Research Life Cycle: Exploring Credibility of Metrics and Value in a New Era of eScholarship that Supports Grey Literature

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Abstract:

The fundamental components of the research process are defined by academic tradition, discipline and its participants. Traditional scholarship has now evolved into eScholarship with emerging technologies providing new methods of innovation and new ways of handling classical research processes. This revised research life cycle not only incorporates the established parts of the research chain, from discovery, gathering, and creating, but now has added phases of citing, sharing, preserving and archiving. There are quantifiable elements that help describe unique elements depending on sector and subject matter and format. Previously defined barriers such as geographical, institutional, digital and domain boundaries that had earlier existed can now be transcended to either accelerate or retard the research lifecycle in amazing and innovative ways. This new paradigm shift of current practices or activities today include the range of literacies that must be demonstrated and include information literacy, visual literacy, financial literacy, and increasingly data literacy. The role of the academic library has become increasingly visible as scholars and scientists seek support in managing their research lifecycle components. Librarians are now managers and curators of the scholarly research lifecycle by protecting, harvesting, and promoting reuse of content for new and unprecedented purposes. In a similar fashion, Grey Literature has previously followed the lifespan of more traditional output. Now new technologies exist to extract value metrics that compare favorably with other information products. This paper will explore how Grey Literature matures through different pathways or life cycles as the new grey becomes less grey with metrics of increasing value to support and describe it. Also, the world of publishing has become increasingly accessible to a new population of scholars to release new information and ideas, contribute to emerging fields and frontiers without the barriers or requirements of following a specific trajectory of traditional publication processes. Examples will be shared about how the research life cycle has evolved with new tools to support Grey Literature from the life cycle management (LCM) and life cycle assessment (LCA) models to determine impacts and drive future directions concerning options for actions like open access, intellectual property and other forms of rights management.

Background

Innovation is the catalyst for positive change and grey literature is the measure of benchmarks in the further process of research and development. Innovation and grey literature share parallel life cycles in which early growth is relatively slow until their use and application become recognized both within and later beyond their community of origin. Expected top-line growth and increased bottom-line results are achieved in part through new technologies, through redeployment and enhancement of existing products and services, which at times are unachieved. Nevertheless, the process shared by innovation and grey literature carries on with analogies to product life cycle management strategies. If grey literature is considered a product, and business or industry the context, then the conditions in which it is developed, tested, applied and sold becomes its lifecycle and changes over time. Product life-cycle management (PLC), often known as marketing include stages such as analyzing the time to market, improving product quality; and considering ways to penetrate new markets, reach new customers and develop new applications. In our contemporary environment, software and technology play important roles in determining the lifespan and obsolescence of any product.

Research is an abstract environment and has many different components but studied in its most benign and natural state, one can assume that research generates products, births new knowledge and engages in a re-engineering process while confirming the following assumptions:

- Every product has a defined life cycle and a limited life
- Sales and marketing require different passages, and both challenges and opportunities are presented to the distributor or seller

- Each life cycle stage demands attention to marketing, financing, manufacturing, purchasing and other strategies to support it successfully

This can be demonstrated by the main stages of a product's life cycle:[1]

1. Market Development – full of unknowns, uncertainties; trying not to prematurely fold
2. Growth – responds to consumer demand/interest; develop brand loyalty over other products; establish pricing
3. Maturity – responds to competitive intelligence; requires creative marketing, communication with users or customers
4. Decline (saturation) – over capacity is usually the result of this stage but it can be a positive outcome with prices and margins reduced diverting the decline with a more creative force.

Again, we confirm that innovation is never easy – the population must perceive that it needs and wants a product or service. The more unclear or new it is, the more challenging it is to enter the mainstream.

Research Life Cycle

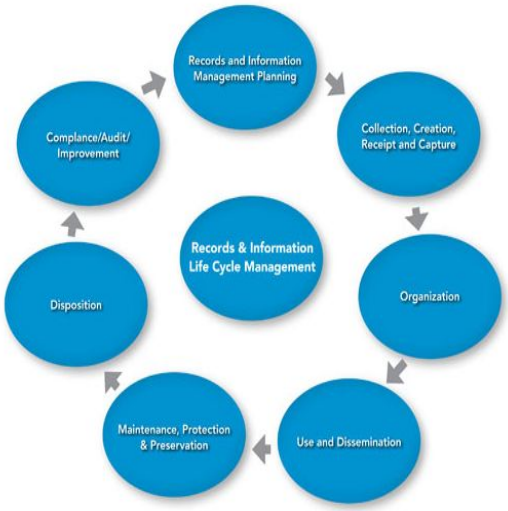
The research lifecycle appears to be measured in different ways. It also refers to different elements in the research chain. In the framework of assessing outputs, one traditionally uses metrics that reflect the activity of the author or contributor, what the product is and how it is cited to determine the value it has to a user, subscriber, or to a more general audience. Libraries have increasingly become engaged in assessing the value of their collections and the source of their resources. Research generates many different products and services, but in library-speak, they tend to be universally described as information sources.

The Library and especially the digital library environment that organizes information have become increasingly central to the research process. The scholarly communication pipeline as it has been referred to at conferences, especially the future of scientific communication has been the focus of all stakeholders representing scientists and scholars, librarians, publishers, technologists who are exploring "how to create continuity across the entire ecosystem and give the scientific community the ability to observe or participate wherever they need to in that ecosystem, …by filling the need for better filtering."[2] The added value of providing a structure to find and store research products or outputs, and as a source for discovering new research trends or evaluating research excellence and thus improve the process of how research is conducted. These values are increasingly part of a new research landscape covered by meetings now held worldwide to help advance publishing, research sharing, informatics, data analysis and hopefully develop new technologies and products to expand the research of research.[3]

"Life cycle management (LCM) is a business management approach that can be used by businesses and organizations to improve products and performance of those companies or institutions involved in production and thus can be used to target, organize, analyze and manage product related information and activities towards continuous improvement along the life cycle."[4] Also it can be simply described as "a framework to analyze and manage the sustainability performance of goods and services."[5]

An example, or one model that diagrams this for the information industry may be something like this:

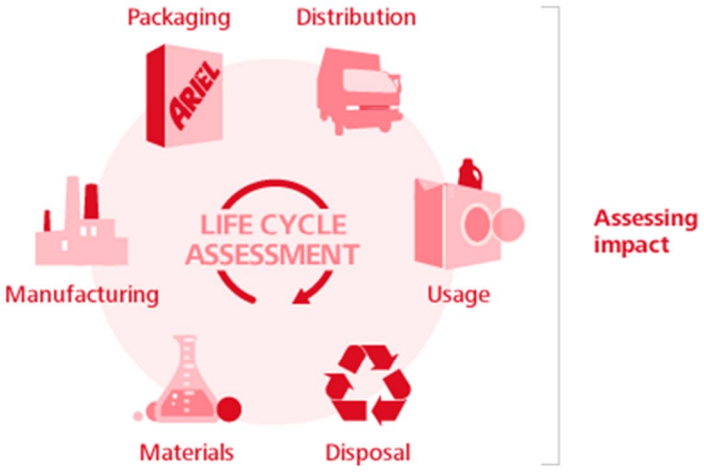
Lifecycle Management



http://www.gallegoinfo.com/content/pages/lifecycle-management

Life cycle assessment (LCA) involves "implementing standards, metrics, procedures and inventory data for the social dimension of sustainability"[6] creating a community that can vet and compare data elements or social indicators as part of this process. With roots in environmental standards, it allows providers a means to improve resource efficiency. It can be extended to information products or resources by adding a social life cycle assessment, (S-LCA) that "can be used to assess the social aspects of products and their potential positive and negative impacts along the life cycle."[7]

What appears to be critical is to know that in addition to LCM and LCA approaches, there are a wide variety of other tools that are used to understand the transition from LCM to LCA or management to assessment. This chain includes the actions of discovery, gathering, and creating, but now has added phases of citing, sharing, curating, preserving and archiving the content whether it be text, images, data, 3D objects, media, etc. This can correspond in the information industry and work of librarians to be part of the scholarly communication model, building out current service emphases of information literacy, outreach, instruction, digitization and the most recently launched data management/curation programs.



Research and scholarship are independent activities that define the academic experience and contribute to creativity and innovation. In recent years, the concept of "knowledge generation" has been applied to the outputs and the goals of research.

When libraries are trying to forge ahead increasing the digital footprint and aligning services to support eResources, the quandary became more complicated this year, as publishers raised the price of eBooks to libraries, and consortia struggle to find ways to reduce unit costs by multi-institution buying plans. This is a serious detour in the research lifespan.

Definition of Innovation

Standard dictionary definitions of the verb innovate include: "make changes in something established, especially by introducing new methods," or "something different that has impact."[8] In order to study or evaluate innovation, some business executives or analysts may consider the context as being one of "perpetual change," and the "imperative of today's times;" and ways to categorize innovation as by the "innovation's strategic intent" or examining the "type of innovation."[9]

Innovation comes in many shapes and sizes with different forms of influence. It is never easy and the population or users must perceive that it needs and wants a product. The more unclear or new it is, the more challenging it is to enter the mainstream and be accepted. The research environment attempts to consider things in a transformational way, again by weighing the impact over time. To understand innovation and see how it plays out, it is critical to determine and anticipate the desired outcome. This can be done by considering three types of innovation:

- Continuous innovation – suggests incremental changes or improvements and is "a common way to satisfy existing customers while grabbing new users."
- Dynamically continuous innovation – represents a change in the way we use a product without changing the technology behind the product all that much
- Discontinuous innovation – requires a significant behavioral change but is not synonymous with disruptive innovation because that causes immediate changes while discontinuous innovation may take significantly longer to influence change.[10]

Certain types of innovation require more resources, time and energy from an organization than others and will determine how to select the right type of innovation to fit the appropriate commitment level.[11]

"The world no longer cares about what you know; the world only cares about what you can do with what you know," writes Tony Wager, Innovation Education Fellow at Harvard's Technology and Entrepreneurship Center, and author of the recent release, *Creating Innovators: The Making of Young People Who Will Change the World*.[12] This book is innovative in itself as its promotion is available in multiple formats inviting discussion and commentary. (see http://creatinginnovators.com/). It states that innovation is dependent upon a skillset, learning style, and keeping up with change. It is inevitable that subsequent generations of students and thus workers will have a different skillset than current employees and the transition to a different work life and organizational culture will continue to be challenging for some time, as new members of the workforce appear to have a different, more technology intensive background.

Innovation in Higher Education – with extensions to libraries

With the recent budgetary challenges, the field of higher education needs to invest in innovation to find solutions to long standing problems. Never easy, the word "innovation" can be used in many different ways. In the *Future of University Libraries: 2012 Midwinter Report*, citations to several examples of entrepreneurial action point to how libraries are:

- demonstrating value
- rethinking library services
- reconfiguring library spaces
- preparing psychologically for the future.[13]

James Neal, Vice-President for Information Services and University Librarian at Columbia University suggests that research libraries of today and the future are "more entrepreneurial organizations, more concerned with innovation, business planning, competition and risk, leveraging assets through new partnerships to create new financial resources."[14]

If innovation can be classified into two basic types, administrative and technical as it describes innovation in organizations such as libraries, then two stages may emerge, 1) initiation and 2) implementation each with its own substages that form what Jantz calls an innovation process model with four major construct groups:

1. leadership
2. new knowledge
3. organizational structure
4. perceived innovation attributes.

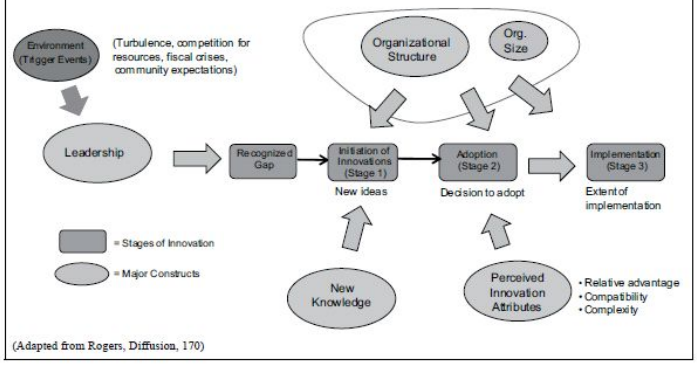
The substages for initiation are:

- knowledge awareness substage
- attitude formation substage
- the decision substage

and the substages for implementation:

- initial implementation substage
- continued sustained implementation substage[15]

