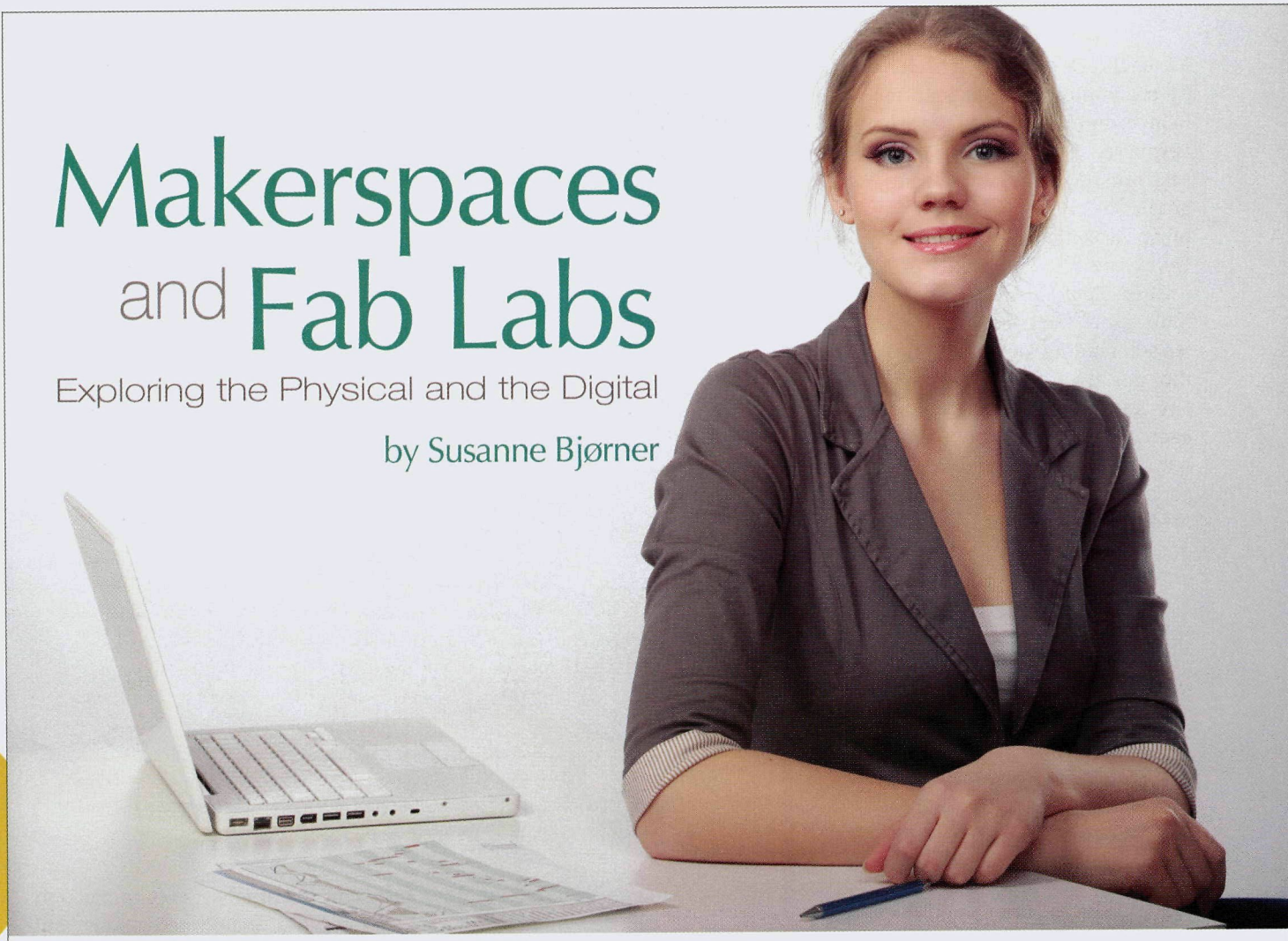
Makerspaces and Fab Labs

Exploring the Physical and the Digital

by Susanne Bjørner



There is something fanciful about attending a conference via desktop computer, especially a conference exploring the physical in libraries and museums. That is how I participated on May 23 in the 6th annual Spring Event in Rome on Modern Leonardos (biblionext.it). It is not the first conference that I attended through the internet, of course, not even the first day-long conference, but it was the first day-long conference held in my own time zone. That was a blessing, as most other live webinars and presentations reach me at my home in Spain in the early evening or even later—not when I am at my freshest for exploring new ideas.

