Innovation and Growth: Applying Clayton M. Christensen's Theories to Academic Libraries
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Abstract

Academic libraries are facing many challenges as documents become digital objects on the network and services that were once their sole province are now provided by others at network-scale. Academic libraries will need to identify and develop new services if they are to remain vital. Using two theories from Clayton M. Christensen's work, the first on different kinds of innovation and their impact on growth, and the second on the "jobs to be done" framework, can guide librarians in this task. Understanding the different types of innovation and the results they bring should shape budget and resource allocation strategies. Understanding the "jobs of be done" framework should provide the means of identifying new products and services that will be valued by students and faculty. The two theories, taken together, can provide academic libraries the means to assure their continuing relevance.

Introduction

"Big breakthroughs happen when what is suddenly possible meets what is desperately necessary." — Thomas Friedman[1]

For the past several decades, academic libraries have been transitioning to a world where documents are bits on the network rather than print on paper. It has not been easy. Digital content and the systems that make it discoverable, accessible, and preserve it are most efficient at network scale. Leveraging network scale services to provide value in local contexts has often been difficult. Often these network scale services replace functions that were long a staple of library practice. For example, Google and Wikipedia have supplanted much of traditional reference work.

The transition to digital content is driving changes in many aspects of the library's work. The scholarly record, which it has long been the library's primary responsibility, is morphing and becoming more complex. As Brian Lavoie and his colleagues put it in their 2014 OCLC whitepaper, *The Evolving Scholarly Record*:

> The ways and means of conducting scholarly inquiry are experiencing fundamental change, with consequences for scholarly communication and ultimately, the scholarly record—the curated account of past scholarly endeavor. The scholarly record is evolving into a corpus of material vastly different from its previous print-based version. While in the past the scholarly record was largely defined by the formally published monographic and journal literatures, its boundaries are now both expanding and blurring, driven by changes in research practices, as well as changing perceptions of the long-term value of certain forms of scholarly materials.[2]

Academic libraries are grappling with how to manage the new digital terrain without being able to relinquish their traditional responsibility for a large, but increasingly little used, legacy print collections. They have been, for several decades, been caught in a financial squeeze

between journal price increase well above the rate of general inflation and limited increases in library budgets.

With the growth of the Internet and the ease with which anyone can find basic information on almost any topic, a task that once required the use of a library and often the help of skilled librarians, many understandably wonder whether libraries continue to be necessary. Responding to these concerns has been a primary ACRL focus for over a decade. In 2010 *Value of Academic Libraries: A Comprehensive Research Review and Report* was published and since then there has been continued research, workshops and webinars. Outreach material, additional reports, and an online dashboard have been created.[3]

This article will apply two theories form the business theorist Clayton M. Christensen in the hope of providing a way of thinking about how to proceed. The first is Christensen's analysis of the different types of innovation and their impact on growth.[4] This work can provide a way of thinking about budget and resource allocation strategies that will provide the library the capacity to make investments in new services. The second, Christensen's "jobs to be done" framework is useful in identifying opportunities for disruptive, or what Christensen now calls market-growing, innovations.[5] It is this type of innovations that will add value for students and faculty and assure continued support for the library even as many of the library's traditional functions are being disrupted by network scale systems and services.

Previous Applications of Christensen's Work to Academic Libraries

The application of Christensen's work to academic libraries and scholarly publishing has been surprisingly limited given the broad influence of this work in the business world. Shea-Tinn Yeh and Zhiping Walter apply Christensen's work, especially his Resources-Processes-Values framework, to academic libraries, argue that libraries need pursue service innovations, and make recommendations on ways this can be done.[6] David W. Lewis reviewed Christensen's 1997 book *The Innovator's Dilemma* and applied its lessons to academic libraries.[7] Lewis also used Christensen's work to argue that gold open access was a disruptive innovation and predicted that it was "inevitable" that gold OA would become the dominate business model for scholarly journal publishing.[8] Siddhartha Menon linked Christensen's disruptive innovation theory with theoretical work on the generativity of the internet in the context of information and communications technologies.[9] Lee Sims examined legal research tools in light of Christensen's disruption model and identified new players who were disrupting established publishers.[10] Heather Lea Moulaison and Anthony Million speculate that link data may provide the basis for disruptive innovation in the future, though it has not yet done so.[11] Albert N. Greco looked at recent developments in scholarly journal publishing in light of Christensen's models of sustaining and disruptive innovation and found most developments to be sustaining and the disruptive ones, he identifies predatory publishers and Sci-Hub, to have to have negative impacts.[12] Joseph J. Esposito opines on innovation in an *Against the Grain* Op Ed and notes that most innovation in publishing is sustaining and identifies the ArXiv as a rare example of innovation of the disruptive type.[13]