FIGURE 1
The Innovation Process Model and Stages of Diffusion



Perhaps this sets us up for the prediction made by Daniel Greenstein in 2009, "The university library of the future will be sparsely staffed, highly decentralized, and have a physical plant consisting of little more than special collections and study areas."[16] This scenario he describes is already a truism as budgets decline to support library collections and associated services are reconfigured to offer greater access via more remote connections and library reorganizations tackle how best to meet ongoing service and information needs. Extending the reference to a research context, Christine Borgman has stated, "the role of libraries in research institutions is evolving from a focus on reader services to a focus on author services."[17]

Unique to the United States: The Community College Experience

In a one-year study completed by O'Banion, T. & Weidner, L. (2010), *The nature of innovation in the community college,* the authors examine community college views of innovation in higher education. The community college movement got its stride in the 1960s in the United States when divisions between higher education sectors were defined. Community colleges allowed students to fulfill their core

competencies with an A.A. degree before matriculating in a baccalaureate degree program, or gain vocational or specialized expertise and credentials. Today, community colleges are providing a critical and necessary function in higher education as students and their families are facing increased tuition and fees, are less mobile, where the emphasis is on teaching and learning outcomes, the greater demand for new skills in the workforce and lifelong learning is at an all time peak. O'Banion and Weidner found after examining hundreds of statements on the definition of innovation in both higher education and business, all definitions of innovation led to this fundamental concept, "a creative process that results in an improved product."[18] Among the other definitions of innovation include the following:

	Number of Respondents	Percent of Respondents
The development or adoption of new or existing ideas for the purpose of improving policies, programs, practices, or personnel	25	21.3%
The creation of new opportunities that are transformative	25	21.3%
The placing of creative ideas into action	21	17.9%
The application of ideas, with the goal of effecting positive change	20	17.0%
The creation of new programs or practices, or the improvement of old ones	12	10.2%
A creative approach to increasing effectiveness	7	5.9%
Other	5	4.2%
No Response	2	1.7%
Total	**117**	**100%**

Source: O'Banion, T. & Weidner, L. (2010)

The two most commonly expressed ideas were "The development or adoption of new or existing ideas for the purpose of improving policies, programs, practices, or personnel" and "The creation of new opportunities that are transformative".[19]

Institutional barriers to innovation

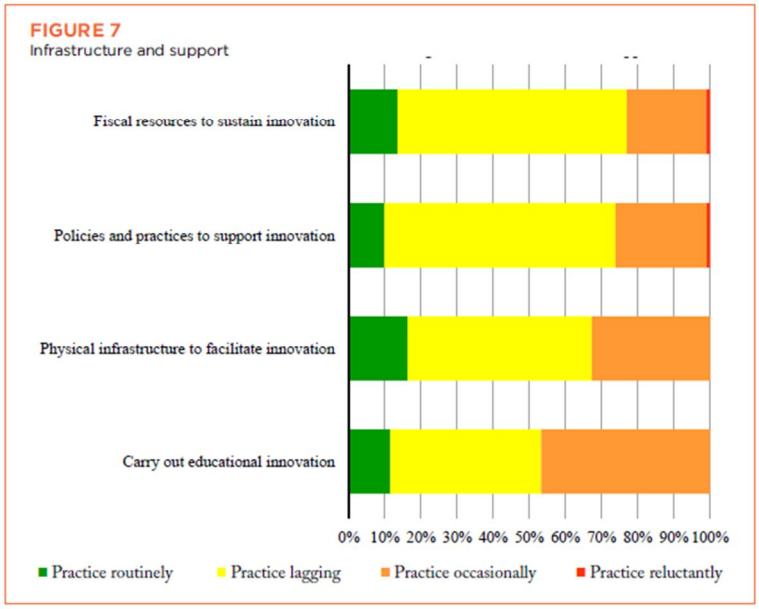
Institutional support from a college administration is the most important source for responding to institutional needs. It is logical to conclude that at the research university level, that these more complex institutions would place a much higher emphasis on innovation than their community college counterparts. However, evidence largely parallels their community college findings. In a report issued by the American Society for Engineering Education (ASEE), fiscal resources to sustain innovation and policies and practices to support innovation were shockingly low. The report also states that "This is mostly good news in that the faculty committees and administrators generally want to increase their involvement in educational innovation. They just do not feel that they have the policies, practices, resources, and infrastructure they need to be more successful."[20]

In contrast to O'Banion and Weidner, the ASEE report tends to take a more holistic approach to creating a culture of innovation in their engineering institutions. Both groups stress the need for partnerships and teamwork, securing administrative support for innovation, and assessment. The ASEE takes their recommendations one step further by integrating them into the "pre-professional, professional, and continuing education of engineers."[21]

RECOMMENDATIONS FOR CREATING A CULTURE FOR SCHOLARLY AND SYSTEMATIC INNOVATION IN ENGINEERING EDUCATION: GOING FROM *INNOVATION* TO *INNOVATION WITH IMPACT*

1. Value and expect career-long professional development programs in teaching, learning, and education innovation for engineering faculty and administrators, beginning with pre-career preparation for future faculty.
2. Expand collaborations and partnerships between engineering programs and (a) other disciplinary programs germane to the education of engineers as well as (b) other parts of the educational system that support the pre-professional, professional, and continuing education of engineers.
3. Continue current efforts to make engineering programs more engaging and relevant, and especially expand efforts to make them more welcoming.
4. Increase, leverage, and diversify resources in support of engineering teaching, learning, and educational innovation.
5. Raise awareness of the proven principles and effective practices of teaching, learning, and educational innovation, and raise awareness of the scholarship of engineering education.
6. Conduct periodic self-assessments within our individual institutions to measure progress in implementing policies, practices, and infrastructure in support of scholarly and systematic innovation—innovation with impact—in engineering education.
7. Conduct periodic engineering community-wide self-assessments to measure progress in implementing policies, practices, and infrastructure in support of scholarly and systematic innovation—innovation with impact—in engineering education.

Source: Innovation with impact (2012).



Source: Innovation with impact (2012).

