Selecting and implementing leading edge technology services: Library as partner in the innovation ecosystem

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Abstract

The practice of libraries – and with it, librarianship – continues to evolve. New technology and services are fundamental to library support of innovation and creativity; deciding which technologies and/or services to implement can be less clear. The overlap of design thinking with best practices of emerging technology and libraries offers a practical approach: real-world examples of success and failure reveal the outlines of an emerging framework for improved selection and implementation of leading-edge technology in the library environment. Novel services and technologies offered by a library that is part makerspace, part accelerator, and full partner in the innovation ecosystem of the university are shared, offering simple steps and insight that can increase the likelihood of successful selection and implementation. Revitalized spaces of the library become a natural hotbed for open innovation; enhanced depth of learning, creativity, and increased opportunities for successful tech transfer appear to be a natural result.

Keywords: Emerging Technologies, Open Innovation, Design Thinking, Makerspace

1 INTRODUCTION

Across the educational landscape the practices of teaching and learning continue to shift. Today's library is more knowledge center than merely repository of books; libraries continue to evolve their practice in response with increasingly direct support of innovation and creativity within its walls. The growing recognition of the connection between active learning and student performance (Falcon, n.d.) combine to create new roles for today's academic library. (Lankes, Silverstein, and Nicholson, 2007) clearly identify a core function of the 21st century library: "knowledge is created through conversation. Libraries are in the knowledge business. Therefore, libraries are in the conversation business." This paper explores a framework by which conversation with the communities of the library creates actionable knowledge that informs and increases the likelihood of successful implementation and adoption of technology and associated services within the library.

At the University of Nevada, Reno, the author served as one of the members of the team that opened the Mathewson-IGT Knowledge Center in 2008. With the role of "knowledge center" central even to the name of the facility, the building with over 28,000 square meters of public floor space specifically incorporated collaborative spaces throughout – in addition to serving as home of several libraries the building. At the heart of its design was the concept that knowledge is created through conversation. As librarians, our collective mission grew to embrace facilitation of that knowledge creation and its distribution throughout the communities supported by the library.

Over the course of time, conversations between members of the supported communities expanded to incorporate library faculty and staff, enabling a deeper understanding of their needs. That deeper engagement and empathy led directly to increased success in the selection and implementation of technology services within the library. The increased success appeared to be largely due to the library's application of design thinking methods informed by best practices of emerging technologies and knowledge management. This paper explores that combination by sharing details of a number of technologies and services selected and implemented by the library, revealing outlines of emergent best practices and a framework that may enable others to benefit.

2 TARGETED INNOVATION

Out of a universe of possibility, which technologies should the library invest in and build services around? Available resources, temporal, financial, and human, are intrinsically limited. Figure 2 illustrates the pragmatic approach taken by the library in selecting and working across the organization to build out and support technological services within the library:

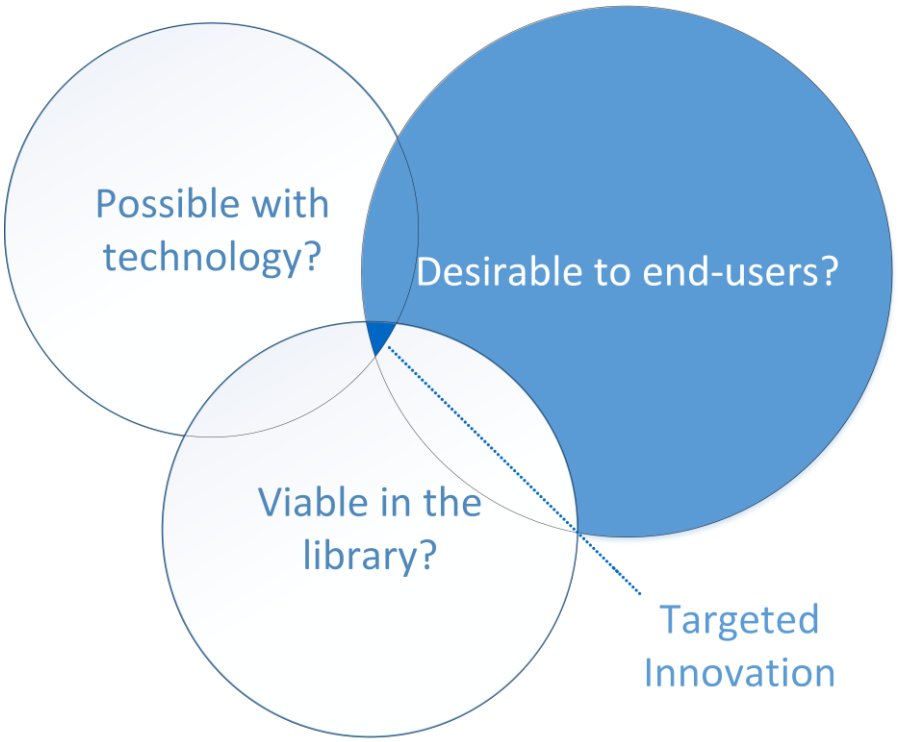

Figure 1: Targeted innovation that maximizes use of resources while optimizing chances for successful implementation draws from the overlap between the possible, the desirable, and the viable in the library.

The overlap of three filters can increase the likelihood of successful selection and implementation. The first, awareness of what is possible with technology, is informed by ongoing environmental scans by the library practitioner, a standard practice in the field of emerging technology. The second, awareness of what is desirable to end-users, can be greatly enhanced by leveraging the methods of design thinking, and is detailed in the following section. The third, what is viable in the library, is a moving target and arguably a strength of library management. Targeting innovation in the overlapping area

of the three subsets maximizes the likelihood of successful implementation and adoption, while optimizing use of limited resources.

3 DESIGN THINKING AND THE BEGINNINGS OF A FRAMEWORK

The methodology of design thinking can be a powerful tool in the library's ongoing efforts to identify technologies for implementation within the library. An approach to improving libraries through creative problem-solving (IDEO, 2018), the outlines of the practice can be detailed in as few as three to as many as eight phases. For the purposes of this paper the author has opted to use the framework as defined by the Hasso-Plattner Design School (Plattner, Meinel, and Liefer, 2011) at Stanford University. Presented in Figure 2, the five phases of Empathise, Define, Ideate, Prototype, and Test outline the practice. Although represented as a seemingly linear progression, the design process can operate in a fundamentally parallel fashion, with phases feeding one another and potentially several underway simultaneously. At the outset, Define and Ideate phases serve to bootstrap ideas further refined in the Prototype and Test phases. Once underway, however, the prototype testing informs repeated secondary passes through the Define and Ideate phases; one phase informing the other, as the initially serial process becomes parallel in its progress toward a converged outcome.

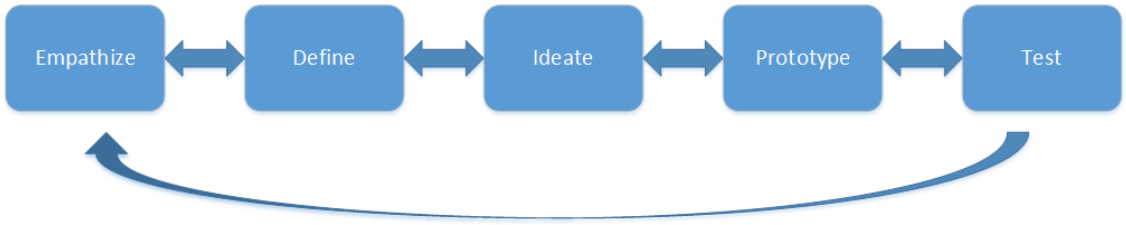

Figure 2: Five phases of design thinking. Note that although phases can operate sequentially, in practice multiple phases might be operating simultaneously and in parallel.

The fundamental phase that enables effective design is a deep-seated understanding of the end-users of the library and its services – that is, to Empathize with the communities to be supported. Building on that understanding, it becomes possible to Define relevant design challenges around the needs of the communities served within the context of the library, bringing clarity and focus to the task at hand. Identifying a meaningful and actionable statement drives the process by building on the deep understanding of, and empathy with, potential end-users. Indeed, the design process is best done in collaboration with the community; rather than operating in the relative vacuum of secluded and private office and staff space, throwing the doors of the process open to include the community will greatly increase the richness and eventual success of the process.