The limited application of Christensen's theory to academic libraries, fewer than ten articles in the past decade, is surprising given the challenges libraries face. As Lewis put it, "What is clear in the review of all three areas of library practice is that alternatives exist, or could easily exist, that are cheaper, easier, faster, and more convenient than the comparable services now offered by libraries."[14] While the threats Lewis identifies are well understood using Christensen's work, which has been widely applied in other sectors, to understand and respond to it has not been a focus for academic libraries.

Christensen's more recent work should provide library leaders with tools to they can use to seer their organizations so as to grow services and create new sources of value for their campuses.

Theory One: Three Types of Innovations

Christensen's early work considered two types of innovations. The first and most common was sustaining innovations. Second was disruptive innovation, which in his later work Christensen terms market-growing innovation. The identification of this counterintuitive form of innovation was Christensen's most powerful insight. The third type of innovation is efficiency innovation. Each type of innovation has its own dynamic and leads to different results.

Sustaining Innovation

Sustaining innovations make existing products or services better for existing customers. These types of innovations happen constantly and are what all good organizations do day in and day out to keep their products and services competitive. Some of these innovations are small tweaks and others involve complex and difficult technical transformations. Regardless of the nature of the sustaining innovation the existing providers almost always emerge with their market share intact. They are motivated to battle to maintain their position in the market and have the resources to be successful at doing so. New entrants who attempt to attack establish markets with sustaining innovations are as a result rarely successful. Importantly, sustaining innovations do not create new jobs and the resources required to produce the new version of the service or product is similar to what as required to produce the older version. The product is improved, but the business model remains the same as do the resources, both human and capital, require to produce it.

Disruptive or Market-Growing Innovation

One of Christensen's key insights was that the speed at which products get better is greater than the ability of individuals to integrate the improvements into their daily lives. As a result, products that start out with limited capacity relatively quickly develop more capacity than most customers require. What starts out as not good enough become better than it needs to be. Christensen also observes that most products and services begin by targeting consumers who richer and have the time and skills to use the product. The product or service might have the potential to help many more people, but only the top end of the market can afford it. These two dynamics provide an opportunity. Occasionally a new product is introduced, almost always deploying a new technology in combination with a new business model. This product or service has less capacity than the existing products, so established customers don't adopt it, but it is cheaper and easier to use and so people who hadn't been able to afford the established product become consumers of the disruptive product. This process democratizes the product. Over time the product gets better and better and attracts more and more customers from the established providers who will often give up the bottom end of their customer base and move upmarket to serve their most demanding customer who provide the highest margins. This dynamic serves everyone until the new disruptive product becomes good enough to serve the high end and then the established provider goes out of business. Christensen originally

documented disruptive innovation in the disk drive industry and it has taken place in many industries from computers to music to travel. Think personal computers, iTunes or Spotify, and Travelosity, Airbnb, and Uber. Disruptive or market creating innovations don't happen often, but when they do they create dramatic change and restructure industries. Disruptive innovation though are risky ventures that require time and resources to create and bring to market, but when they succeed new companies are born creating new high quantity jobs, which in turn drive prosperity for communities and nations.

Efficiency Innovations

Efficiency innovations are what the name implies. They provide existing products or services at a lower cost. This can be done with technological, process, or organizational changes. For example, Walmart streamlined its supply chain and by doing so reduced costs giving it a significant efficiency advantage over its competition. Outsourcing is another common form of efficiency innovation. Efficiency innovations result in fewer jobs and they free resources, usually capital. This type of innovation can be good for individual organizations, but the results for the community are often negative. The experience of many communities when a Walmart store is opened is a good example.