It was also the first internet conference that I have attended "Live-streamed with simultaneous translation" in English and in Italian. But technical directions for logging in to this conference were sparse—consisting of only a URL—and I was disconcerted at first to discover myself listening to *both* the Italian and the English, though not quite simultaneously. Two voices, one of which, at least, was radically different from what appeared to be the current speaker, plus a slight but noticeable echo on the line almost made me give up on the conference during the introductory remarks. I clicked out and in and around several times in my attempt to find the problem and finally realized I had multiple windows open on my computer—one containing the agenda of the day (biblionext.it/page/programma), another showing the speakers or their slides. And each one carried different audio. I printed out the agenda on paper—give one point to the physical!—and quickly closed that window. Calm and understanding emerged.

SPRING EVENTS

This Spring Event was the sixth in an annual series cosponsored by the U.S. Embassy to Italy and The American University of Rome. Previous events focused on the Digital Omnivore (aur.edu/american-university-rome/2012/04/apr-19-5th-annual-biblionext-spring-event) and BookNext: The Future of Reading (aur.edu/american-university-rome/2011/03/booknext-the-future-of-reading). Vendor sponsors read like a who's who of companies serving libraries in Italy, Europe, and beyond.

The day started in accordance with the southern European timetable. That is, it was scheduled to begin at 10:00 a.m., so even though I am used to fluid timetables in Spain, I was at my station at 9:50 a.m. It wasn't until 10:24 a.m., however, that I heard a voice say, "Bon giorno, bon giorno … Good news, we are about 1 minute away and about to begin." If there was an explanation for the delay, I never heard

it. Perhaps it was due to technical transmission issues—this may have been the first time that sessions were transmitted in streaming video—or perhaps it was because there was a very real in-person conference going on in the Fondazione MAXXI (fondazionemaxxi.it) in Rome and you can be sure that coffee was being served.

But eventually we were welcomed, and welcomed, and welcomed by two representatives of the U.S. Embassy, the president of the MAXXI, the president of The American University of Rome, and the president of the Italian Library Association (aib.it/aib/cen/presaib-e.htm). They all spoke directly to the theme of the day, but by reminding us that Leonardo da Vinci was a scientist, an artist, and an inventor, Ambassador David H. Thorne set the stage and focused our attention for the day's presentations.

> "Digital fabrication gives people the tools to build anything they can imagine."
>
> —*David H. Thorne*

YOULAB PISTOIA

Maria Stella Rasetti, of the Biblioteca San Giorgio, Pistoia, an industrial city not far northwest of Florence, provided the kickoff presentation with a 7-minute video of this public library's YouLab in action. Pistoia is one of more than 450 "American Corners" operated around the world as part of the U.S. State Department's public diplomacy and public affairs program. American Corners are the 21st-century version of older USIA (U.S. Information Agency) libraries. These libraries were located in U.S. embassies in the days when it was possible to walk into an embassy without an advance appointment, without going through security that makes airport screening look like a game, and without leaving the trays with your belongings outside the building for retrieval only upon finishing your embassy business. American Corners are supported by the U.S. Department of State but housed in the physical space of local institutions—often university libraries—and staffed by locals. Pistoia's American Corner is in Biblioteca San Giorgio, a public library, and is the first of its type in the world.

