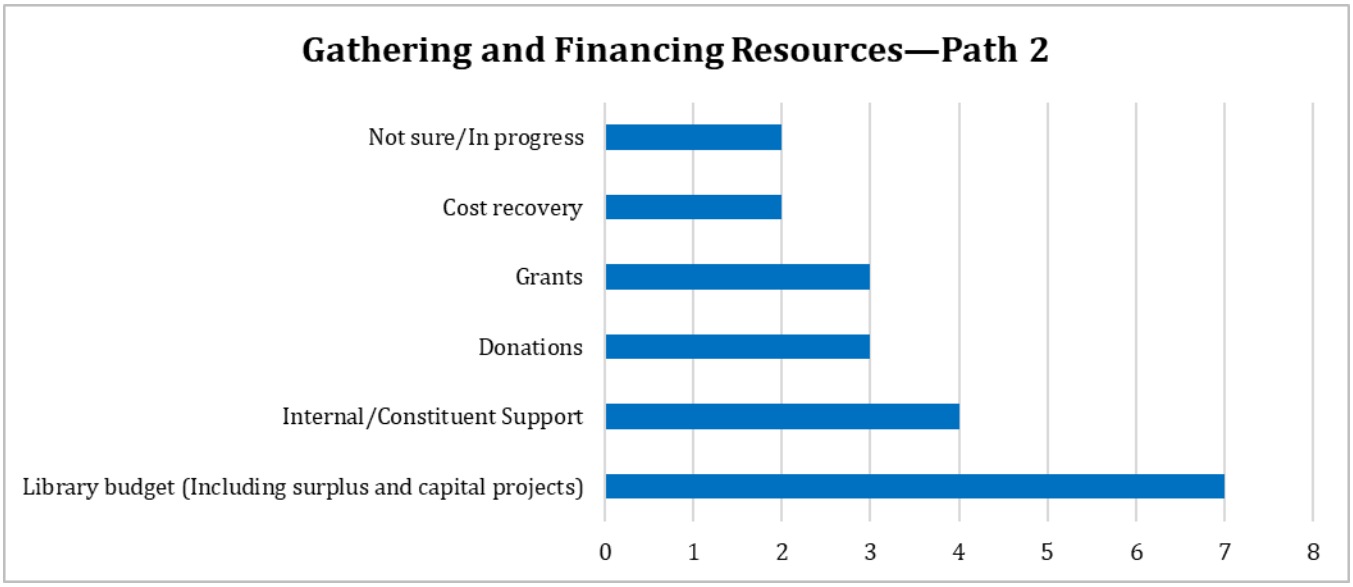

Figure 6. P2respondents' plans for gathering and financing makerspace (*n* = 17).

Regarding target user groups, some respondents focused on opportunities to enhance specific disciplinary knowledge, while others emphasized a general need for creating a free and open environment. One respondent mentioned that at her state-funded library, the space would be "geared to younger [primary and secondary school] ages," "student teachers," and "librarians on practicum assignments." By contrast, another respondent at a large, private, Carnegie R1

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university emphasized that the space was earmarked for the undergraduate and graduate students.

In contrast to the cohort in P1, a notable number in P2 chose to create a makerspace despite the existence of maker-oriented research labs elsewhere on campus. As one respondent noted, the university was still "lacking a physical space where people could transition between technologies" and an open environment "where students doing projects for faculty" could come, especially later in the evenings. Another respondent at a similarly large, private institution explained that his colleagues recognized that most labs at their university were earmarked for specific professional schools. As a result, his colleagues came up with a strategy to provide self-service 3D printing stations at the media center, located in the library at the heart of campus.

CRLs with Operating Makerspaces (P3 = 9)

The final section of the survey (P3) focused on the motivations and means by which CRLs with makerspaces already in operation chose to develop and maintain their sites. In addition, this section gathered information on P3 CRL funding decisions, service models, and types of users in their makerspaces. Of the nine respondents in this path, all had makerspaces that had opened within the last three years. Among these, roughly a third (4) had been in operation from one to two years; another third (3) had operated for two to three years; and two had opened within the last year. (See table 1.)

Table 1. Length of time the CRL makerspace has been in operation for P3 respondents (*n* = 9).

Age of CRL Makerspace or Lab—P3		
Answer Options	**Responses**	**%**
Less than 6 months	1	11.1
6–12 months	1	11.1
1–2 years	4	44.4
2–3 years	3	33.3
More than 3 years	0	0.0
Total Responses	9	100.0

Priorities and Rationale

The reasons behind P3 decisions to make a makerspace were slightly different from those of P2. While "promoting literacy and learning" was still a top priority, two other reasons, "promoting the maker culture of making" and "providing access to expensive machinery," were deemed equally important (6 respondents, or 66.7%, for each). Other significant priorities included "promoting community outreach" (4 respondents, or 44.4%), "promoting the library as relevant" and in "direct response to community requests" (3 respondents, or 33.3%, for each). (See figure 7.)

