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Title

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Permalink

<https://escholarship.org/uc/item/5fw1x0fn>

Journal

Library Hi Tech News, 36(9)

ISSN

0741-9058 0741-9058

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Publication Date

2019-11-04

DOI

10.1108/LHTN-08-2019-0056

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Peer reviewed

Title: Using In-House 3D Printing to Support Creative Solutions to Library Facilities Work

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Journal: Library Hi Tech News

Year: Nov 2019 Volume: 36 Issue: 9

Purpose – The paper describes a case study in which staff at the UC San Diego Library used the Library's 3D printing technology to develop unique solutions to a variety of facilities-related challenges.

Design/methodology/approach – The case study details several scenarios in which in-house 3D scanning and printing produced unique or valuable outcomes with facilities-related issues, as well as the processes that led to successful solutions.

Findings – The paper also shares benefits and challenges of the 3D printing approach to facilities-related issues.

Research limitations/implications – N/A

Practical implications – The paper includes implications for other libraries wishing to explore the use of its existing 3D printing technologies for internal, facilities-related needs.

Originality/value – Based on a poster the author presented at the June 2019 American Library Association conference in Washington, DC, this case study describes how the UC San Diego Library successfully 3D printed a variety of facilities-related items to support library infrastructure.

Keywords: 3D printing, 3D scanning, library infrastructure, furniture, equipment, maintenance, repair, library spaces, facilities

Article Type: Case study

Biographical Statement

With a background in user services at the UC San Diego Library and elsewhere, librarian Kymberly Goodson (kgoodson@ucsd.edu) has worked in a variety of roles since beginning at the institution in 2005. She currently serves as Program Director for the Library's Spaces, Lending, & Access Program. A combination of the former Learning Spaces and Access Operations programs, activities within SLA's purview include user technology and equipment, digital media services, learning space design and functionality, circulation, billing, reserves, building hours, user feedback initiatives, selected outreach to students, and more.

Introduction

The UC San Diego Library's Spaces, Lending, & Access (SLA) program is responsible for a range of activities associated with user spaces, furnishings, technology, and equipment. As such, in collaboration with the Library Facilities Services team, its related staff are assigned to monitor and address facilities-related issues in the Library's public spaces. The SLA program

also manages the Library's Digital Media Lab, which operates a popular 3D printing service for the campus community.

3D printing started to be introduced in public and academic libraries over the past decade and continues to be popular, even as decreasing costs have enabled many to purchase the equipment for personal/home use. The UC San Diego Library installed 3D printers in its new Digital Media Lab in 2015. While this free service is perpetually in demand by library users, staff have also considered how it could be used for operational purposes within the library. As one example, we previously considered whether nametags for service desk staff could be 3D printed in the Lab, in part, as a unique way to spark conversations with users and informally promote the facility and its 3D printing. Another suggestion was to 3D print unique signage for various library spaces such as group study rooms. While these ideas ultimately proved too cumbersome and time-consuming to implement, staff continued to brainstorm ways for the library to take advantage of its 3D printers to support internal needs or uses.

With over two and a half million visitors annually, wear and tear, unexpected breakage or damage, and theft or other loss of furniture, equipment, and infrastructure is frequent and heavy. Some problems can be addressed with existing or available tools and supplies. In other cases, cost, the unavailability of parts, the need for a custom solution, or problematic delivery times from vendors can create barriers or delays to resolving issues. It was in one of these instances that an SLA staff member initially proposed using the Library's 3D printers to develop a unique solution to a facilities-related problem, an initiative that the author later presented as a poster at the June 2019 American Library Association conference in Washington, DC.