Pistoia is an ancient city in the process of moving from its earlier industrial base to a knowledge-based economy; it has renovated a number of old manufacturing spaces to become modern libraries, hotels, and other multiuse buildings. The YouLab American Corner is a makerspace. Establishing makerspaces in libraries is a new American trend, said Karen Hartman, the U.S. embassy narrator of the video, that the State Department was proud to bring to Italy. Makerspaces and digital learning labs are places where people can come to learn how to use digital tools that promote critical thinking, entrepreneurship, and lifelong learning. Makerspaces are also about harvesting the expertise of people in a community to help with users' projects, such as the creation of videos, electronic books, applications, robots, and 3-D objects. The Pistoia YouLab has a 3-D printer, by which users can imagine and design an object on the computer and print it out in three dimensions. President Barack Obama, in his State of the Union speech, declared that 3-D printing can revolutionize manufacturing; the printer shown in his speech is the same model that Pistoia's YouLab is using (the MakerBot Replicator 2) to revolutionize its manufacturing traditions.

Following the video, parts of which were in English (with Italian subtitles) and parts in Italian (without translation), the Italian coordinator of the YouLab project spoke in Italian; her remarks were rephrased into English almost simultaneously by a woman whose ability to translate on the spot impressed me greatly. Here are my edited excerpts of the English translation of the speech by Maria Stella Rasetti:

> An old law that dates back to 1932 talks about libraries as something that can change and adapt to social changes. A library that doesn't change from practices that may have worked brilliantly in the past but do not now is destined to die and fail. We as librarians must remember, as David Lankes said: It is not electronic books or Amazon or Google that will kill libraries; what will kill libraries is lack of imagination or failure to be proactive and to experiment (http://quartz.syr.edu/blog/?page_id=27).
>
> We must experiment with new services and tools. Imagining the future of libraries means being flexible and being open and curious to the extraordinary social effects our libraries can have and should be able to do in our communities. We should be active promoters of community projects that link past to future. We can do this by using new public tools that are usually too expensive [for single users to purchase].

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Reclaiming the Physical

Usually when I return home from a conference, I have a bag full of fliers, notes, disks, and thumb drives with presentations to carry further the ideas to which I was exposed at the meeting. Sad to admit, those physical proofs of attendance are usually still in the bag when I start packing for the next conference.

After this virtual conference, I "came home" without the bag and any tangible evidence of participation, but the ideas presented stayed with me and kept nagging. In a decades-long career in libraries, I have seldom been so enthusiastic about a hot new trend. Indeed, the last time I was so excited about a library innovation was when I discovered that an Apple II+ microcomputer could be connected "online" to the ERIC database and who knew what else.

The maker movement embraces many of the ideas of what libraries are all about—in many situations the implementation of a makerspace simply moves the library mission into new dimensions. Common to many of the makerspaces discussed in Rome was their location in old manufacturing cities and buildings—re-engineering to a knowledge-based economy is a necessity in most areas now. Indispensable to the maker movement is interaction with and support by the community, providing opportunities for learning, teaching, funding, volunteering, and sharing—being social, face-to-face.

It is the notion of creating and fabricating, however, that provides the greatest reason for libraries—or other community agencies—to develop makerspaces. Public libraries have promoted crafts programs for children for decades because it increased the understanding and enjoyment of the process of creation, developed critical thinking skills, and prepared young people to appreciate literature and reading. Makerspaces simply raise the age limit for well-established children's programs and make possible the integration of work, play, and creation for a new idea of literacy and lifelong learning.

Now, 6 weeks after the Modern Leonardos event, I have been to the American Library Association annual conference in Chicago. This time I flew there and participated in person. No fewer than three divisions of ALA (those representing public libraries, youth services, and technology) presented programs on the maker movement. On the last day of the conference, there was a hands-on demonstration area in the special events section of the exhibit hall. A dozen or so tables were staffed with people who have already implemented makerspaces in their library, museum, or community, or who produce materials and resources to assist makers. One-on-one conversation was the order of the day, with the energy level high and positive. On the main exhibit floor, Gaylord, that venerable and trusted library supply company, was advertising a CubeX 3-D printer, so that libraries could become a "creative hub for artists, students, entrepreneurs, and hobbyists."

No, I don't believe that *every* library should develop a makerspace and certainly not a fab lab. But it is not such a foreign idea as it seemed to me at first hearing. And part of the appeal is the sense that since libraries now have successfully integrated all things digital into their missions and operations, it just may be the right time to reclaim the physical.