In comparison, the successes and barriers to innovation as noted by community colleges include the following:

	Number of Respondents	Percent of Respondents
You and/or your team's enthusiasm and perseverance	83	70.9%
The need for the innovation	54	46.1%
An institutional culture that supports and encourages innovation	51	43.5%
Support of college leaders	45	38.4%
Support from colleagues	32	27.3%
One or more champions within the college	27	23.0%
Student interest	21	17.9%
Financial support	19	16.2%
Support from outside the college	18	15.3%
Documented effectiveness of the innovation	17	14.5%
Other	4	3.4%
Opportunities for award or recognition	2	1.7%
Total	**117**	**100%**

	Number of Respondents	Percent of Respondents
Lack of time	60	51.2%
Logistical and/or technical issues	35	29.9%
Unanticipated problems	28	23.9%
Lack of financial resources or support	25	21.3%
Magnitude of the project exceeded the anticipated effort and resources	25	21.3%
Other	23	19.6%
Difficulties in bringing the innovation to scale	17	14.5%
Lack of support from others within the college	12	10.2%
Lack of support from college leaders	7	5.9%
Difficulties among the individuals working on the project	6	5.1%
Lack of sufficient evidence of the effectiveness of the innovation	5	4.2%
An institutional culture that does not support and encourage innovation	4	3.4%
Withdrawal of support before the project was completed	3	2.5%
Insufficient research and preparation	1	<1%
Lack of award or recognition	0	0.0%
Total	**117**	**100%**

Source: O'Banion, T. & Weidner, L. (2010)

Interestingly enough, lack of resources was not the main source of barriers for innovation at the community college level. The main road block was "lack of time," and is understandable due to declining budgets, decreased staffing levels, and an increase of duties for the remaining faculty who have to teach larger enrollments, more sections with less support. Often innovation is thought of as an investment in time when the institution can dedicate resources to innovate. However, in a time strapped environment, people are focused in a reactive planning mode versus a proactive strategy.

Comparing higher education realms

Paradoxically, at the four-year research university level, the main barrier to innovation was "resources." This was consistently cited by faculty and academic leaders. Workload, the main barrier for community colleges, was listed towards the middle of the five challenges among this group.

TABLE 1
Top Five Challenges and Opportunities

Challenges

Faculty	Count	Chairs	Count	Deans	Count
Resources	46	**Resources**	36	**Resources**	19
Rewards	37	**Rewards**	29	**Workload**	17
Workload	36	**Workload**	27	**Rewards**	16
Awareness of Innovations	18	Tech. Research Emphasis	13	Innovation Not Valued	12
Assessment of Innovations	18	Changing the Curriculum	12	Resistance to Change	10
		Awareness of Innovations	12		

Opportunities

Faculty	Count	Chairs	Count	Deans	Count
Faculty Development	16	Faculty Commitment	24	**Rewards**	21
Rewards	15	**Faculty Development**	18	Changing the Curriculum	18
Industry & Entrepreneurship	12	Awareness of Innovations	15	Collaborating with Others	15
STEM Centers	10	Innovative Pedagogy	15	**Faculty Development**	14
Resources	7	**Rewards**	12	Instructional Innovations	14
Changing the Curriculum	7				

Source: Innovation with impact (2012).

The community colleges and research universities both have different approaches to foster innovation in higher education. The community colleges tend to focus on a narrower approach that is defined within the community college framework:

- Demonstrate a need.
- Develop a vision and a plan.
- Put the plan into action.
- Talk with colleagues.
- Build a team.
- Secure administrative support.
- Dedicate the required time and effort.
- Evaluate the innovation's effectiveness.
- Tie the innovation to the college mission, values, and goals.
- Take risks.
- Plan for sustainability of the innovation. [22]

Promoting innovation through assessment

By far the most surprising finding in the O'Banion and Weidner study is the question "How do you know that the innovation had an impact?" The most popular response was "Faculty/staff testimonies or anecdotes" followed by "Student testimonies or anecdotes". This is rather disappointing considering how in today's movement of student learning outcomes and evaluation, there is little to no formal planning or assessment to measure the success or failure of a particular innovation project. At the same time, this could also be explained by the "lack of time" previously mentioned in the survey since community colleges are many times in a reactive "firefighting" mode that will leave little to no time left for proactive, evidenced based planning and outcomes.

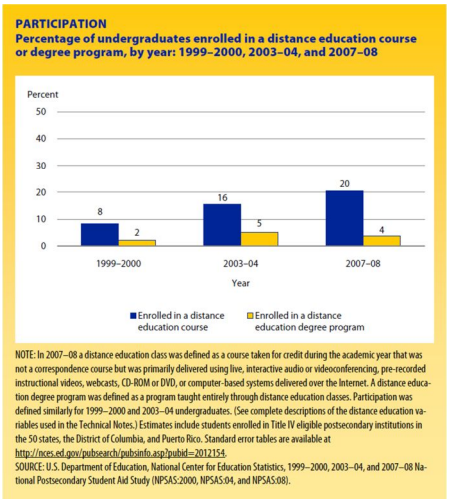
This kind of information gathering, or research findings, can be described as a form of grey literature or social networking and includes these elements.

	Number of Respondents	Percent of Respondents
Faculty/staff testimonies or anecdotes	69	58.9%
Student testimonies or anecdotes	61	52.1%
Student surveys	48	41.0%
Faculty surveys	28	23.9%
Student interviews or focus groups	28	23.9%
Institutional data (e.g., course completion rates, student retention rates)	28	23.9%
Faculty interviews or focus groups	27	23.0%
Other	20	17.0%
Formal pre- and post-tests	17	14.5%
Administrator and/or staff surveys	16	13.6%
No formal or informal evaluations have been conducted.	12	10.2%
Use of balanced scorecard or other management tools	6	5.1%
Total	**117**	**100%**

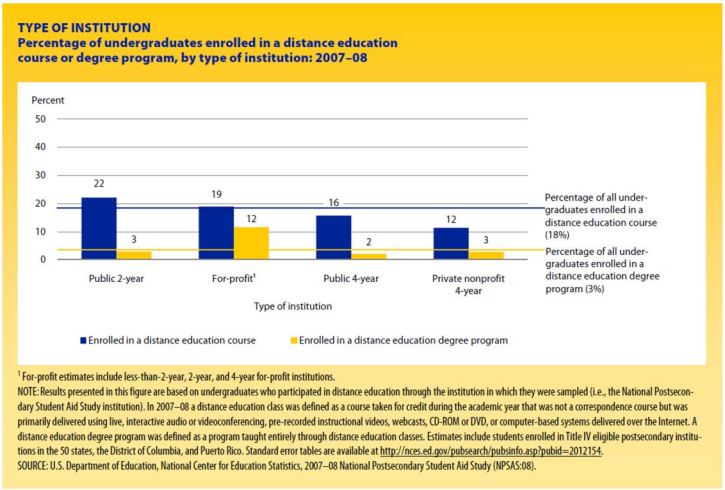
Source: O'Banion, T. & Weidner, L. (2010)