All three types of innovation are present in academic libraries and scholarly communication. As is the case in other industries, sustaining innovations are common. They cover all aspects of a library's activities — a better workflow, a different pedagogical approach, better wayfinding in the building. Efficiency innovations are also reasonably common. Approval plans are an example; book selection is outsourced to experts working for a book dealer. Patron driven acquisition is another example; here selection is outsourced to users. Disruptive innovations, as is the case in other sectors, are rarer. As noted above, Lewis has suggested that gold open access is a disruptive innovation. A clearer example is the ArXiv, which used the new technology of the Internet and a new business model — self-deposit and automatic delivery — that resulted in much quicker access to the physics preprints for both established physics researchers and at the same time making them available to students and the general public.

To summarize, Christensen notes that the different types of innovations lead to different results both for organizations and the communities they inhabit. Sustaining innovation improves product or service quality, but generally uses the same human and capital resources as earlier versions of the product. They provide stability, but not growth. Efficiency innovation delivers a product that is of the same quality, but uses fewer people and less capital to do so. These freed resources can be reinvested or taken as profits. The product cost less, and the size of the organization shrinks and jobs are reduced. Disruptive or market-growing innovation requires patient capital investment and can be risky, but if it is successful new jobs are generated that increases the size of the organization, often significantly. Disruptive innovation, Christensen argues, is what drives both organizational and community growth.

Theory Two: Jobs to Be Done

Many people believe that disruptive innovation is unpredictable. Christensen disagrees. He argues that with the right approach opportunities for developing disruptive innovations can be identify. Taking advantage of these opportunities may not be easy, but if solutions can be found they have a good chance of success.

The key to identifying opportunities, Christensen argues, is to focus on the jobs people need to have done to make progress in their lives. Most of the time product development focuses on the customer. Christensen argues that this is the wrong unit of analysis. Individuals have many jobs to be done and they are different at different times and in different circumstances. Christensen's classic example is milkshakes.[15] He was asked to look at milkshake sales for a fast food company. The company had large amounts of data on the characteristics of the people who bought milkshakes. They had done focus groups with people who had these characteristics asking them how their milkshakes could be improved. When the recommendations of the focus groups were implemented, there was no impact on sales. Christensen and his colleagues identified people who bought milkshakes and then asked them to explain the job they had hired the milkshake to do and what they hired to do that job when they didn't hire milkshakes. This approach identified opportunities to modify milkshakes and how they were sold. When the customer is the unit of analysis you get correlation. People with these characteristics tend to do or want a certain thing. When the unit of analysis is the job to be one you are more likely to get causation. A person in these circumstance needs to accomplish something and will hire this product or service to do so. The insights provided by the second analysis are much more likely to lead to products or services that people will value and use, or as Christensen would put it, hire. Once the job to be done and the context in which it needs doing is understood, it is easier to create a solution that will make doing the job cheaper, faster, or easier. This is the best way to attract users of your product or service. Many of the jobs to be done have been around for a long time, for example, needing to get a message from here to there as fast as possible. New technologies offer new way to do the job. Once the best way to do this job was with a messenger on horseback; then there was the telegraph, the telephone, FAX, e-mail, and texting. As new solutions to this job were provided more people who needed to do it could because the new solutions were cheaper, faster, or easier.

When looking to develop disruptive or market-growing innovation Christensen suggests looking for people who have a job to be done, but whose situation or means do not provide a way of accomplishing that job. If you can find a way of accomplishing that job that makes it affordable and accessible to a new group of people who have in the past have not had a good way of accomplishing this job, you can be assured you will easily find users for your product or service. Christensen suggests looking for situations where there is nonconsumption. Nonconsumption is often view as an indication that these users have no demand for the product or service. Christensen argues that this is often wrong, rather there is no affordable or accessible solution that these nonconsumers can use to accomplish the job. When individuals find themselves in a situation where none of the available solutions do the job, they hire nothing and the job doesn't get done and progress they hoped to make in their lives is stymied. They struggle. Exploring these struggles often provides insights that create new solutions. These

new solutions inevitable use a new technology and, of equal importance, a new business model. When the two are combined, a disruptive or market-growing innovation is created. Let's consider a some of examples form scholarly communication.