Building on core understanding and depth of connection with the communities served the design team can springboard into the free-thinking Ideate process. Ideas flow fast and furious around the identified design challenge(s), producing the raw material of innovation; a rich environment that coalesces and expands into real-world possibility in the Prototype and Test phases. It bears mention that the goal of the prototyping and test phases is not a final polished product, ready for production use, but rather the further exploration of the ideas introduced earlier in a rapid fashion. The iterative nature of the process ensures further refinement of potential solutions, and the discarding of others in

favor of more optimal solutions; a continuing spiral of refinement and improvement as the design challenge is more effectively resolved.

4 WORKING THE FRAMEWORK

The following examples of real-world design challenges/opportunities that have led to successful implementation of novel library services at the University of Nevada, Reno, are offered in illustration:

4.1 Large-Format Poster Printing

An early example, in late 2006 the library embraced a design challenge centering around appropriate potential use/re-purposing of a large-format printer that had been purchased more than five years previously. The initial intended use, that of printing maps on an as-needed basis for the geosciences community supported by the library was still valid, though woefully underutilized. How might the library make more effective use of the printer to meet needs more broadly across its supported communities?

The printer was one of the resources of the DataWorks visualization lab of the library. Students and faculty that made regular use of the computer lab to perform research and analysis of data would often share their results by means of large-format posters presented at professional meetings. Could the library consider implementing and operating a large-format poster printing services designed to meet researcher's needs to be able to print posters to be presented at professional meetings? It seemed a natural adjunct to the data visualization role of the lab and could be accomplished at minimal additional cost. Building on a fundamental empathy with the community, with a depth of understanding of the need, it was a simple task to conceive of and prototype a library service: after initial conversations surrounding paper types and sizes, the earliest prototype of the poster printing service was launched on a cost-recovery basis.

In its first semester of availability, the service printed only a few tens of posters. Nevertheless, its availability was enthusiastically welcomed by the supported community: the following semester saw as many as 45 posters printed in one day, dramatically overreaching the capacity of the aging printer. Returning through the prototype/test phases, new technology was identified that could better meet the need, and over the course of several years multiple printers were obtained, with the development of associated supporting software infrastructure and staff. In the University with student enrollments passing 20,000, and a Carnegie ranking (Indiana University, 2017) of Doctoral Universities: Higher Research Activity (R2), the poster printing service prints on the order of 7,000 large-format posters annually across two libraries and three large-format printers.

4.2 Whiteboard Walls

By engaging more deeply with members of the science and engineering communities that adopted the large-format poster printing services, the need for collaborative writeable surfaces, such as chalkboard and whiteboard, was surfaced. Expressed by potential end-users as a need to be able to "get ideas and mathematics out of our heads" and into an arena where they could be actively worked on with others, in 2008 the

library implemented an early prototype by purchasing several rolling whiteboards to test the need.

Despite repeated encouragement, the new whiteboards saw little use; in its haste to be of service, the design team had skipped a critical step: low-fidelity prototyping with the community that would have revealed the flaw. Dimensioned at 24 inches wide by 36 inches in height, the surfaces were simply too small – in the words of one member of the community, the small whiteboards weren't "even big enough to write the problem down." Subsequent purchases of rolling whiteboards dimensioned at 48 inches in height and 72 inches in width saw immediate heavy and repeated use throughout the library.