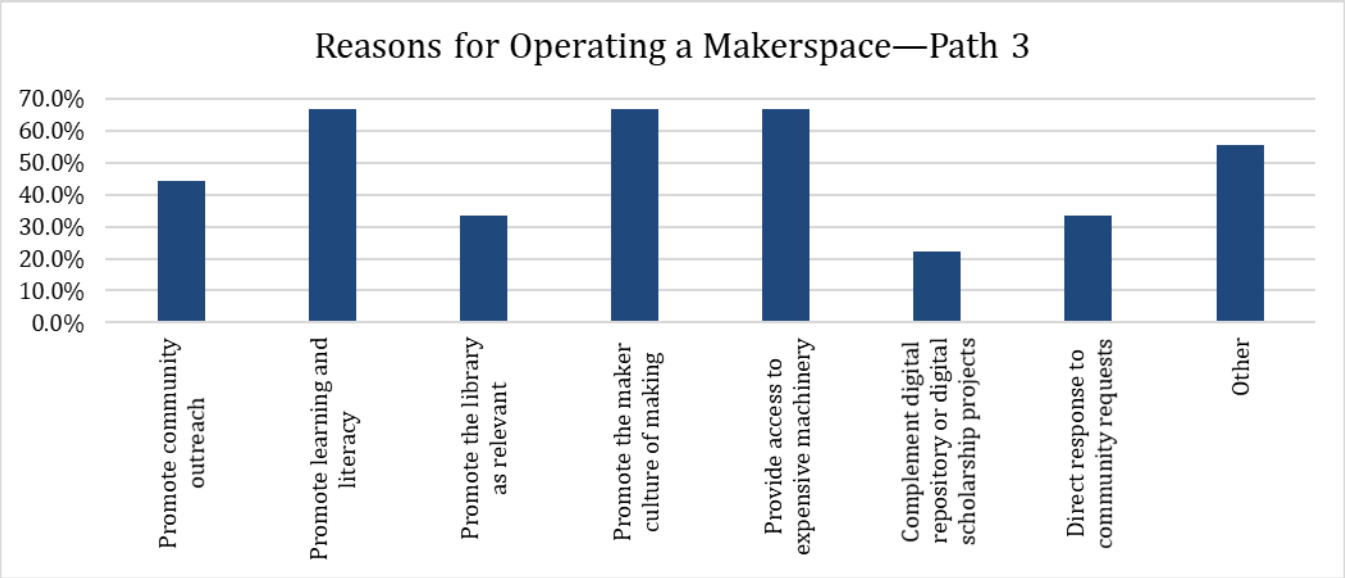

Figure 7. Rationale behind P3 respondents' decision to develop and maintain a makerspace (*n* = 9).

The answer of "other" was also given top priority (5 respondents, or 55.6%). I conclude that this indicated a strong desire among respondents to express in their own words their library's unique decisions and circumstances. (Their free responses to this question are discussed below.) A familiar theme in the responses of the five respondents who elaborated on their choice of "other" was the desire to situate a makerspace in the central and open environment of the campus library. As one participant noted, there were "other access points and labs on campus," but those labs were "more siloed" or cut off from the general population. By contrast, the campus library aimed to serve a broader population and anticipated a general "student need." Later, the same respondent added that the makerspace was an opportunity to promote social justice, cultivate student clubs, and encourage engagement at the hub of the campus community.

This type of ecumenical thinking was manifested in a similar remark that the library's role was to *reinforce* other learning environments on campus. One respondent saw the makerspace as an additional resource "that complemented the maker opportunities that we have had in our curriculum resource center for decades." Likewise, the library makerspace was intended to offer opportunities to a range of users on campus and beyond.

Funding, Staffing, and Service Models

When prompted to discuss how they gathered the resources for their makerspaces, the largest group (4 respondents) stated that a significant means for funding was through gifts and donations. Thus, the majority of CRL makerspaces in New England depended primarily on contributions from friends of the library, university/college alumni, and donors. The second most common source (3 respondents) was through the library budget, including surplus money at the end of the year. Making use of grant money and cost recovery were mentioned by two library participants, and internal and constituent support was useful for two libraries. (See figure 8.)