ArXiv

Up until the 1990s it was common for researchers, when they needed and article to request a copy from the author. This was usually done by sending the paper's author a postcard and the author would mail the researcher a copy of the paper. Often journals would provide authors of articles extra copies of their article for this purpose. This solution for the "I need a paper to advance my research" job was cumbersome and slow. In the early 1990s the Internet and the TeX file format made it possible to send scientific papers electronically, but even with e-mail the process was not much better and require an individual request and response to each time. Paul Ginsparg recognized that a central repository for papers would simplify the process for both the requesters and authors and created a primitive version for high energy physics at Los Alamos National Laboratory. The technology was improved and the coverage expanded and it became ArXiv. As of June 2019, ArXiv contained over 1.5 million papers. In May 2019 there were 1,381,920,799 downloads from ArXiv.[16] Clearly Ginsparg found a means of getting a job done both for authors and readers that was cheaper faster and easier. The preprint server innovation has subsequently expanded to a large and growing number of disciplines. It dramatically changed the way researchers share papers.

Sci-Hub

In 2011 Alexandra Elbakyan returned to her native Kazakhstan after studying in Russia, Germany, and the United States. She found that a job she needed to have done — reading scientific papers — was now impossible because of high subscription costs and paywalls. Her response was to create a services — Sci-Hub — that did this job for her and many others in her circumstances.[17] Sci-Hub clearly infringes the copyrights of publishers, but for Sci-Hub users the using an illegal service is the only way they can get done a job that is important for them to make progress in their lives. Given this, they are prepared to set aside any qualms they might have about Sci-Hubs methods. Sci-Hub claimed to host over 76 million papers in September 2019.[18] In February 2016 Sci-Hub was serving 200,000 request per day.[19] By one estimate in 2016 downloads from Sci-Hub accounted for 3% of downloads from all science publishers.[20] The job Elbakyan needed doing was clearly a job many others also had and her solution — using a web-based repository technology and a business model of giving away stolen papers — meant that many who could not previously do so could get a job they had that needed doing done.

These examples demonstrate the power and impact finding disruptive solutions to jobs to be done that that work at network scale.

Implications for Academic Libraries

Like most organizations, academic libraries innovate all of the time. They modify their practice looking for better ways of accomplishing their goals. Most of these innovations are sustaining innovations. That is, they provide better services for existing users. As is usually the case these sustaining innovations end up using roughly the same resources as the previous version of the service. Academic libraries will sometimes pursue efficiency innovations such as a PDA model for book purchase or replacing subscriptions with an article purchase-on-demand system. This reduces cost and should free up resources, but because libraries typically only enact efficiency innovations in response to budget pressures, the innovation rarely results in surpluses that can be invested in other areas. The result is a more efficient, but smaller organization. Creating disruptive or market-growing innovations is difficult for academic libraries. They are always pressed for resources so finding or reallocating the resources necessary for the investments required to create disruptive innovations is a challenge.

Without developing new disruptive innovations that grow the demand for library services, the library is caught in a cycle of sustaining innovations, which improve quality but do not grow the library's service portfolio, and efficiency innovation which shrink the library's footprint. This is not a good place to be at a time of rapid technological change that offers competitors opportunities to target library users with disruptive products that can replace what the library provides. There is a danger that libraries that only pursue sustaining and efficiency innovations will end up in a downward spiral. A strategy for avoiding falling into this trap requires a number of things:

1. Developing surplus resources that can be invested in developing innovative or market-growing innovations.
2. A strategy for identifying jobs that students, faculty, and others have that need doing where existing solutions create frustrations or where there is nonconsuption.
3. Avoiding the innovator's dilemma and investing in disruptive innovations.
4. Developing these disruptive innovations in ways that are most likely to be successful.

Developing Surplus Resources

It is unlikely that campus administrators will provide libraries funds to invest in disruptive innovations, which by definition won't serve established users well, at least at the beginning. Therefore, libraries will need to develop these resources themselves. There are three possible sources. The first two are grants and philanthropy. These can sometimes be successful, especially if the library has had previous success in launch services in this way, but for most libraries getting grants or gifts will be challenging.