Innovations in Higher Education – Distance Education

With the nature of higher education changing from the physical classroom to the online environment, the popularity of distance education has increased in recent years not only in the United States, but globally as students enroll in courses and programs at institutions around the world without ever leaving home. According to the most recent report by the US National Center for Education Statistics, the percentage of undergraduates enrolled in a distance education course has grown from eight percent in 1999 to almost 20 percent in 2008, with variances across the higher education spectrum.[23]



Furthermore, the breakdown of students enrolled in distance education courses from a US public 2 year institutions was at a surprisingly high 22 percent compared to their public 4 year university counterparts at 16 percent.[24] The private 4 year non-profit universities were not as inclined to have distance education courses at this time since only 12 percent was reported. This gap may be narrowing as new and emerging technologies have become more evident in the past 3-4 years; it is safe to assume that from 2008 that these figures have increased overall for all categories of distance education. [25]

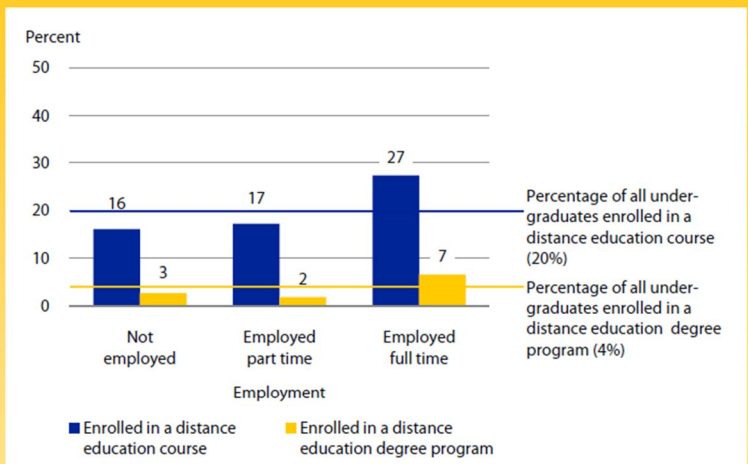


There are a variety of reasons why Distance Education has enjoyed an exponential increase in popularity over the past decade. The most salient reason is cost, as higher education institutions grapple with leaner budgets, increasing staff costs, and decreasing support from public funding sources. Providing distance education is one way to trim costs as Distance Education courses require no physical space to teach courses; a higher number of students enroll without impacting space constraints on campus facilities; in extreme circumstances the professor can telecommute from her/his home negating the need for a physical office on-campus, and the asynchronous learning environment of Distance Education courses allow colleges to decrease the number of on-campus courses while providing the maximum flexibility for both students and faculty.

For students, the benefits and personal convenience of Distance Education are equally numerous as the asynchronous nature of Distance Education allow students to take courses and study at their own pace. This is especially attractive for students who work full-time and can take advantage of Distance Education courses by studying and completing the coursework before and after their jobs. According to the National Center for Education Statistics, nearly 27 percent of undergraduates who were employed full-time took

Distance Education courses compared with 17 percent for part-time workers and only 16 percent for those not employed. [26]

WORK OBLIGATIONS
Percentage of undergraduates enrolled in a distance education course or degree program, by work obligations: 2007–08

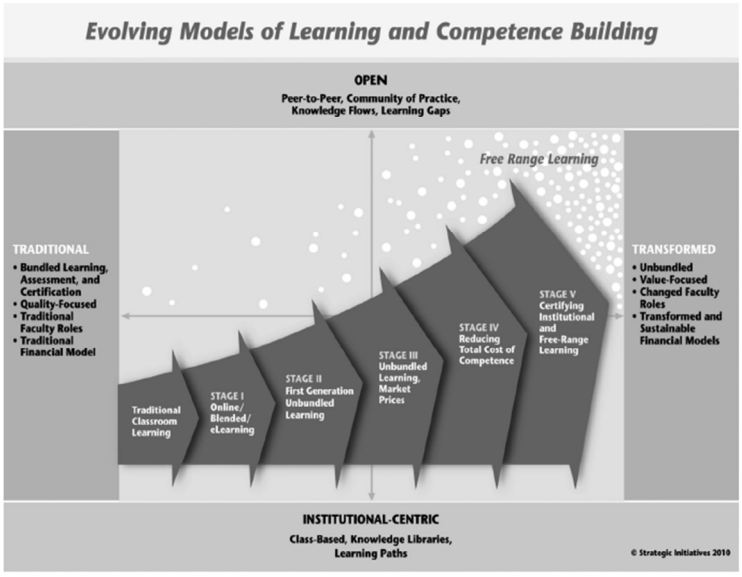


NOTE: Students whose sole employment was through work-study or an assistantship were considered employed. For all employed students, full-time status was defined as working 35 or more hours per week and part-time status was defined as working less than 35 hours per week. In 2007–08 a distance education class was defined as a course taken for credit during the academic year that was not a correspondence course but was primarily delivered using live, interactive audio or videoconferencing, pre-recorded instructional videos, webcasts, CD-ROM or DVD, or computer-based systems delivered over the Internet. A distance education degree program was defined as a program taught entirely through distance education classes. Estimates include students enrolled in Title IV eligible postsecondary institutions in the 50 states, the District of Columbia, and Puerto Rico. Standard error tables are available at http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2012154.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2007–08 National Postsecondary Student Aid Study (NPSAS:08).

Learning online

Today we are in a transitional phase in higher education, a shift away from traditional paradigms of brick and mortar learning and breaking through to online learning environments that have virtually no boundaries. Norris and Lefrere identified five phases of Distance Education environments that lead to an evolution of online learning from the traditional physical classroom setting to a peer-to-peer learning system that is accredited by specialized bodies. [27]

As shown in the figure, there are four quadrants: on the left represents the traditional learning environment of bundled learning and assessment, on the right represents the "transformed" learning environment of unbundled learning and value focused coursework. On the bottom we see the "Institutional-centric" learning environment of traditional class-based learning vs. the open learning environment of peer-to-peer learning. As we move from the right to the left, we note that in Stage I is the start of most Distance Education programs that "digitize" the traditional learning environment through hybrid classes (a continuum of traditional classroom and online coursework), as we move towards the right Norris and Lefrere state that the Distance Education environment, specifically online learning, will evolve into a system where peer-to-peer learning is commonplace with institutional certification boards providing the levels of certification demonstrating competence in a particular field of study.[28]



Source: Norris and Lefrere, 2011

Norris and Lefrere note the following:

Universal web access supports a shift toward greater reliance on informal local communities of practice and web-based and cross-border knowledge-sharing, and a shift away from peer-reviewed articles as the definitive source of accounts of experiences of successes in online learning and in the early adoption of transformational innovations at the course or subject level.