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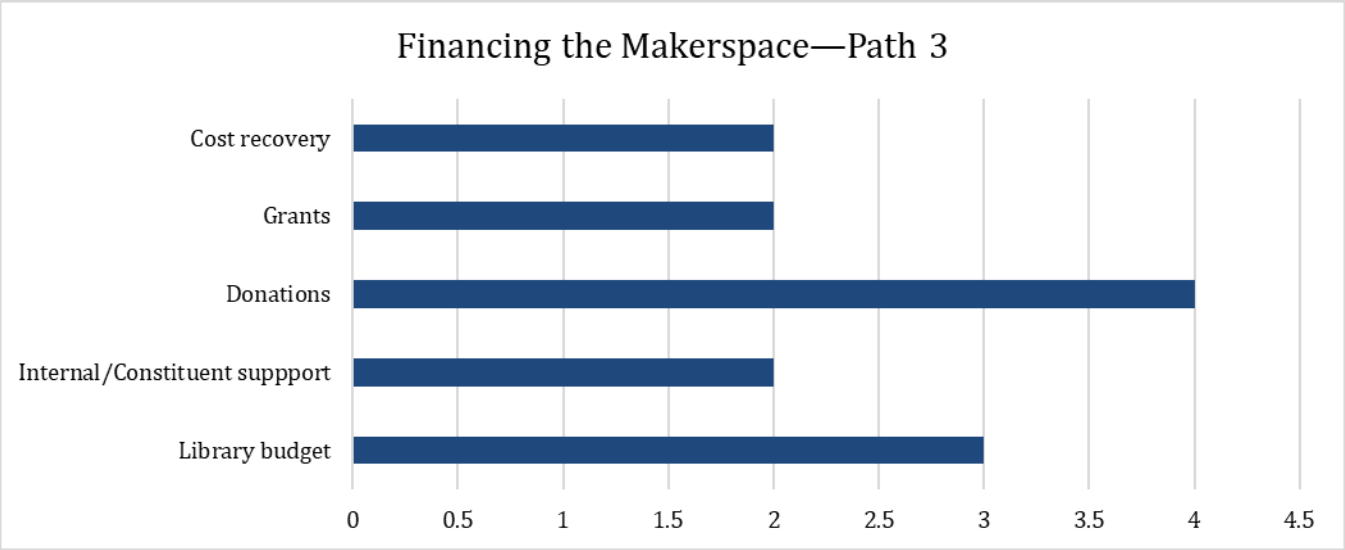

Figure 8. P3 methods for gathering and financing a makerspace (*n* = 9).

Among these, a particularly noteworthy case was a makerspace that had originated from a new student club focused on 3D printing. Originally based in a student dorm, the club was funded by a campus student union, which allocated grant money to students through a budget derived from the college tuition. As the club quickly grew, it found significant support in the library, which subsequently provided space (on the top floor of the library), staff, and financial support from surplus funds in the library budget. As this example would suggest, the sum of the responses showed that financing the makerspaces depended on a combination of strategies. One participant summarized it best: "We've slowly accumulated resources over time, using different funding for different pieces. Some grant funding. Mostly annual budget."

Regarding service models, more than half of these libraries (five) currently offer a combination of programming and open lab time where users could make appointments or just drop in. By contrast, two of the libraries offered programs only, and did not offer an open lab; another two did the opposite, offering no programming but an open makerspace at designated times. Of the latter, one is open Monday to Friday from 8 a.m. to 4 p.m., and the other is open during regular hours, with spaces that "can be booked ahead for classes or projects." Most labs supported drop-in visitors and were open evenings and weekends. At one makerspace, where there was increasingly heavy demand, the staff required students to submit proposals with project goals. (See table 2.)

While some libraries brought in community experts, others held faculty programs, and some scheduled lab time for individual classes. One makerspace prioritized not only the campus, but also the broader community, and thus featured programs for local high schools and seniors. Responses from this library emphasized the social justice thread that inspired their work and the community culture that they aimed to foster.

Table 2. Model for services offered in the CRL makerspace or 3D printing lab

Do you offer programs in the makerspace/lab or is it simply opened at defined times for users to use?		
Answer Options	**Responses**	**%**
Yes, we offer the following types of programs.	2	22.2
No, we simply leave the makerspace/lab open at the specific times.	2	22.2
We do both. We offer the programs and leave the makerspace/lab open at specific times.	5	55.6

As this data would suggest, most makerspaces were used by students (undergraduates and graduates) and faculty, in addition to local experts and generational groups. Survey responses showed that undergraduate students were the most common users (9 of 9 respondents checked this group as the most frequent type of user), and faculty and graduate students were the second and third most common (8 of 9 respondents checked these groups as most frequent) user groups in the labs. Local entrepreneurs, artists, designers, craftspeople, and campus and library staff also use the makerspaces. (See figure 9.) When prompted to identify "other" categories, one respondent specifically listed "learners, makers, sharers, studiers, [and] clubs."