The alternative is to use efficiency innovations to create a pool of surplus resources that can be used to make investments in disruptive or market-growing innovations. As noted above libraries tend to make efficiency innovations only to the extent required by their budget circumstances. The challenge is to deploy efficiency innovations before and beyond the immediate budget requirements, thus creating surplus resources.

It is important to recognize that there are at least three kinds of resources in play: people, space, and money. In many ways finding surplus people is the easiest and probably the most important. There are many opportunities for streamlining operations that can free staff time and there is always some staff turnover. A 2015 McKinsey Global Institute study of potential for automation found that across all occupations 45% of work activities could be automated using already demonstrated technology. They estimated that the percentage of such activities for library technicians was 59% and for librarians 43%.[21] One can quibble with these findings, but it is clear that automation can provide opportunities for efficiency innovations. Having the discipline to claim staff savings and the willingness to move staff to new priorities is all that is required, but cutting more deeply than is required can be difficult. There is currently a one-time opportunity to create surplus space by reducing print collections, but doing so in a ways generates surplus space for the library and not the campus is not always easy to manage. Space is also the least useful and least fungible of the three resources. Financial surpluses require first creating efficiency innovations that cost less, and second having or developing the ability to spend these funds in new ways. When developing disruptive innovations, the most important resource is people with the appropriate skills. Some money, especially recurring rather than one-time, is also required, but the amounts often do not need to be large.

Identifying Jobs to Be Done

Christensen argues that it is in understanding the struggles that people have that you gain an understanding of the jobs that need doing and the contexts in which doing them is difficult, or in cases of nonconsumption, impossible. If librarians begin to view students and faculty through this lens they may find opportunities in their day-to-day interactions. A more formal approach would be to that taken at the University of Rochester that used methodologies from anthropology in an attempt to understand student's needs.[22] But as Michael Khoo, Lily Rozaklis, and Catherine Hall note in their reviewed ethnographic research in libraries, "Ethnography is a complicated and time-consuming research method that requires significant individual and institutional investment."[23] For most libraries research at this level is beyond their means and capabilities. Unfortunately, the tools available to academic libraries, particularly LibQUAL and the Ithaka Faculty Survey use the customer — students and faculty — as the unit of analysis, not the particular jobs students and faculty have that need to be done. Techniques like those used to study user experience with websites might be usefully applied more broadly. Observational studies of how space is used can be insightful, especially when they show the workarounds students use when their needs are not met, for example, how they rearrange furniture and how they get to power sources. Getting out of the library building to identify nonconsumption will also be important.

There are real challenges in identifying jobs to be done. These two examples might be useful. First, recognizing the struggle faculty had in demonstrating the impact of their work and widely understood flaws of the standard metric, the journal impact factor, librarians at the IUPUI University Library developed workshops for faculty preparing dossiers and for promotion and tenure committees reviewing dossiers. They introduced both groups to a wide range of metrics and how and when they could be used.[24] One faculty member who used this service commented, "Several of her tables, and an impressive world map, are now part of my dossier

and helped my external reviewers and the university committees understand the significance and impact of my work. I am so grateful for this effort by the university librarians!"[25] For this faculty member, and most others, the library's guidance on the effective use of research metrics was a welcome solution to a critical job to be done.

Second, the struggles students have affording textbooks is clear from their many workarounds and in some cases their nonconsumption. Open educational resources have the potential to provide a solution that will make the job of getting access to textbooks easy and cheaper for those who currently are in circumstances where this is difficult. The technology seems to be available, but the service models to take the technology to scale, even with many interesting pilot projects, have not yet been satisfactorily developed.[26]

Avoiding the Innovator's Dilemma

Library leaders, like leaders in all established organizations, face the innovator's dilemma. When the choice is: one, investing in a product or service that will be better for the organization's most important customers, or two, investing in a product or service that many suspect is going to be important, but which none of your current customers now care about, it is nearly impossible not to choose the first option. Thus, it has been difficult for libraries to make significant investments in open access if the alternative use of the resources was to maintain purchased collections. Senior faculty care about books and journals; open access is nice, but not worth spending book and journal money on.