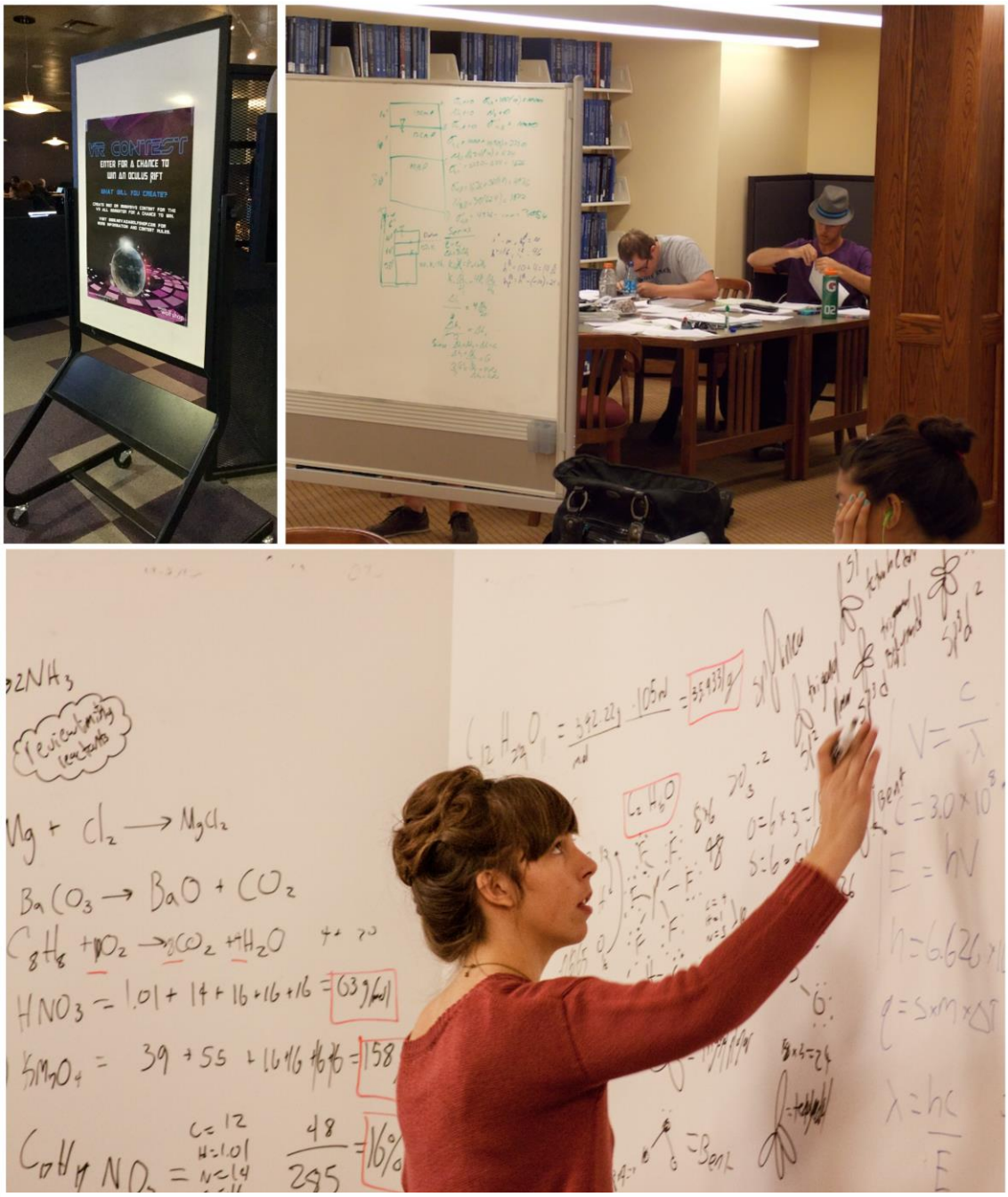

Figure 3: Illustrating serial iterations of the prototype/test phase in the development of collaborative writeable surfaces as a resource within the library; one of the earliest, seen at top left, was "too small" and quickly relegated to tasks such as displaying signage.

Continued iteration of the design process yielded further refinement and achieved critical mass in terms of use; by 2011 the design challenge shifted to scalability and sustainability. Subsequent prototyping/testing involved the use of whiteboard paint, enabling significant expansion of availability of the technology throughout the library (MDC, 2018): at a cost of less than one-fourth that of the enameled porcelain whiteboard, significant expansion became possible. Continued working of the design process with the supported community yielded insights that further ensured successful implementation and use: for example, painting a wall floor to ceiling, rather than simply a framed rectangle on the wall, not only increased the utility and availability of the technology, but in the minds of the end-users, stimulated creativity.

The library's most recent iteration through the process included the addition of targeted coating of collaboration and workstation tables throughout the library, expanding the availability of the technology to the point of need. The library of 22,500 square feet currently has nearly 20,000 square feet of whiteboard writable surfaces.