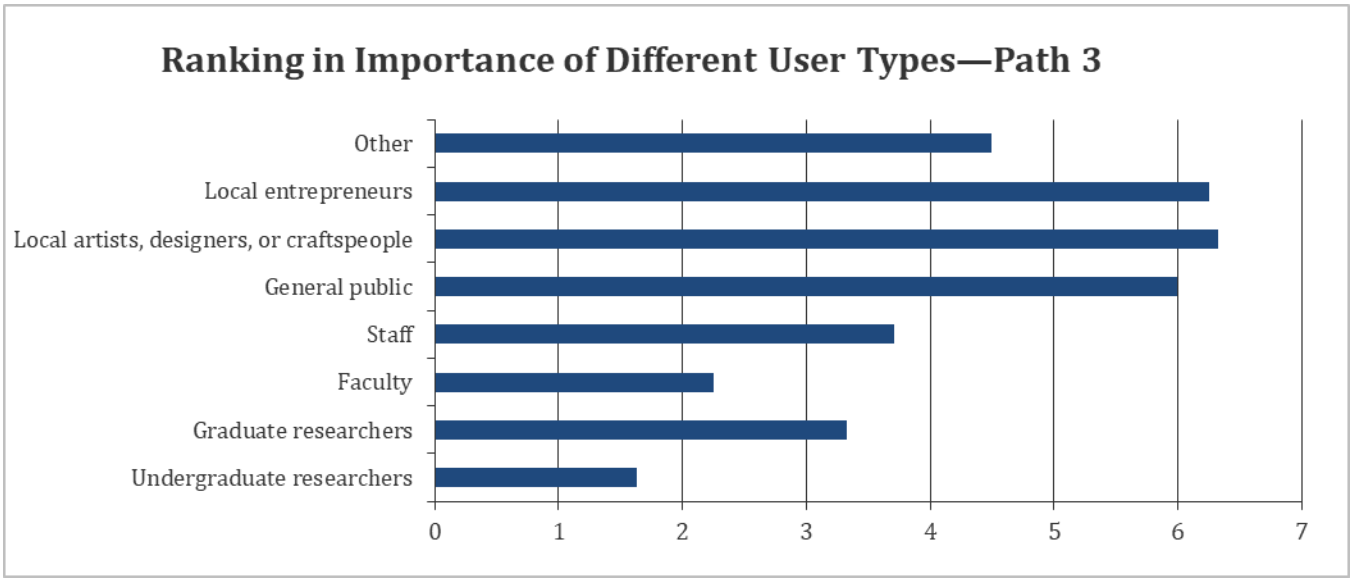

Figure 9. Of the different types of users listed above, P3 respondents ranked them in order of who used the makerspace or equivalent lab most often (n = 9).

The number and type of staff that managed and operated the makerspaces also varied widely at the nine CRLs in P3. Seven of the CRLs employed full-time, dedicated staff, among whom four participants checked off the "dedicated staff"–only options. Of the remaining two CRLs, one

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reported staffing the makerspace with only one student, and one reported not having any staff working in the makerspace. I assume that the makerspace with no employees is managed by staff and students who are assigned to other, unspecified library departments or work groups. (See figure 10.)

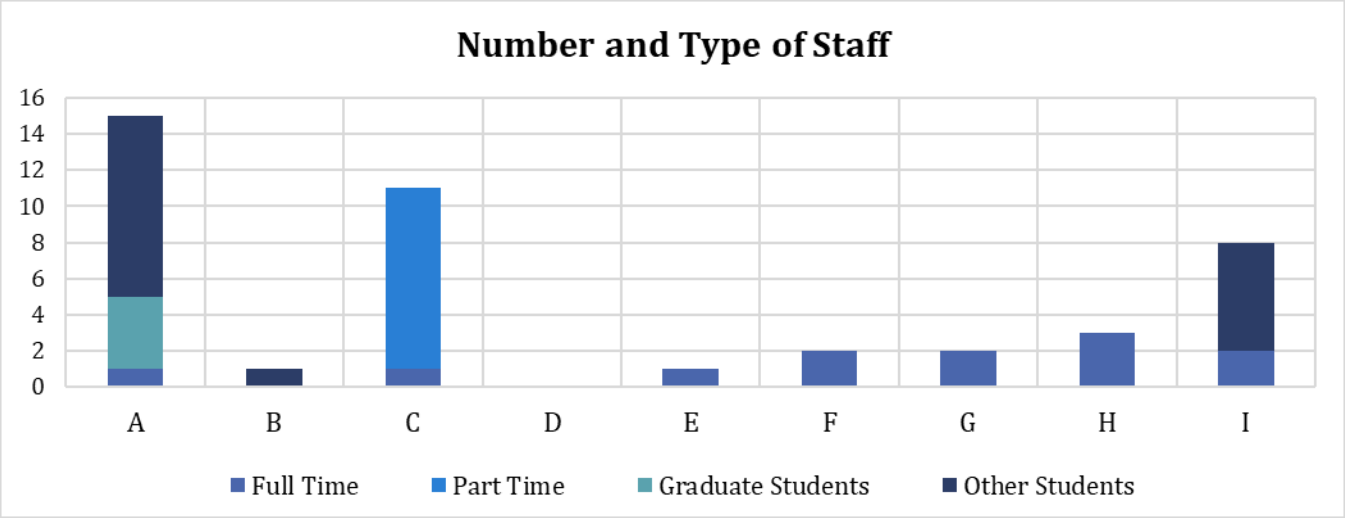

Figure 10. The staffing situations at the P3 respondents (*n* = 9), where each respondent is assigned a letter from "A" to "I."