Escaping the innovator's dilemma requires that library leaders first be clear that developing disruptive innovations is required for the library's continued success. It is not optional. With this conviction strategies can be developed to justify politically difficult decisions or to fly projects under the radar. The example of how libraries have approached exiting "big deals", particularly the work done by the University of California libraries, is a model of the former.

Developing Disruptive Innovations

When academic libraries do make investments in potentially disruptive innovations that, if successful, will grow their programs and attract new resources, they usual implement these services in ways that ignore the lessons of Christensen's work.[27] The first iteration of a disruptive innovation is by definition not going to be able to meet the needs of high end users and it is unreasonable to expect that high end users to embrace it. In the library's case high end users means faculty. Instead, graduate or undergraduate students are a much better initial target. They are more likely to have jobs for which there are currently no good solutions. As the library gains experience and expertise, the service will get better and eventually faculty will find that it is a good solution to the jobs they have that need doing. This patient strategy can be difficult to maintain if it is not understood.

A good example is the deployment of institutional repositories. Most libraries deployed them with the expectation that senior faculty would find them useful and immediately begin using them. They did not. This led to wide spread disappointment. The better approach would have been to focus on graduate students. Repositories for thesis and dissertations did a

number of useful jobs. They provided a URL for the student's vita and in many cases generated use of the work, and sometimes citations, that would not have happened without the repository. As libraries refined the repositories and developed services around them, more faculty, especially those, usually junior faculty, who recognize the value of open access, began depositing their work. A similar strategy was often effective with library journal publishing programs. Beginning with student research journals and working up to faculty driven fully peer reviewed titles gave the library time to develop expertise and build capacity.

Conclusion

It is inevitable that the jobs students and faculty needed to have done and for which the academic library historically offered solutions will be disrupted by network-scale services. It is important to recognize that often the solutions libraries offered where time consuming and often inconvenient and the new solutions are fast and easy. The library will not be able to compete and it shouldn't try. Rather academic libraries need to discover the jobs that students and faculty have that are not now being met, or that can be met in new ways that are easier and faster for them. If this can be done successfully, the library will continue to be valued and supported. This will be challenging, but it is the only way to keep the library's role on campus from diminishing.

To return to the Thomas Friedman quote with which this article began, "Big breakthroughs happen when what is suddenly possible meets what is desperately necessary." The desperatey necessary are the jobs to be done. The suddenly possible are disruptive or market-growing innovations. What academic libraries need to do is create breakthroughs large and small.

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Notes

[1] Thomas L. Friedman, "Come the Revolution," *New York Times*, May 15, 2012, https://www.nytimes.com/2012/05/16/opinion/friedman-come-the-revolution.html

[2] Lavoie, Brian, Eric Childress, Ricky Erway, Ixchel Faniel, Constance Malpas, Jennifer Schaffner, and Titia van der Werf, *The Evolving Scholarly Record* (Dublin, OH: OCLC Research, 2014), https://doi.org/10.25333/C3763V

[3] Association of College and Research Libraries, *Value of Academic Libraries: A Comprehensive Research Review and Report*, researched by Megan Oakleaf (Chicago, IL: Association of College and Research Libraries, 2010), www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/value/val_report.pdf; Association of College and Research Libraries, *Academic Library Impact: Improving Practice and Essential Areas to Research*, prepared by Lynn Silipigni Connaway, William Harvey, Vanessa Kitzie, and Stephanie Mikitish, (Chicago, IL: Association of College and Research Libraries, 2017), http://www.ala.org/acrl/sites/ala.org.acrl/files/content/publications/whitepapers/academiclib.pdf, and "Visualizing Academic Library Impact: The ACRL/OCLC Literature Analysis Dashboard," http://experimental.worldcat.org/valresearch

[4] His 2019 book, Clayton M. Christensen, Efosa Ojomo and Karen Dillon, *The Prosperity Paradox: How Innovation Can Lift Nations Out of Poverty* (New York, NY: Harper Business, 2019), discusses the different types of innovation and their impact on growth. This material is also covered in Bryan C. Mezue, Clayton M. Christensen and Derek van Bever, "The Power of Market Creation: How Innovation Can Spur Development," *Foreign Affairs* 94, no. 1 (January/February 2015): 69-76, https://www.jstor.org/stable/24483219. A video of a talk Christensen gave at Google, "Where Does Growth Come From? And What Happens to It," June 23, 2016, https://www.youtube.com/watch?v=rHdS_4GsKmg also covers this material.