In other words, as we transition from Stage I towards Stage V, there will be a greater reliance on grey literature rather than the traditional peer-reviewed articles that are pervasive in traditional academic settings. Rather than relying on editorial boards and publishers to evaluate the level of scholarly information, the future will rely on practice-based and collaborative knowledge communities that transcend borders and the traditional academic boundaries of scholarly information sources. As time goes on, grey literature will become more important and proliferate in the Distance Education environment due to the universal access to of publication, the speed of producing a finished product, and harnessing the practice-based knowledge of experts in the field that are not traditionally tied to the peer-review environment. However, it is possible that peer-reviewed literature will continue to evolve into a format that is certifiable for the accreditation institutions to base the levels of competence in Norris and Lefrere, Stage V Distance Education institutions.

Grey Literature as distance education matures

Five years ago I presented at the Grey Literature conference how technology and other elements of cyberinfrasture, specifically distance education, impacted the maturity of grey literature.[29] With more ubiquity, a growing dependence on networking, and an infrastructure now to support a full industry of home schooling for the K-12 cohort, the latest evolution is the massive open online course or MOOC. 2012, known to be the "Year of the MOOC" is where we see traditional online courses where tuition and fees were charged for credits that translated into degrees, give way to the usually free, credit-less and massive enrollments of tens or hundreds of thousands of students taking a given class. All that is required is an internet connection and due to the large enrollments relationships with instructors are indeed different. The course delivery, methods of interaction, and student engagement are what contribute to the success of the course, and communities evolve to foster that with the support of social media directing a framework of options for students to collaborate and congregate to share the learning experience. Lectures still are the central core but the rollout will take elements from entertainment, especially gaming and social networking to facilitate the conversations, exchanges and dialogues course content should stimulate. Many questions

remain about the efficacy and how to handle cheating and plagiarism, how to scale learning this way, whether it can translate into degree programs, global registration and how credits will be earned and students will record such registrations and experiences. Currently three major platforms exist for massive open online courses, edX, Udacity and Coursera[30] and each of them has their own "flavor" indicating subject orientation, technology focus and directives. Some top, prestigious academic institutions continue to partner with innovators in industry to bring this form of instruction and learning to the mainstream, and since it remains a "work in progress," with "many kinks" it is premature to suggest what role it will play in coming years in higher education. We can speculate that it may have a role for the Emeriti Colleges, for lifelong learning and other continuing education roles but will it assume a place in post-secondary higher education as we currently know it?

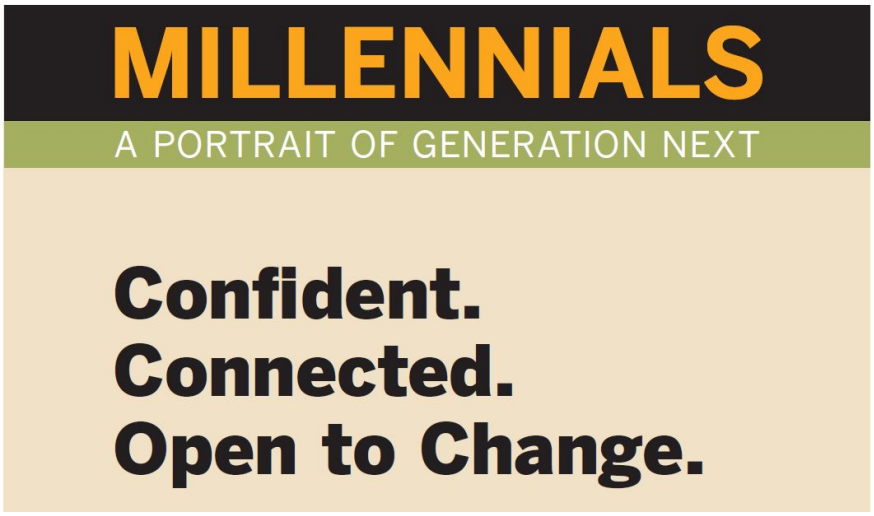
Assessing consumer needs: the academic experience

With the current generation of students as digital natives, their customs and expectations, according to a new edition of, *Generation on a Tightrope: A Portrait of Today's College Student*, are grounded in technology, they appear pragmatic, concerned about their future and jobs, have a more global interest, but act locally and deal with diversity by claiming to want to live in a networked world but many of their associates, including parents and teachers are analog or digital immigrants. Students struggle with face-to-face relationships and prefer communicating via texting and choose to "hook up" but not with a lot of talking, yet a more open communication system exists but the bond with parents is tighter than they want to admit, suggesting less independence, probably due to longer financial and residential dependency. They are part of a transformation to a new and diverse digital economy, where students appear to want convenience, service, quality and lower prices in all aspects of their daily lives, including their education.[31]

Students as consumers are an important population demographic thing to focus on. Not only by age, but it is taking longer to matriculate and graduate, students are attending multiple institutions in seeking credits for their degrees, and in several different educational settings and domains as the undergraduate career can be spent at all of the forms of higher education, due to transfer status and concurrent registrations, community college, a liberal arts institution, a research university and a distance education option from yet another discrete campus.

The 18-25 age cohort may be the largest concentration of any student group, but there are many older students returning to university, continuing their studies, beginning new programs, and seeking new academic training. Serving the needs of military veterans and more international students are examples of the extended services campuses must offer today.

Examining the Beloit College Mindset data, demonstrates how important it is for faculty to know who their audience is. Conducted annually since 1998, this review is a "look at the cultural touchstones that shape the lives of students entering college each fall."[32] The takeaways are how connected this generation is with their peers and family, how important hand-held devices and technologies are and how committed they are to cultural diversions, a healthy lifestyle and good eco-values.