3D-Printed Examples

The first circumstances for which 3D printing proved to be an effective intervention had plagued us for several months. Fifty flush-mounted, tabletop electrical outlet inserts on a series of tables across the library were no longer functional. Our desire was to replace the inserts rather than leave non-working outlets or large open holes in the tables, or to spend limited library funds on new electrified tables. However, the size of the holes left from removal of the damaged outlet inserts were mismatched from any new inserts we could identify in the marketplace. We'd spent several months corresponding with and sending photos to vendors to attempt to find an outlet insert that would fit the existing openings. Four options were sent to us one by one, each of which proved too large or small for the opening and were sent back. Our Spaces Specialist then drew on paper a panel that he thought might work to fill the gap and allow a smaller insert in the hole and then approached local machine shop staff to see if they could create one on their CNC machine for us to try. However, they wouldn't fulfill an individual or small batch order. Weary from this cumbersome, time-consuming, and ultimately unsuccessful exploration, our Spaces Specialist then began brainstorming with our Digital Media Lab (DML) Manager. With requirements and dimensions established for a workable panel, the DML Manager used Autodesk to prepare a file for 3D printing. The collaborative team developed a customized solution pairing smaller outlet inserts with flat 3D-printed panels to fill in the resulting gaps between the outlets and the table left by the removal of the previous, larger outlet inserts (see *Image 1*). They first printed one model, then perfected the design with a modified version. The pairing of the new 3D-printed panels with an existing supply of smaller outlet inserts from a different batch of previously discarded tables enabled us to save a substantial amount of money over purchasing either new outlet inserts or new tables.

The UC San Diego Library's second instance using 3D printing to address a facilities-related problem was our need to install and secure SenSource people counters in the public stairwell.

We'd successfully used the counters for several years in doorways to specialized rooms in the library. However, the counters weren't made to be installed effectively on the square, metal railings of a staircase. This unique need for something not available in the marketplace again brought together our Spaces Specialist with our Digital Media Lab Manager. The pair visited the install site for the counters and brainstormed possible designs, with the Lab Manager again finalizing a successful design in Autodesk. This second exploration led to the 3D printing of 5 copies of the customized holders for the counters (*see Image 2*) and further established this successful collaboration on possible solutions to this and later facilities issues.

One example where that we've been able to implement in two capacities has been light switch covers. Several years ago, we implemented these in a set of four group study rooms. These rooms were fronted by a glass wall in a series of colors intended to match other areas of the library. Because the lights in the rooms need to be on for maximum artistic effect of the colored glass, and to enable easy monitoring of group study room use, the lights are intended to stay on during the library's open hours. However, students often turned out the lights when leaving the rooms. The 3D-printed light switch covers had the desired effect of keeping the lights consistently on. More recently, we discovered another use for these items. Because of the construction of various library staff spaces over the years, two sets of roughly a dozen lights each in two adjacent public areas are controlled by switches in two separate staff areas. Staff in at least one area were unaware of this and thus unknowingly turned off a section of public lights when they left the office each day. Neither users nor late night staff knew how to turn the lights back on. Once discovered, light switch covers were installed to prevent this troublesome issue and thus reliably keep the public space lights on.

These early successes helped to solidify our commitment to this 3D-printed approach wherever possible, reasonable, and/or beneficial. We've since 3D-printed a wide variety of other facilities-related items, including short chair legs, missing levelers (feet) for chairs in the Library's public spaces, multi-use brackets, outlet covers for the child-friendly study room, and cord management solutions. We've found that once the idea is raised to 3D print items on demand, uses for this approach reveal themselves regularly.

Such was the case when, after having used this approach in a variety of circumstances, 3D printing proved an apt solution to another longstanding problem. One endcap of a crash bar on a frequently used fire door in the library's public space had been missing for several years. As a result, the sharp, exposed piece on the edge of the crash bar posed a risk of user injury and required staff to regularly wrap the end in duct tape. Our Media Lab Manager began by taking a photo of the remaining endcap and using it to produce a file in Autodesk to fabricate a new, customized endcap using 3D printing. Not only does the bar with the 3D-printed endcap no longer pose a hazard, but it no longer looks unprofessional and neglected (*see Image 3*).

Two final examples illustrate how we were able to repair items using 3D-printed parts, again, when the needed items were not available individually in the marketplace, rather than discarding or replacing costly equipment. When two large whiteboards formerly used in a library classroom were replaced, the older ones were to move to the public spaces, as our inventory of whiteboards has yet to satisfy students' ever-growing need for these tools. However, one of the whiteboards was missing a knob that held the writable surface onto the large, wheeled frame. With relative ease, we were able to 3D scan a remaining knob as a model and then 3D print the absent one. Likewise, one of our free-standing wooden sign holders was missing one of the four knobs that held its acrylic front to the frame. While it remained functional, the missing piece made it look unprofessional. Again, student workers from our Digital Media Lab 3D printed the knob after 3D scanning an existing one.