Library programing was also diverse in terms of targeted audiences, speakers, and learning objectives. Instructional workshops varied from 3D scanning and printing to soldering, felt making, sewing, knitting, robotics, and programming (e.g., Raspberry Pi.) The type of equipment contained in each lab is likely correlated to the range in programming; however, investigating these links was beyond the scope of this study. Regarding this equipment, the size and activity of the participant CRLs varied considerably. Some responses were more specific than others, and thus the resulting dataset was incomplete (See table 3.)

Challenges and Philosophies of CRL Makerspaces

The final portion of the survey invited participants to freely offer their thoughts about operating a CRL makerspace. What follows below is a summary of the two most prominent themes that emerged: the challenges of building the lab and the social philosophies that framed these initiatives.

In terms of challenges, the most common hurdle noted was the tremendous learning curve involved in establishing, maintaining, and promoting a makerspace. Setting up some of the 3D printers, for example, required knowledge about electrical networks, computer systems, and safety policies at a federal and local level. Once the hardware was running, lab managers needed to know how the machines interfaced with different and challenging software applications. Communication skills were also critical, as one respondent reported, "Printing anything and everything takes knowledge, experience." Communicating with stakeholders and users in accessible and proactive ways required strong teaching and customer service skills.

Table 3. The types of tools and equipment used at P3 CRL respondents (*n* = 8), which are assigned letters from A to H.

Major Equipment Offered by Individual Library Makerspaces or Equivalent Labs—Path 3	
CRL Label	**Response Text**
A	Die cut machine, 3D printer, 3D pens, raspberry pi, arduino, makey makey, art supplies, sewing supplies, pretty much anything anyone asks for we will try to get.
B	2 Makerbot replicators, 1 digital scanner, 1 Othermill
C	3D printing, 3D scanning, and Laser cutting.
D	3D printing, 3D scanning, laser cutting, vinyl cutting, large format printing, cnc machine, media production/postproduction.
E	No response
F	3 CreatorX, 1 Powerspec, 3 M3D, 2 Replicator 2, 1 Replicator2x, 1 Makergear, 1 LeapfrogXL, 1 Ultimaker, 1Type A,1 Deltaprinter, 1 Delta Maker, 2 Printrbot, 2 Filabots, 2X-box kinect for scanning, 2 Oculus rifts, embedded systems cabinet with Soldering stations, solar panels and micro controllers etc, 1 formlabs SLA, 1 Muve SLA, RoVa 5, a bunch of quadcopters
G	3D printers (4 printers, 3 models), 3D scanning/digitizing equipment (3 models), Raspberry Pi, Arduino, a laser cutter and engraving system, poster printer, digital drawing tablets, GoPro, a variety of editing and design software, a number of tools (e.g. Dremel, soldering iron, wrenches, pliers, hammers, etc.), and a number of consumable or misc. items (e.g. paint, electrical tape, acetone, safety equipment, LED lights, screws and nails, etc.)
H	48 printers (all Makerbot brand), 35 replicator 5th Gen (a moderate size printer, 5 Replicator Z18 printers (larger built size), and 5 replicator minis, 3 Replicator 2X) 5 Makerbot digitzers (turntable scanners 8" by 8") 1 Cubify Sense Hand Scanner 7 still cameras for photogrammetry 21 I-Mac computers 2 Mac Pros 2 Wacom graphics tablets (thinking about complementing other resources at other labs on campus)

Another challenge that often came up was that of managing resources. As one respondent warned, CRLs should beware the "early adoption of certain technologies," which can become "quickly

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outdated by a rapidly growing field." For others, it was a challenge to recruit the right staff that could run and fix machines in constant need of repair. In addition to hiring people with manufacturing and teaching skills, a successful lab required individuals who were savvy about outreach and community needs.

Despite such challenges, many respondents were eager to discuss the aspirations and rewards of CRL makerspaces. Above all, respondents focused on the pedagogical opportunities on the one hand, and the potential for outreach and social justice on the other. One participant conceded that measuring advances in literacy and education was "intangible," but he saw great value in "giving students the experience of seeing their ideas come to fruition." The excitement that this created for one student manifested in a buzz, and subsequently a "fever" or groundswell, in which more users came in to tinker and learn. Meanwhile, the learning that took place among future professionals on campus was "critical," even when results did not "go viral."

The aspiration to create human connections within and beyond campus was another striking theme. According to one respondent, the makerspace had "enabled some incredibly fruitful collaborations with different departments on campus." This "fantastic outcome" was becoming more and more visible as the maker community grew. Other CRL makerspaces took pride in fostering a type of learning that was explicitly collaborative, exciting, and even "fun" for users. This in turn meant that some libraries were becoming "very popular," generating a lot of "good PR," and becoming central in the lives of new types of library users.