In Pistoia, thanks to the U.S. Embassy in Rome, we recently had the opportunity to envision a new future for our citizens by offering them what libraries always have in the past offered to their patrons, something that is traditional but more; we can as well offer them new skills that are transforming in a very short period of time. Teens and young patrons, creators and protagonists, creators of new digital objects that are created by them and are the results of a creative journey, a shared empowerment, created in a relaxed and informal teaching environment, peer-to-peer setting. This is what YouLab Pistoia is. It is based on energy and activity, proactively and sharing, to create a sense of community in a country where a feeling of knowledge is still lacking.

Biblioteca San Giorgio, like many other libraries, has worked extremely hard to create new alliances and groups to redefine a sense of service and to transform crisis into opportunity.

FAB LAB BARCELONA

Tomas Diez, director of Fab Lab Barcelona (BCN; fablabbcn.org), is an urbanist and has been working with fab labs for 5 years. Speaking in English and very quickly—in less than 10 minutes—he took us through 2 millennia of city models as they related to the culture and industry of the times, somehow managing to touch on and interrelate Roman style cities, medieval walled cities, the introduction of the printing press, the British industrial revolution, Henry Ford's assemblyline production, ENIAC, CNC machines, personal computers, and much more.

Diez then gave a quick visual portrait of fab labs around the world—in Afghanistan, Utrecht, Kenya, and Peru—with examples of what they are doing to make technology accessible and democratizing it. In fab labs, people can fabricate objects that are "out of the shelf," i.e., you can't buy them in a normal store—such as low-cost wireless networks, customized solar powered lamps, low cost prosthetics, and (my favorite) a chair that tells stories depending on how you sit.

Fab Lab BCN is located in a school of architecture. In a city where there is already plenty of interesting architecture, Fab Lab BCN has produced a house that changes its shape "depending on what side of the world it is in"—it will set itself to take advantage of the best solar pass. Other projects range from a digital fruit (containing a sensor and placed in a tree to sense and transmit changing environmental conditions) to Smart Citizen, a system whereby many residents place machines on their balconies to capture data about contamination in their street.

The project in Barcelona was originally planned as part of a library, but somehow decisions made after the start of the financial crisis prevented the installation of the library. The Fab Lab project continues, however, supported by crowd-

funding and the city institutes of culture, education, and economy. Diez acknowledges that perhaps Fab Lab BCN will be able to create a library. Barcelona will host the 10th annual International Fab Conference in August 2014.

NEIL GERSHENFELD AND THE ILLIBERAL ARTS

Neil Gershenfeld, director of MIT's Center for Bits and Atoms, dedicated to "breaking down boundaries between the digital and physical worlds" (ng.cba.mit.edu/neil/bio.html), then provided more background and theoretical foundation for the conference's activities. Gershenfeld is the originator of the fab lab concept and father of a growing global network of field fab labs that provide widespread access to prototype tools for personal fabrication.

Professor Gershenfeld remarked that as a young student, he had wanted to go to vocational school so that he could "make things," i.e., weld and fix cars, but he was "too smart," so he had to go to university to study. He jocularly said, "It's Rome's fault," and explained that in the Renaissance, a separation occurred between the liberal arts (the arts and humanities that "liberated" individuals) and the "illiberal arts," which existed for commercial gain. Those in the liberal arts became artists, those in illiberal arts became artisans (workers), and the divide has characterized society for centuries, ever since the invention of the printing press. He then quickly traced three analog-to-digital revolutions: in communications (1945), in computing (1955), and in fabrication (2005). He compared the hoopla about 3-D printing to the introduction of the microwave oven: When the microwave was introduced in the 1950s, the press said it would replace the kitchen oven. Of course it didn't, and 3-D printing will not take over fabrication any more than microwaves took over the kitchen. The space of digitized fabrication is much larger. About 20 manufacturing processes, including milling, grinding, cutting by laser and other means, bending, weaving, and depositing, have been digitized; printing is only one of them.

Fab labs are like minicomputers—useful for work groups, not whole companies or individuals. They are a part of the larger makerspace movement, which is inventing a future in which anyone can make anything. Digitized fabrication goes even further, in some cases, to where machines can make other machines, allowing people to "turn data into things and things into data."