The student community is a combination of millennials, boomers, Gen Xers and others surveyed by the Pew Research Center trying to better under understand how generations differ. According to Pew, "age group differences can be the result of three overlapping processes:

1. Life cycle effects – becoming more like their parents once they themselves age
2. Period effects – affected by major lifetime events, catastrophes and breakthroughs
3. Cohort effects – how period events and trends leave specific impressions as youth are still developing core values[33]

The influence of social media on organizations and research

It has been stated that using "a defined approach to manage social media can stifle innovation and creativity."[34] Some key factors that Bradley and MacDonald introduce to make mass collaboration an organizational capability include the premise that, "an organization becomes a social organization when it discovers the power of mass collaboration and develops the necessary corporate skills to address challenges by readily and repeatedly creating collaborative communities."[35]

- Understand when community collaboration is appropriate
- Know where community collaboration is more likely to deliver value
- Apply an understanding of your organizations goals and culture
- Craft an organizational vision for community collaboration[36]

The principles of mass collaboration and social organizations and the management guidance each requires are:

- Participation – encourage contributions from across community and make it safe by discouraging destructive and dysfunctional behaviors and promoting productive ones
- Collective – ensure results by reaching consensus and taking action together
- Transparency – use most accurate and appropriate information; encourage openness and inclusivity
- Independence – encourage and facilitate multiple viewpoints and broader perspectives
- Persistence – keep collaborative content, contributions, feedback and decisions with the social media platform and easily available to community members
- Emergence – concentrate on community results rather than controlling the means of producing those results. Defining terms of engagement may compromise community contributions.[37]

Social media practices - innovation strategies

Collaboration and social networking reduce a range of geographical, institutional, hierarchical, and digital barriers and promote implementing technology to bridge those structural silos. Within the information and

higher education sectors, the more technology centric publishing, libraries and information distribution can become; the more likely that the research lifecycle will be impacted by improved access. Still a business enterprise, these services will benefit from more Open Access / Open Source content and the promotion of information sharing, repurposing and reuse of content.

On a global scale the ICT environment that is defined by "Information and Communications Technology" reaffirms that there are internal stakeholders of leaders, customers and support staff plus the network of external sources, vendors, customers, officials, lenders and media who also contribute to the success of innovation. With the flattening of the world, global geography is smaller and reachable via same time communication technologies. World events are shared within moments across the globe, introducing and displacing innovation all at the same time. In higher education, the customer may be the student, the innovator may be the faculty or scholar, the product is the learning outcomes, teaching and scientific methods that are advanced.

Many organizations are now using and relying upon social networking tools to reach out to all constituencies and solicit innovative ideas from them. The literature and media refer to ICTs as the method by which groups create and vent ideas – without a culture that supports ideation, innovation is challenged. Social ideation is an extension of engagement that encourages the use of social media internally so that colleagues can share ideas with each other and also can communicate externally with outsiders for more input and follow through.

More techniques and tools – leading to greyness

Social media can also encourage the use of crowdsourcing, the outsourcing of tasks to the external masses that are typically performed by internal employees or those close to the job.[38] This may be simpler than engaging research firms to conduct surveys, monitor and track consumer behavior. It also builds on the semantic enrichment of scientific publications and efforts of text-mining.[39]

Another method of gaining insight into the innovation process is the more academic version of storyboarding, a technique that has its roots in filmmaking and allows for groups of people to discuss sequencing and the narration of events. Somewhat related to the ethnographic analysis an anthropologist or social scientist may pursue when they study specific populations and cultural norms, these techniques utilize questions and answers, observation, surveying and other information gathering methods to gain insights about ideas, actions and activities. This can be applied to organizational settings to outline an acquisition, define an entry into a new market or movement of people, or to measure change.

Mind mapping is a tool that explores relationships, and ideas or connections are strung together by the power of the relationship. This visible interconnectedness illustrates potentially innovative ideas that can fix, remedy, re-engineer, and stimulate new ways to go forward and con
tribute a product or methodology.

http://www.pmcomplete.com/InformationLifecycleManagement.asp

A wordle has become an accepted simplified, randomly and spontaneously software generated "mindmap" of concepts minus the relationships but releases a summary of covered ideas.

created with www.wordle.com

Byproducts of the research lifecycle

An environmental scan of products that document the research lifecycle suggests that there are a growing number of resource formats. Organizing and measuring various impacts are a common theme. Market penetration and other business and management themes are reflected in each of these byproducts of the research lifecycle. There are various forms of intellectual property. The release of constant new products measures productivity, commercial success and ultimately, innovation. The international stage promotes the global importance that each of these play flattening the world and reducing deficits of time. Examples are:

- Intellectual Property & Patents – greater global contributions
- Industry Standards – by certifying organizations - in the information industry with examples from ISO, NISO, OASIS, ANSI, and closed and emerging standards from the W3C (World Wide Web Consortium) and those maintained by the Society of Scholarly Publishing[40]
- Library Standards – based on literacies and created by professional societies (ACRL Professional Standards)[41]
- Benchmarking
- Social media – multiple ways to connect, view, contribute, participate, respond to issues of the day
- ICT channels – communications, news outlets, visual content, archiving
- New & multiple formats responding to user preferences and marketplace shifts focusing on digitization
- Publishing and Usage Metrics, Bibliometrics and Altmetrics

The academic community has always evaluated its members, both institutions and individuals by determining the rankings, reputation and success of its creators and increasingly on the commercial potential for those ideas and products. In their own way, each of these establishes new separate communities where there is an element of competition, sharing, informing, educating, that takes place.

(http://altmetrics.org)

Within the spectrum of innovation, several metrics are critical to the research lifecycle. Most scholars are familiar with the impact factor, coined by Eugene Garfield in the early 1960s when he founded the Institute of Scientific Information in Philadelphia and birthed the products, *Science Citation Index, Journal Citation Reports* morphed into other larger and more interdisciplinary products that tracked impact by individual article, author and publication. The measurement of overall scholarly impact, bibliometrics as a tool and science was defined by Alan Pritchard in 1969 as, "the application of mathematics and statistical methods to books and other media of communication."[42]

The expanding Altmetrics movement, defined as "the creation of new metrics based on the social web for analyzing and informing scholarship"[43] is just a few years old and gaining momentum with activists Jason Priem and Healther Piwowar directing much of the development, especially with her development of ImpactStory and her blog, ResearchRemix.[44] Altmetrics provides not just counts and cumulative totals, but rich metadata.[45] Citation analysis has driven the method of how the scholarly community attributes value to information. We can conduct literature searches by not only examining retrospective contributions but forward tracking by citation in different formats. Increasingly indexing now covers data elements, illustrative content as well as print. With the scholarly community focused on journal literature, the article and conference paper/proceeding has always been vital to track and follow. This gives insights into what defines competitive journals that publish the most important content critical to interested readers; and determines the lifeline of the journal, its cost and role in a subject. In addition to metrics associated with authors, content, institutional rankings, benchmarking and reputation, there are also methods for assessing impact for research groups and interdisciplinary intersections. Utilizing data mining and emerging technologies with many methods of reviewing the changing scholarly landscape new products and metrics are introduced.