Along these lines, some respondents aimed to leverage the power of the makerspace to achieve social justice goals that resonated with core values of librarianship. According to one enthusiastic participant, the ethos of sharing was alive and strong among the staff and the many students who saw their participation in the lab as a lifestyle and culture of collaborating. In another initiative, the respondent looked forward to eventually offering grants to those users who proposed meaningful ways to use the makerspace to create practical value for the community. From this perspective, there was added value in having the 3D printing lab situated specifically on a college or university campus. According to this respondent, the unique quality of the CRL makerspace was that by virtue of its location amid numerous and energetic young people, it was ripe for exploitation by those "who had great ideas and time and energy to do good."

DISCUSSION

The aim of this study was to explore why and which types of CRLs had developed makerspaces (or an equivalent space) for their communities. Of the 56 respondents, roughly half (46%) were P2 and P3 libraries who were currently developing or operating a makerspace, respectively. Data from this survey indicated that none of the P2 or P3 CRLs fit a mold or pattern in terms of their size, educational models, or classifications.

Upon analyzing the data, I found that the differentiators between the three groups were less clearly defined than originally anticipated. In one example of blurred lines, at least two respondents in P1 indicated that they were more actively engaged with makerspaces than two respondents in P2. Despite not having physical labs within their libraries, these P1 respondents were in the process of actively supporting or making plans for a makerspace within their CRL community. One P1 respondent, for example, served on the planning board for a local community makerspace and had therefore "thoroughly investigated and used" the makerspace at a

neighboring university. Based on his knowledge, he decided to develop a complementary initiative (e.g., a book arts workshop) at his university library. Although his library did not yet have a formal makerspace, he felt confident that the diffusion of 3D printers would come to his library in the near future.

Another P1 respondent was responsible for administering faculty teaching and innovation grants. Among the recent grant recipients were two faculty collaborators who used the library's funds to build a makerspace at a campus location that was separate from the library. Although the makerspace was not directly developed by the respondent's library, it was nevertheless a direct product of his library's programmatic support. The respondent reported that for this reason, his library did not want to compete with its own faculty initiatives.

In another example of blurred distinctions, one librarian in P2 was as deeply immersed in providing access and education on makerspaces as his colleagues in P3. Although he was not clear on when or how his library would finance a future makerspace, his library already offered many of the same services and workshops as P3 libraries. As a "Maker in the Library," he offered non-credit-bearing 3D printing seminars to students and offered trial 3D printing services in the library for graduates of the 3D printing seminar. In addition, he made appearances at relevant campus events. When the university museum ran a 3D printing day, for instance, he participated as an expert panelist and gave public demonstrations on library-owned 3D printers and a scanner Kinect bar.

In sum, despite the respondents' categorization in P1 and P2, they sometimes shared more in common with the cohorts in P2 and P3, respectively. Given their library's programmatic involvement in creating and endorsing the maker movement, these respondents were more than just "interested" or "open to" the prospect of creating a makerspace. While only 16% of CRLs (P3 = 9) responded as actively operating a makerspace, another 30% (P2 = 17) were involved in developing a makerspace in the near future. Moreover, the number of CRLs formally involved with the diffusion of maker technologies was not limited to just these two groups. Although some makerspaces were not directly run by the library, they had come to fruition because of library-based funding, grants, and professional support. And although some libraries did not have immediate plans for a makerspace, they were already promoting maker technologies and the maker ethos in other significant ways.

CONCLUSION

This study is one of the first comprehensive and comparative studies on CRL makerspace programs and their respective goals, policies, and outcomes. While the number of current CRL makerspaces is relatively low, the data suggests that the population is increasing; a growing number of CRLs are involved in the makerspace movement. More than two dozen CRLs were planning to develop makerspaces in the near future, helping to diffuse maker technologies through CRL programming, and/or supporting nonlibrary maker initiatives on campus and beyond. In addition, some CRLs were buying equipment, hiring dedicated staff, offering relevant workshops and demonstrations, and supporting community efforts to build labs beyond the library.

Although the author aimed to find structural commonalities between CRLs in groups P2 and P3, none were found. Respondents in these groups came from institutions of all sizes, a wide variety

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of endowment levels, and both public and private funding models, and they ranged in emphasis from the liberal arts to professional certifications and graduate-level research.

Although a majority of CRL respondents were not currently making plans to create a makerspace, many respondents were enthusiastic about current trends, and some even promoted the maker movement in unexpected ways. Acknowledging the steady diffusion of 3D printers, many anticipated using such technologies in the future to promote traditional library values and goals.