Benefits

A 3D printing approach brings with it several operational benefits, including the potential to save money on parts or by fixing rather than replacing broken equipment. In some cases, UC San Diego Library staff found that aged, broken parts were no longer available from vendors or that a particular vendor had gone out of business. In other cases, vendors simply no longer carried the needed parts or parts were out of stock. 3D printing permits the creation of one-off items or a desired quantity on demand, rather than requiring one to buy and store inventory in bulk. 3D printing on-site can make parts available more quickly, eliminating delivery time from a vendor, and materials costs for 3D printing on this scale are negligible.

Another significant benefit is how this approach enables fabrication of unique, customized solutions not available in the marketplace. 3D printing accommodates experimentation, testing of iterative designs to ensure needed functionality, and the ability to improve upon existing options and solutions.

More philosophically, 3D printing takes advantage of the Library's existing resources and investment in technology, supports expansion of staff skills, and allows staff to model desired behavior for users. This approach supports lifelong learning for facilities/spaces staff who learn 3D printing and skill-building/training for those who perform or teach 3D printing. It fosters the development of facilities/spaces staff as ambassadors for 3D printing and digital media services. Additionally, it encourages brainstorming and creative problem-solving among participating staff. Further, we've built a bank of stored 3D scans that we can use again, as needed, while also sharing some of the designs more widely with others via upload to Thingiverse.

Finally, through signage or labeling, libraries can promote their 3D printing and media services at the site of 3D-printed items in the library's public spaces.

Challenges

While the benefits to this approach can be numerous, challenges can also exist. Facilities/spaces staff are likely to experience an initial learning curve, and some may be resistant to learning new tasks. 3D printing/media lab staff may also show resistance to any additional workload in supporting new learners and assisting with these projects. A further challenge seen at the UC San Diego Library was that heavy existing student use of the library's 3D printers limits the time available for use of these machines.

Advice for Others

When trying to introduce this initiative in your library, seek out a facilities or spaces staff member that is excited and/or knowledgeable about 3D printing. However small, identify a facilities-related challenge for which a solution (or an *ideal* solution) has not yet been found. Establish a partnership between the facilities/spaces designee and those who manage your 3D scanning and printing operations. Share the potential of the approach with these technical staff and ensure that they are willing to participate. Have the new team explore and experiment with solutions to the identified problem, and then implement the preferred solution. Use this initial success story to inspire facilities/spaces staff to enlist additional participation from their peers and to brainstorm further opportunities to apply this method. Going forward, continue to actively seek out occasions to use this approach to maintain and hone staff skills.

Remember to be patient and encouraging with those learning new skills. Our Media Lab Manager taught our Spaces Specialist more about 3D printing by first printing an exact copy of a simple triangular door stop. Thereafter, they developed and iteratively improved upon the 3D-printed design by adding gripping spikes to the bottom to better grasp a carpeted floor when holding open a door. This helped teach the Spaces Specialist about the design and scanning process behind 3D printing and about the potential of this iterative approach. This also inspired the Spaces Specialist to brainstorm and watch for additional opportunities to take advantage of this practice, and also to introduce Facilities colleagues to it, where appropriate.

Another approach could simply be to search for items useful in your environment on an open database such as Thingiverse. Numerous generic items such as door stops, business card holders, pencil cups, and over-the-cubicle coat hooks are available there. You can view and download the files for some of the items mentioned in this article on that resource.

- Crashbar Endcap <https://www.thingiverse.com/thing:3825833>
- Power Plate Adapter <https://www.thingiverse.com/thing:3825823>
- PeopleCounter Stairwell Bracket <https://www.thingiverse.com/thing:3825828>

Conclusion

The UC San Diego Library has successfully 3D printed a variety of facilities-related items to support its library infrastructure, furniture, and equipment using existing library resources. Most recently, our efforts have expanded further, with our Digital Media Lab Manager collaborating with our Safety & Security Director to 3D print emergency call box brackets and stands for use at public service desks and elsewhere in the public spaces. We're confident that our example can inspire other institutions to begin using their 3D printing technology to support similar creative, cost-saving, and lifelong-learning applications.

Special thanks to Nicklas Lee, Scott McAvoy, and Keith Langford for their assistance in designing and creating the 3D-printed items mentioned in this article.