4.3 3D Printing and Scanning Services

Perhaps emboldened by the library's continued focus on building the deep understanding and empathy with its supported communities, in 2011 researchers from across campus approached the library expressing the need to be able to 3D print objects in support of their research. How might the library better support that need? Would the library consider purchasing the technology needed and implementing 3D printing and scanning services in support? The library convened the conversation from across disciplines (Colegrove, 2014) to work the Empathize-Define-Ideate phases of the design process. By clearly defining the need from a trans-disciplinary standpoint, and brainstorming potential resolutions, the library was able to more successfully launch early prototypes of the service. In mid-2012 the library had become the first academic library in the United States to have implemented 3D printing and scanning services available to all (Chin, 2012).

Initial prototypes included aspects that would not survive into subsequent versions of the service: for example, selection of a 3D scanner that, unbeknownst to the design team, had previously been vetted and identified as a poor choice by researchers in the Engineering disciplines. Although the library's understanding of and connection with its supported communities had grown, the team lacked input that would've enabled better initial selection. Nevertheless, subsequent iterations benefitted as early equipment selections were retired and replaced: over the course of the nearly seven years' existence of the service, the library has iterated through five different scanners and eight different types of printers, arriving at its current offering of two different handheld scanners and three printers that bracket the range of end-user needs.

4.4 Lendable Technology

As connections with the supported communities of the library deepened, so did the understanding of their needs. Seen through the lens of the library, targeted acquisition and sharing of selected technologies as part of the library's growing lending technology collection became commonplace in meeting community information needs. Examples included the acquisition, support, and provision of lending of visualization resources ranging from Oculus Rift and HTC Vive virtual reality headsets to the augmented

reality heads-up display Google Glass. Both cases illustrate a fundamental truth in terms of lendable technology: the more exciting and cutting-edge the technology the more rapidly changing the landscape is. To maintain relevance, such technology is rapidly changed out by its replacement: from the initial launch of the Oculus Rift Development Kit "DK1" in 2013, the library has replaced/upgraded the version of the technology available in its lending collections three times in just under four years. In a similarly rapid fashion, despite intense interest and use for a relatively brief period of a year, the Google Glass quickly became obsolete as the company seemingly changed direction entirely with the product.

On a more granular level, micro-programmable technologies such as the Arduino Inventor Kits (Sparkfun, 2018) and a broad range of resources surrounding open source development with the Raspberry Pi (Raspberry Pi, n.d.) were introduced, proving fundamental to the support of electronics tinkerers. Lending collections, supported by library traditional print and electronic resources, provided a path for end-users interested across the spectrum – from building circuits, to programming, to high-end visualization tools. In each case, technology selection began in the fertile grounds of conversation building the deep-seated understanding and empathy for the needs of the community.

4.5 Laser and Vinyl Cutters and the Emergence of Makerspace

Other examples quickly followed suit, one building upon the next. Needs identified by means of the design process led to the selection and implementation of both laser and vinyl cutter services within the library (Colegrove, 2017). In contrast to the additive nature of 3D printing, both the laser cutter and vinyl cutter services are intrinsically subtractive, as material is cut or ablated away to produce output. In each case, not only was the initial need identified, but the particular technology purchased, and the supporting library services – such as scheduling and maintenance – were developed following the design process: building from empathy and understanding, through definition and ideation around the design challenge, with an ongoing iteration of prototyping and testing to refine.

With the addition of yet another subtractive service, that of the printed circuit board mill, capable of manufacturing custom circuit boards to the design specification of end-users, the library once again got ahead of the design process. Although a service of key interest to a subset of the communities supported, technologically possible and theoretically viable within the library, the library continues to struggle with its support. The reality of working the design process is that failure is a fundamental part of the process, serving to inform ongoing development and refinement.

5 DISCUSSION AND SUMMARY

This paper has introduced the beginnings of an operational framework that can enable the practitioner to more effectively select, and successfully implement, technology and associated services in the library. Rather than a step-by-step prescription, examples shared offer insight into the practice of one library in its support of researcher, classroom instructor, and learner alike; a tantalizing view that only hints at the possibility as libraries more effectively target and implement technology services in support of their communities. Building from a deep-seated understanding of, and empathy with, the community, a laser-sharp focus becomes possible – informed by the combination of best practices of emerging technology and brought into focus by library

management's keen sense of viability. By working with the supported community to define the challenge what is working what is not, while coming up with ideas to resolve identified challenge while quickly iterating through prototypes and tests of potential offerings, it becomes possible to arrive at a more direct meeting of end-user needs while more economically and effectively introducing new services to the benefit of all.

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