Respondents in P2 and P3 indicated that their primary rationale for developing a makerspace was to promote learning and literacy. Other prominent reasons included promoting library outreach and the maker culture of learning. Data from CRLs with makerspaces indicated that these benefits were often symbiotic and correlated to strong ideas about universal access to emergent tools and practices in learning.

Unexpected challenges for developing and operating makerspaces include staffing them with highly skilled, knowledgeable, and service-oriented employees. Learning the necessary skills—including operating the printers, troubleshooting models, and maintaining a safe environment, to name a few—was time-consuming and labor intensive. The majority of funding for CRLs with or planning maker labs came from internal budgets, gifts and donors, and some grants.

While some P1 CRLs indicated that their reason for not developing makerspaces was a lack of community interest, P2 and P3 CRLs were not necessarily motivated by user requests or needs, nor was lack of explicit need or interest a deterrent. On the contrary, a few reported a desire to promote the campus library as ahead of the curve by keeping in front of student and community needs.

In a similar contradiction, some P1 respondents reported that their libraries did not want to compete with other labs on campus. Respondents from P2 and P3, however, wanted to offer an alternative to the more siloed or structured model of department- or lab-funded makerspaces. Although makerspaces were sometimes forming in other parts of campus, some P2 and P3 CRLs felt there was a gap in accessibility and therefore aimed to offer more open and flexible spaces.

A final salient theme among P2 and P3 respondents was their commitment to equity of access and issues of social justice. Above all, they saw a unique fit for makerspaces in their CRL philosophies to serve the greater good. Among other advantages, CRLs were in a unique position to leverage the power of the makerspaces to take advantage of campus communities of "cognitive surplus" and millennial aspirations to share and create spontaneous communities of knowledge.

Given the amount of resources that are required to create and maintain a makerspace, this research will be useful for CRLs considering such a space in the future. The present data suggests that no one type of library currently has a monopoly on maker spaces; regardless of size or funding levels, the common thread among P2 and P3 CRLs was simply a commitment to providing access to emergent technologies and supporting new literacies. While annual budgets and grant applications were critical for some libraries, the majority of CRLs funded the bulk of their makerspaces through gifts and donations. Future studies on the characteristics and challenges of P2 and P3 populations beyond those in New England will certainly amplify our understanding of these trends.

APPENDIX: SURVEY QUESTIONS

Informed Consent

CURRENT TRENDS IN THE DEVELOPMENT OF
MAKERSPACES AND 3D PRINTING LABS
AT NEW ENGLAND COLLEGE AND RESEARCH LIBRARIES

Consent for the Participation in a Research Study
Southern Connecticut State University

Purpose
You are invited to participate in a research project conducted by Ann Marie L. Davis, a masters student in library and information studies at Southern Connecticut State University. The purpose of this project is to investigate the experiences and goals of college and research libraries (CRLs) that currently have or are making plans to have an open makerspace (or an equivalent room or space). The results from this study will be included in a special project report for the MLS degree and the basis for an article to submit for peer-review.

Procedures
If you decide to participate, you will volunteer to take a fifteen-minute online survey.

Risks and Inconveniences
There are no known risks associated with this research; other than taking a short amount of time, the survey should not burden you or infringe on your privacy in any way.

Potential Benefits and Incentive
By participating in this research, you will be contributing to our understanding of current trends and practices with regards to community learning labs in CRLs. In addition, you will be providing useful knowledge that can support other libraries in making more informed decisions as they potentially develop their own makerspaces in the future.

Voluntary Participation
Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or withdraw from this study.

Protection of Confidentiality
The survey is anonymous and does not ask for sensitive or confidential information.

Contact Information
Before you consent, please ask any questions on any aspect of this study that is unclear to you. You may contact me at my student email address at any time: xxx@owls.southernct.edu. If you have questions regarding your rights as a research participant, you may contact the Southern Connecticut State Institutional Review Board at (203) xxx-xxxx.

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Consent
By proceeding to the next page, you confirm that you understand the purpose of this research, the nature of this survey and the possible burdens and risks as well as benefits that you may experience. By proceeding, this indicates that you have read this consent form, understand it, and give your consent to participate and allow your responses to be used in this research.

ACRL Survey on Makerspaces and 3D Printers

Q1. What is the size of your college or university?

- 4,999 students or less
- 5,000–9,999 students
- 10,000–19,999 students
- 20,000–29,999 students
- 30,000 students or more

Q2. How would you categorize your institution? (Please check all that apply)

- Private
- Public
- Doctorate-Granting University (awards 20 or more doctorates)
- Master's College or University (awards 50 or more master's degrees, but fewer than 20 doctorates) Liberal Arts and Sciences College
- Other

Q3. Do any of the libraries at your institution have a makerspace or equivalent hands-on learning lab (including a 3-D printing station or lab)?

- Yes [if "Yes," respondents are directed to question 14]
- No [if "No," respondents are directed to question 4]

Q4. Do any of the libraries at your institution have plans to develop a makerspace or equivalent learning lab in the near future?