[5] His Jobs to Be Done theory is covered at length in his 2016 book, Clayton M. Christensen, Taddy Hall, Karen Dillon, and David S. Duncan, *Competing Against Chance: The Story of Innovation and Customer Choice* (New York, NY: Harper Business, 2016). A shorter version can be found in Clayton M. Christensen, Taddy Hall, Karen Dillon, and David S. Duncan, "Know Your Customer's 'Jobs to Be Done'," *Harvard Business Review* 94, no. 9 (September 2016): 54-60. The Google talk referenced above also covers this material

[6] Shea-Tinn Yeh and Zhiping Walter, "Determinants of Service Innovation in Academic Libraries through the Lens of Disruptive Innovation," *College & Research Libraries* 77, no. 6 (November 2016): 795-804, DOI: https://doi.org/10.5860/crl.77.6.795

[7] David W. Lewis, "*The Innovator's Dilemma*: Disruptive Change and Academic Libraries," *Library Administration and Management* 18, no. 2 (April 2004): 68-74, post print available at: https://scholarworks.iupui.edu/handle/1805/173

[8] David W. Lewis, "The Inevitability of Open Access," *College & Research Libraries* 73, no. 5 (September 2012): 493-506, DOI: https://doi.org/10.5860/crl-299

[9] Siddhartha Menon, "Linking Generativity and Disruptive Innovation to Conceptualize ICTs," *Internet Research* 21, no. 3 (January 2011): 347-361, DOI: https://doi.org/10.1108/10662241111139345

[10] Lee Sims, "Legal Publishing: Establishing Context through the Lens of Disruptive Innovation," *Legal Reference Services Quarterly* 35 no. 3 (July/September 2016): 195-213. DOI: https://dio.org/10.1080/0270319X.2016.1227203

[11] Heather Lea Moulaison and Anthony Million, "The Disruptive Qualities of Linked Data in the Library Environment: Analysis and Recommendations," *Cataloging & Classification Quarterly* 52, no. 4 (April 2014): 367-387, DOI: https://doi-org.proxy.ulib.uits.iu.edu/10.1080/01639374.2014.880981

[12] Albert N. Greco, "The Impact of Disruptive and Sustaining Digital Technologies on Scholarly Journals, *Journal of Scholarly Publishing* 48, no. 1 (October 2016): 17-39, DOI: https://doi.org/10.3138/jsp.48.1.17

[13] Joseph Esposito, "Op Ed—Inadvertent Innovation," *Against the Grain* 25, no. 6 (December 2013/January 2014): 38-40, DOI: https://doi.org/10.7771/2380-176X.7408

[14] Lewis, "*The Innovator's Dilemma*: Disruptive Change and Academic Libraries," 71.

[15] Carmen Nobel, "Clay Christensen's Milkshake Marketing," *Harvard Business School Working Knowledge*, February 11, 2011, https://hbswk.hbs.edu/item/clay-christensens-milkshake-marketing

[16] "arXiv Useage Statics," https://arxiv.org/help/stats

[17] See: John Bohannon, "The Frustrated Science Student Behind Sc-Hub," *Science* 352(8285): 511, DOI: https://doi.org/10.1126/science.352.6285.511; Life Extension Advocacy Foundation, "Interview with Alexandra Elbakyan: Sci-Hub and the Importance of Open Scientific Knowledge | LEAF," June 27, 2017, https://www.youtube.com/watch?v=dz1Uj20tZvs; John Bohannon, "Who's downloading pirated papers? Everyone," *Science* 352, no. 6285 (April 2016): 508-512, DOI: 10.1126/science.aaf5664, and Daniel S. Himmelstein, Ariel Rodriquez Romero, Jacob G. Levernier, et al., "Sci-Hub Provides Access to Nearly All Scholarly Literature," *Elife* 7 (March 1, 2018): e32822, DOI: https://doi.org/10.7554/eLife.32822

[18] "About Sci-Hub", https://sci-hub.tw, accessed September 22, 2019.

