

Keynote Address

Next generation libraries: changing roles of libraries in promoting research and innovation

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1.0 Background

The academic libraries have a great potential for inducing changes in contemporary society through its services and support to the community it serves. In a multi-phase international study conducted in eight institutions in eight countries in North America, Western Europe, Asia Pacific and Africa (Tenopir, 2010), it was confirmed that for every monetary unit invested in academic libraries, the parent institutions received a ROI in the range 15.54: 1 to 0.64:1 as research grant income. Moreover, in 6 of the 8 countries, the ROI for grants is more than 1:1. The ROI in this study was calculated using the entire library budget, if the portion of the library budget that is just related to e-collections is used, the ROI rates range from 155:1 to 6.4:1. The study also reported that in two North American universities, regression analysis using 10 years of data shows that an increase in the library budget correlated with increase in grant funding.

Before Internet, libraries were the most important publically available source of authentic information. The emergence of Internet, particularly, the World Wide Web (WWW) as a new media of information delivery, has triggered proliferation of Web-based full-text online resources from diverse sources. While increasing number of traditional publishers are using the Internet as a global way to offer their publications to the international community of scientists and technologists, there are thousands of individuals, entrepreneurs and organizations who are publishing their information on the Web that may not pass the test of integrity, authenticity and authority.

In today's information era, web search engines, such as Google and Yahoo, challenge the position of libraries as leading source of information. However, dependability and integrity of all information that is found through Google is highly doubtful.

2.0 Information Requirement of a User in an Academic Institution

Let us now examine information requirement of a user in an academic institution and how can libraries design their services to match his or her requirements. Typical requirements of a user from a library are as follows:

- Access to books, journals, conference proceedings, manuscripts and other print and non-print materials available within the four walls of a library or outside the library through Library OPAC or through external databases.
- Timely access to research works by his peers and contemporaries duly filtered to include articles from qualitative journals.
- Self-serve online environment with support in terms of library portals, federated search interfaces, resource selection aids, etc.
- Seamless access to subscribed e-resources anytime, anywhere, anyway (open access / subscribed) using access management technology such as EZ proxy, Athens or Shibboleth.
- Guidance in publishing his / her work in high-impact journals and assistance in analysis of his / her research output on various performance parameters.
- Access to research funding opportunities.

3.0 How Users Access Information?

Although the libraries are seen as providers of reliable information, but most users start their searches with a search engines like Google and not with library portals. Fee-based content, even if accessible through library portals, are losing its value-added edge. Wikis are much more popular even for scientific information in comparison to fee-based information products published by international scholarly publishers.

Striking difference in preferences and information seeking behaviours is observed based on functional roles and domain knowledge of librarians and users. In a survey on information seeking behaviour and preferences, librarians and scientists were asked to name the top scientific and medical search resources that they use or are aware of. The difference is startling. While the scientist preferred Google, Yahoo and PubMed as their primary choice, the librarians choose ScienceDirect, Web of Science, MedLine, JSTOR and Springer (Regazzi, 2004). In a study conducted by OCLC (Rosa, 2005), 89% of the college students begin their search on a given topic on search engines (including 62% on Google). There are only 2% of the students who go to the library website.

4.0 Today's User: Highly Aware and IT Savvy

Before attempting to re-design library services and activities to suit the requirement of today's user, it is important to note that today's user is highly aware and computer savvy. They has greater opportunity to use web-based

resources than the library staff. Users do not have time or patience for unauthenticated information. They prefer electronic access to e-resources for the convenience it offers. Most users are self-sufficient and can independently search and access information available through Web-based products and services accessible to them on their Desktop. They are impatient and demanding and expect Library to provide expeditious and efficient service. Users demand highly specific and timely information on varieties of devices such as desktop, laptop, tablets and smart phones.

In the background given above, today's user prefers to work independently, however, they would like to interact with librarians who have:

- Domain / subject expertise with ability to provide in-depth and extensive assistance;
- Knowledge of research methodology;
- Awareness of publishing trends & publishing channels;
- Knowledge to assess information quality, credibility and accuracy; and
- Trained in techniques of information retrieval.