- Yes [if "Yes," respondents are directed to question 8]
- No [if "No," respondents are directed to question 5]

PATH ONE

(CRLs with no makerspace, no plans for makerspace)

Q5. Are there specific reasons why your institution has decided not to pursue developing a makerspace or equivalent lab in the near future?

- No reasons. We have not given much thought to makerspaces for our library.
- Yes

Q6. Thank you for your participation. Would you like a copy of the results when the report is completed? If yes, please enter your email address in the space provided.

- No
- Yes (please enter your email address below)

Q7. You have almost concluded this survey. Before signing off, please feel free to share your thoughts and comments regarding the makerspace movement in college and research libraries. If no comments, please click "Next" to end the survey.

PATH TWO

[CRLs with plans to build a makerspace]

Q8. What are the main goals that motivated your library's decision to develop a makerspace or equivalent lab? (Please check all that apply)

- promote community outreach
- promote learning and literacy
- promote the library as relevant
- promote the maker culture of making
- provide access to expensive machines or tools
- complement digital repository or digital scholarship projects
- as a direct response to community requests or needs
- other

Q9. Of these goals, please rank them in order of their level of priority for your library. (Choose "N/A" for goals that you did not select in the previous question)

- promote community outreach
- promote learning and literacy
- promote the library as relevant
- promote the maker culture of making
- provide access to expensive machines or tools
- complement digital repository or digital scholarship projects
- as a direct response to community requests or needs
- other

Q10. What is your library's time frame for developing a makerspace or equivalent lab?

Q11. What are your library's current plans for gathering and/or financing the resources needed for developing and maintaining the makerspace or equivalent lab?

Q12. Thank you for your participation. Would you like a copy of the results when the report is completed?

- No
- Yes (please enter your email address below)

Q13. You have almost concluded this survey. Before signing off, please feel free to share your thoughts and comments regarding the makerspace movement in college and research libraries. If no comments, please click "Next" to end the survey.

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PATH THREE

[CRLs with a makerspace]

Q14. How long have you had your makerspace or equivalent learning lab?

- less than 6 months
- 6–12 months
- 1–2 years
- 2–3 years
- more than 3 years

Q15. What were the main goals that motivated your library's decision to develop a makerspace or equivalent lab? (Please check all that apply)

- promote community outreach
- promote learning and literacy
- promote the library as relevant
- promote the maker culture of making
- provide access to expensive machines or tools
- complement digital repository or digital scholarship projects
- as a direct response to community requests or needs other

Q16. Of these goals, please rank them in order of their level of priority for your library. (Choose "N/A" for goals that you did not select in the previous question)

- promote community outreach
- promote learning and literacy
- promote the library as relevant
- promote the maker culture of making
- provide access to expensive machines or tools
- complement digital repository or digital scholarship projects
- as a direct response to community requests or needs
- other

Q17. How did your library gather and/or finance the resources needed for developing and maintaining the makerspace or equivalent learning lab?

Q18. Do you offer programs in the makerspace/lab or is it simply opened at defined times for users to use?

- Yes, we offer the following types of programs:
- No, we simply leave the makerspace/lab open at the following times (please note times and/or if a reservation is required):
- We do both. We offer the following types of programs and leave the makerspace/lab open at the following times (please note types of programs, times open, and if a reservation is required):

Q19. What type of community members tend to use your library's makerspace or equivalent lab most? (Please check all that apply)

- undergraduate researchers
- graduate researchers
- faculty
- staff
- general public
- local artists, designers, or craftspeople
- local entrepreneurs
- other

Q20. Of the cohorts chosen above, please rank them in order of who uses the makerspace or equivalent lab most often. (Use "N/A" for cohorts that are not relevant to your space or lab)

- undergraduate researchers
- graduate researchers
- faculty
- staff
- general public
- local artists, designers, or craftspeople
- local entrepreneurs
- other

Q21. How many dedicated staff does your library currently employ for the makerspace or equivalent?

- 0
- 1
- 2
- 3
- other

Q22. Where is your makerspace or equivalent lab located?

Q23. What is the title or name of your makerspace or equivalent lab, and if known, what were the reasons behind this particular name?

Q24. What major equipment and services does your library makerspace or equivalent lab provide?

Q25. What unexpected considerations, challenges, or failures has your library faced in developing and maintaining the makerspace or equivalent lab?

Q26. How would you assess the benefits or "return on investment" of having a makerspace or equivalent lab?

Q27. Thank you for your participation. Would you like a copy of the final results when the report is completed? If yes, please enter your email address in the space provided.

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- No
- Yes (please enter your email address below)

Q28. You have almost concluded this survey. Before signing off, please feel free to share your thoughts and comments regarding the makerspace movement in college and research libraries. If no comments, please click "Next" to end the survey.

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