Gershenfeld started the first fab lab when the National Science Foundation required him to show some social impact in exchange for the funding it had given for his MIT research into digitized fabrication. He decided to spend $20,000 for a few machines, give them to the community, and let people use them; then he watched to see if there was any community impact. From a single fabrication laboratory in inner-city Boston, the concept and reality spread virally throughout the world, aided by graduate students and lots of enthusiasm and innovation.

Gershenfeld gave a picture tour of several fab labs around the world; he also showed some items that students in his MIT classes have fabricated: a portable "scream body" that captures silently your scream of frustration and releases it later at a more appropriate time; a web browser for parrots; an alarm clock that you have to wrestle to prove you are awake; and a dress engineered to defend your personal space. The point of personal fabrication is to make one-of-a-kind things that cannot be bought in stores. There is a lot of innovation, and many fab labs have become successful both commercially and from a social entrepreneurial perspective.

Gershenfeld acknowledged that he had not at first appreciated the key connection between fabrication and education. But it has become apparent that three elements of life are integrated in fab labs: people make products, they learn, and they play, all in the same space. What is emerging is a new notion of literacy. Universities, museums, and libraries *as organizations* will not survive unchanged, Gershenfeld said. A large challenge is finding organizational leadership capable of managing such intense innovation. In response to a question about how to preserve and manage all the data being created, Gershenfeld acknowledged the impossibility of imposing order: "We need to relinquish control and depend on distributed version control and search."

DOWN TO BRASS TACKS

After a generous period of time for lunch, networking, and mini-presentations by two of the conference sponsors, the afternoon sessions scaled down from the broad perspective and big-budget projects described in the morning to several concrete examples of fab labs and makerspaces in action, where the integration of fabrication, learning, and playing were often in evidence. Although some of the presentations came from live participants in the room in Rome, others appeared at the conference site from afar through Skype or other video-conferencing media with further transmission by the Spring Event live streaming.

Kristin Fontichiaro, clinical assistant professor at the University of Michigan School of Information, spoke (in person) about Michigan Makers, a university-middle school project in Ann Arbor. The project operates on a budget of $1,400 with a lot of donated materials, including sewing machines, which are as popular with boys as with girls. The one bought piece of hardware Michigan Makers has is Arduinos (arduino.cc), a popular open-source electronics prototyping platform intended to help artists, designers, and hobbyists create interactive objects or environments.

Michigan's is a "pop-up," once-a-week makerspace, aimed at developing STEM (Science, Technology, Engineering, Math) skills in middle school kids. ("How can we create the next generation of Leonardos?" is what they asked.) In only 90 minutes of activity a week, the program is making an impact, showing that libraries with makerspaces can welcome people—both makers and mentors—who think libraries are not for them. Children in the "swipe your iPad" era are hungry to make something they can hold, she suggested. Paper crafts, particularly gift-wrapping, are some of the most popular maker activities. More information about this project can be found

Ten Ways to Learn More

Neil Gershenfeld's Fab Lab FAQ
fab.cba.mit.edu/about/faq

Neil Gershenfeld on TED.com
blog.ted.com/2007/02/20/neil_gershenfel
In this 17-minute video, Professor Gershenfeld declares that the digital revolution is over and we won, discusses digital fabrication, and talks about next steps.

Makerbridge
makerbridge.si.umich.edu
Spearheaded by Sharona Ginsberg, a master's student at the University of Michigan's School of Information, MakerBridge is an online community for everyone interested in makerspaces and maker culture, including those working in makerspaces within libraries, community centers, and schools. Includes reviews of tools.