[19] John Bohannon, "Who's downloading pirated papers? Everyone," and Brian M. Till; Niclas Rudolfson; Saurabh Saluja, Jesudian Gnanaraj, Lubna Samad, David Ljungman, and Mark Shrime, "Who is Pirating Medical Literature? A Bibliometric Review of 28 Million Sci-Hub Downloads," *Lancet Global Health* 7, no. 1 (January 1, 2019): PE30-E31, DOI: https://doi.org/10.1016/S2214-109X(18)30388-7

[20] Richard Van Noorden, "Alexandra Elbakyan: Paper pirate," in "*Nature*'s 10: Ten People Who Mattered This Year," *Nature,* December 19, 2016, https://www.nature.com/news/nature-s-10-1.21157

[21] Michael Chui, James Manyikais, and Mehdi Miremadi, "Four Fundamentals of Workplace Automation," *McKinsey Quarterly,* November 2015, https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/four-fundamentals-of-workplace-automation The details by profession can be found at: https://public.tableau.com/profile/mckinsey.analytics#!/vizhome/AutomationandUSjobs/Technicalpotentialforautomation To locate the library jobs, click on the educational sector. The two circles with the most automation potential are library technicians and librarians.

[22] See: Nancy Fried Foster and Susan Gibbons, *Studying Students: The Undergraduate Research Project at the University of Rochester* (Chicago, IL: Association of College and Research Libraries, 2007). A good short review of the work is Michael Seadle, "Anthropologists in the Library: A Review of *Studying Students*," *Library Hi Tech* 25, no. 4 (November 2007): 612-619, DOI: https://doi.org/10.1108/07378830710840545

[23] Michael Khoo, Lily Rozaklis, and Catherine Hall, "A Survey of the Use of Ethnographic Methods in the Study of Libraries and Library Users," *Library & Information Science Research* 34, no. 2 (April 2012):82-91, DOI: https://doi.org/10.1016/j.lisr.2011.07.010

[24] Heather L. Coates, Jere D. Odell, and Caitlin Pike, "Upskilling the Promotion and Tenure Process: Training Administrators for Responsible Use of Research Impact Metrics," Presented at Transforming Research, Providence, RI. October 2018, http://hdl.handle.net/1805/17449 and Heather L. Coates, "Changing the Culture of P&T Through Conversations About Research Metrics," Presentation to the Association of College & Research Libraries (ACRL) Research Metrics Interest Group [virtual], February 26, 2019, http://hdl.handle.net/1805/19112

[25] IUPUI University Library, *IUPUI University Library: Our Commitment to the IUPUI Community* (Indianapolis, IN: IUPUI: 2018), 8, http://hdl.handle.net/1805/16796

[26] See for example: Karen Okamoto, "Making Higher Education More Affordable, One Course Reading at a Time: Academic Libraries as Key Advocates for Open Access Textbooks and Educational Resources," *Public Services Quarterly* 9, no. 4 (November 2013): 267-283, DOI: 10.1080/15228959.2013.842397; Kristi Jensen and Quill West, "Open educational resources and the higher education environment: A leadership opportunity for libraries," *College & Research Libraries News* 76, no. 4 (April 2015): 215-218,doi: https://doi.org/10.5860/crln.76.4.9298, and Joseph A. Salem, Jr., "Open Pathways to Student Success: Academic Library Partnerships for Open Educational

Resource and Affordable Course Content Creation and Adoption," *Journal of Academic Librarianship* 43, no. 1 (January 2017): 34-38, DOI: https://doi.org/10.1016/j.acalib.2016.10.003

[27] See: Clayton M. Christensen and Michael E. Raynor, *The Innovator's Solution: Creating an Sustain Successful Growth* (Boston, MA: Harvard Business School Press, 2003), also, Clayton M. Christensen and Michael Overdorf, "Meeting the Challenge of Disruptive Change," *Harvard Business Review* 78 no. 2 (March/April 2000): 66-76, and Clayton M. Christensen, Heiner Baumann, Rudy Ruggles, and Thomas M. Sadtler, "Disruptive Innovation for Social Change," *Harvard Business Review* 84 no. 12 (December 2006): 94-101.