Bibliographic management software is yet another example of managing references and organizing retrieval of multiple sources in a highly personal and customized way that can accommodate a range of information sources. Many are free software applications that can be downloaded, some have web-based functionalities and others are offered as fee-based subscription models.

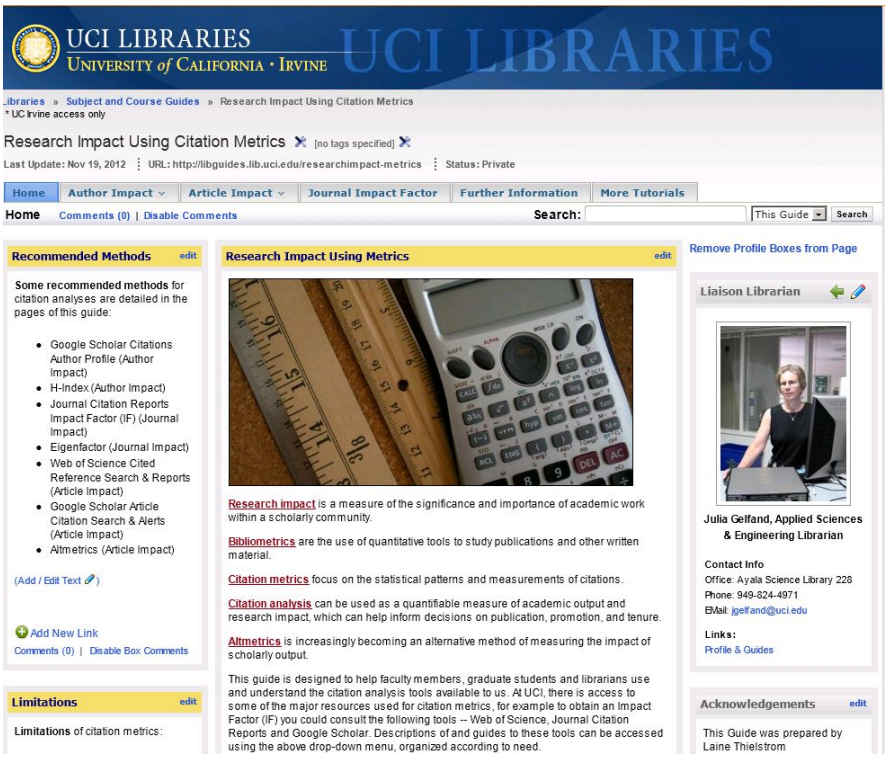
Brand new applications of how to manage pdfs of journal articles or conference papers or book chapters allows one to build on products such as Mendeley or Zotero with the latest rollout of ReadCube by the Nature Publishing Group[46], which builds on providing access to fulltext articles. Priem states, "Bibliometrics mined impact on the first scholarly web, altmetrics mines impact on the next one."[47]

Examples of different impacts are:

- Impact factor
- H-index
- Times cited (different variations but counts times cited in primarily journal articles)
- i10 Index (articles with 10+ citations)
- Highly cited (usually relates to authors)
- Eigenfactor

- Source Normalized Impact per Paper (SNIP)
- Google Scholar Citations
- Microsoft Academic Search
- Publish or Perish (PoP
- Altmetric for Scopus (tracks mentions of papers across social media sites, blogs and reference managers)
- Academia.edu

Innovation is right, front and center in the research lifecycle. In recent years, there have been many new examples of products that are offering new ways to analyze data. Most libraries have a subject guide that demonstrates and describes the processes and products. My LibGuide[48] is but one example.



Conclusion

When we consider what makes people, companies, organizations or products innovative, we often conclude that they are different in some special, unique way. Innovation is often a catalyst for the mindset needed to achieve success and the result of a journey in which discovery plays a large part. Influenced by the recent book, *The Innovator's DNA*, we share how those authors provide five steps that they suggest leads to innovation where a bigger and better impact can be achieved:

1. Review and establish priorities
2. Assess discovery skills systematically
3. Identify a compelling innovation challenge that matters
4. Practice discovery skills (association, questioning, observing, networking, experimenting, skills)
5. Be coached to support development efforts[49]

Within the research community, innovation will be tested as new products are being released to manage the range of information and new knowledge generated by sponsored research.

Data is probably the most critical of the new forms of grey literature that libraries and librarians need to address. Issues related to eScience and grey literature were more fully addressed in a paper delivered three

years ago at this conference.[50] Occasionally libraries have described the new research landscape as "data deluge" as they grapple with how to manage such resources so that they can be consulted, archived and reused. This is the new landscape of eResearch and eScholarship that has extended the boundaries and intersections of library collections and services. If libraries fail to embrace treating data, the risk of losing credibility and remaining relevant to the academic research and institutional landscape is huge. Activity at research libraries around the world now demonstrate how new structures are evolving to support institutional metrics that build on data management service models that include repositories, data curation and data management plans and extend to a range of other scholarly communication related services. The European Association of Research Libraries has documented ten recommendations for libraries to get started with data management plans[51] and in the US over the last year the Association of Research Libraries and the Digital Library Federation hosted a series of institutes for their members to respond to the eScience and data agendas on their campuses. [52] A recent conference in China highlighted such activity by Pacific Rim universities.[53]

Data and research impacts including the new bibliometrics are clearly examples of the next generation of grey literature that will pave the changing times of higher education. They are an important indicator of how scholarship is viewed from the outside looking in at a given point of time. These are times of great change and fluidity where coping with ambiguity is the new norm. Michael M. Crow, President of Arizona State University and known as perhaps the most visible innovator currently leading a major research institution in the US, in the thriving metropolitan area of Phoenix, where he has created, an "unusual academic structure with 'fused intellectual disciplines' meant to reflect the way knowledge is developed and applied today and a culture deliberately focused on admitting and graduating a student body that is ethnically and economically representative of the community."[54] Thus, innovation, grey literature and new paradigms in higher education fuel the research lifecycle.

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