Manufacturing Makerspaces
americanlibrariesmagazine.org/article/manufacturing-makerspaces *American Libraries*. January/February 2013

Internet Express: "Make to Learn,"
by Irene F. McDermott.
Searcher; Oct 2012, Vol. 20, No. 8; pp. 7-13.
infotoday.com/searcher/oct12/McDermott--Internet-Express--Make-to-Learn.shtml

"The Makings of Maker Spaces, Part 3: A Fabulous Home for Cocreation," by Lauren Britton and Sue Considine.
Library Journal; October 2012
thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-3-a-fabulous-home-for-cocreation

The Makings of Maker Spaces, Part 2: Espress Yourself, by Jennifer Koerber.
Library Journal; October 2012
thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-2-espress-yourself

The Makings of Maker Spaces, Part 1: Space for Creation, Not Just Consumption, by Lauren Britton.
Library Journal; October 2012
thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-1-space-for-creation-not-just-consumption

U. Nevada Library Offers 3D Printing Across the Board, by Yvette M. Chin.
Library Journal; August 7, 2012
lj.libraryjournal.com/2012/08/academic-libraries/u-nevada-library-offers-3d-printing-across-the-board

To Remain Relevant, Libraries Should Help Patrons Create, by Matt Enis.
Library Journal; May 25, 2012
thedigitalshift.com/2012/05/ux/to-remain-relevant-libraries-should-help-patrons-create

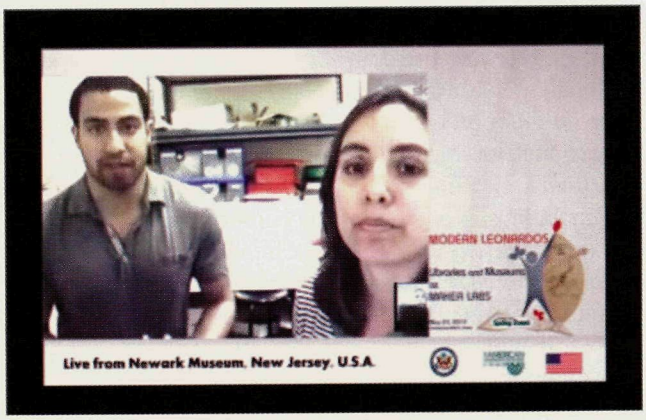
at fontichiaro.com/uploads/2013/modernleonardos.pdf and fontichiaro.com/uploads/2013/modernleonardos.ppt.

> "Today I have been stimulated with the incredible feeling of curiosity."
> —*A young Michigan Maker*

Kim Robledo-Diga, director for innovation and learning, and Jon Santiago, co-director of STEM2GETHER, spoke about the makerspace at the Newark Museum (newarkmuseum.org) in Newark, N.J. Theirs was an online presentation, transmitted from Newark through Skype. It worked, the moderator said, with a touch of relief in his voice. Indeed, there were no drops anywhere and no echo; I could see the two presenters and their slides well, though I am not sure how well they could see themselves. Even the bilingual streaming remained intact throughout.

The Newark Museum is an art, science, and technology museum; it started developing its makerspace a little more than a year ago because "it fit the mission" of the museum. The pair showed slides of some of the objects made by their makers, who may be youth in the 14- to 16-year age group, younger elementary school aged kids, or whole families. Many of the made objects are inspired by objects in the holdings of the museum: headdresses, jewelry, and woven arts. The museum runs several programs, some free and some fee-based; it had a $15,000 equipment budget and receives funding from several different sources, including grants. A big outcome for the museum is that young people are beginning to see the cultural institution as something that can benefit them now and in the future.

Sue Lawson, Manchester (U.K.) City Library, formerly outreach librarian and currently service development coordinator, gave a different perspective on libraries and makerspaces. Manchester got involved with the maker movement by partnering with organizations outside the libraries. Manchester has a long history of radicalism, innovation, and creativity,



Live from Newark Museum

according to Lawson. Karl Marx wrote part of *The Communist Manifesto* at the main city library in this city, where the first Industrial Revolution began. Manchester was the first U.K. city with a free public library, and the city also had the first fab lab in the U.K.

Due to budget cuts, there is no makerspace in the library per se, but the library works in tandem with several other organizations to support its maker programs. Thus the title of this presentation was "Makerspaces and Libraries—A Match Made in Heaven," with the emphasis on "match."

The library has started a science-fiction book club in conjunction with the Manchester MadLab (madlab.org.uk). The library buys the books for the program and houses discussions, though it would like the library to be based in the MadLab itself. The library has also hosted self-publishing workshops. It works with the Manchester Girl Geeks group (manchester.girlgeekdinners.com), providing computer programming courses for girls in two of their libraries, and with RoboGirls (manchester.robogals.org.uk). These programs have so far resulted in 35 new makers, 40 self-publishers, and 60 robot builders within the target group. Lawson explained that she loved hearing the two big questions they got from the community about these programs—"Why just girls?" and "Why in the library?"—because it made them think!

Leah Kraus, Margaret Portier, and Sarah Lawler presented on FabLab Fayetteville Free Library (fflib.org) from the library in New York. Fayetteville is known as the first public library to have a makerspace, and much has been written about its programs. One of the first things that executive director Sue Considine (cited as one of *Library Journal*'s Movers and Shakers for 2013) did upon arriving at the library in 2001 was to oversee its move to a 46,000-plus square foot former Stickley furniture factory; a "culture of creativity" has been evolving ever since.

The joint presentation placed makerspaces squarely within library traditions. "What we do as librarians is provide access to tools, content, technology, spaces, and each other ... we do it every day and we are good at it." Makerspaces do the same, they said. Makerspaces developed out of the DIY culture. They have not always been freely open to the public—often you have had to go to a university, take a course, or pay a fee. In libraries, makerspaces can provide free access to tools otherwise too costly for individuals.

Fayetteville provides programs built around STEAM Literacy (Science, Technology, Engineering, Arts, and Math), which adds arts to the four STEM literacies for which many foundations are ready to provide funds today. Making can be low cost because lots of open source materials are available. In addition to foundation grants, local companies and organizations may provide funding; Fayetteville's first 3-D printers were given by a local copy company.

The Fayetteville group said that you don't necessarily need a dedicated makerspace in the library; you can use existing spaces or an area that is being used for something that is no longer relevant. They did a maker open house in their community room with demos of 3-D printing, orange juice makers, and sewing machines—hundreds came out for these programs. Then they transformed their old teen tutoring room into a Creation Room and added video cameras, greenscreen photo developing, and space to make physical things.

Makerspaces don't need a list of equipment or activities. Ask your community these questions: "What type of things do you want to make?" and "What skills do you want to learn or share?" Librarians do not have to be experts in any of the maker activities. The librarian role is to find the people and resources to teach and learn. The Fayetteville Library is making space and tools available, but the community drives the programs.

One of the programs developed there is Take Apart Thursdays, when used and broken electronics are donated, and anyone can take them apart, learn, and maybe put them together again. Make Your Own Book uses digital cameras, iPads, and iPods owned by the library to enable patrons to create individual books. A STEAMpunk club encourages teen reading and experimenting related to the steampunk subgenre of sci-fi. Another group works with LEGO robotics (firstlegoleague.org).

One of the recurring themes of the day was the role of volunteers. Several questioners suggested that there may be a real difference between the U.S. and Europe regarding the role and practice of volunteering. More than one speaker reported that it is much easier to get volunteers for makerspace activities than for mundane tasks "like shelfreading." Teens are eager to play these roles, because it builds their self-esteem and provides them with a first job. New retirees also are great volunteers with useful skills to share. The Fayetteville team stressed that we, as librarians, can remain vital by recognizing that people in the community are experts and providing the opportunity for them to share.

WRAPPING UP THE DAY

There was an endnote speech, but it was only partially caught on the recording system, and I have to admit that by the time Matteo Tangi started to speak, my head was spinning so fast, I wouldn't have been able to bring in anything he had to say anyway.

There were also other features in the day. A series of photos showing events at the physical venue is available at flickr.com/photos/ambasciatausa/8789727649/in/set-72157633594120553; apparently, many sponsors had tabletop exhibits. There was also a 3-D design contest of some sort and awards.

I finished the day exhausted, even without a journey to Rome. In the days following the conference, I was pleased to discover that almost all the speakers were recorded, and I have returned to the Modern Leonardos site many times to hear again some of the ideas expressed. You all might enjoy the web trip yourselves.

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