Librarians are required to prepare, train and equip themselves for above-mentioned specializations.

5.0 Assumption about the Library

David W. Lewis, Dean, IUPUI University Library, Indianapolis (Lewis, 2007) made the following five assumptions about libraries to examine their sustainability in its present format and to prepare libraries for the next generation.

5.1. Assumption 1: Libraries are Means, Not the End

A library in academic institution is a kind of subsidy that is provided to their users for carrying out study and research on its missions and objectives. Likewise, a public library is a kind of subsidy that is provided to the people and communities for making them better informed and well read citizens. The information contained in library cannot be shared and used in efficient quantities. However, when better subsidy mechanism than libraries becomes available they will be preferred.

As such, it should be our endeavor to find strategies that provides the most value for the subsidy made available to the libraries. The libraries should encourage open access as an alternative method of publishing and set-up institutional repositories, open access journals, etc. Moreover, study should be undertaken to produce more scholarly content with the current investments in libraries.

5.2. Assumption 2: Disruptive Technologies are Disrupting Libraries

Disruptive technology refers to new or enhanced technology that either replaces or disrupts an existing technology, making it obsolete or redundant. Disruptive technologies are designed to succeed existing technology with improved functionalities. Disruptive technology applies to hardware, software, networks and converged technologies. Advent of Internet, for example, has made printed format of scholarly communication redundant and obsolete. Indexing and abstracting services like Index Medicus, Chemical Abstracts, Biological Abstracts and Engineering Index has disappeared in print and are used sparingly online. Journals are preferred in e-format and print versions are disappearing gradually. Likewise books are increasingly appearing in e-format.

A number of disruptive technologies are now available as alternative to various services of library challenging its very existence. Lets look at some of the important examples of disruptive technology.

Library Service	Disruptive Technology
Search Everything	Google, Yahoo, NetFlix, SiteSeer, PubMed Central, etc.
Catalogue	Library Thing, Google Books, Good Reads, etc.
Journals	SiteSeer, DOAJ, Scitopia.org, etc.
My Account / Citation Guide	Zotero, Endnote, Mendeley, etc.
Site Search	Google
Distance Learning Services	You Tube, E PG Pathshala, Coursera, edX, Ask
Pathfinder, Guide to Internet Resources	IPL-2, Intut,
Digital Collections	ArXive.org, Flickr, Photomuse, Digital Commons, JSTOR
Ask-a-Librarian	Yahoo Answers! AmazonMechanical turk, Ask

Let us take some examples of disruptive technology in consumer market.

Disruptive Technology	Disrupted Technology	Obsolete Products
Digital Camera	Film-based Cameras	Camera films (Kodak)
Smart Mobiles	Traditional Mobiles	Nokia, Blackberry, etc.
MP3 Players (iPod)	Walkman / Audio Cassette Recorders	Sony, Panasonic, etc.
Mobile Operating System (Android)	Palm OS, Limo, etc.	Windows mobile

5.3. Assumption 3: Real Change Requires Real Change

The process of imparting education is going through a paradigm shift. Libraries cannot make incremental adjustments and marginal changes to cope with the paradigm shift. New technological tools and techniques will have to be evolved since it is not possible to keep doing the today's job with yesterday's tools.

5.4. Assumption 4: We have a Window of Opportunity

Libraries are considered as hub of all academic activities. Sarvepalli Shri S. Radhakrishnan, Former President of India said that "a university is a string of buildings around a library". However, this opportunity will not stay open forever. Alternatives will be brought in force as and when available.

5.5. Assumption 5: Funds Available to Libraries / Institutions are Limited

Libraries are getting limited funds whereas subscription rates of journals and average price of books has increased exponentially in past five decades. As on now, increase in subscription rates of journals are much higher than general inflation rate, i.e. 273% increase from 1986 till 2003. Increase in library budgets will not be greater than the rate of general inflation. As such, buying power of libraries would decrease gradually year after year.

6.0 Continuing Role of Libraries

Role of academic libraries is to stir curiosity, inspire and provide affordable access to authentic information with an aim to create a literate environment with well-informed students and faculty. Libraries provide information resources to its users to "read and learn", physical space to "meet and discuss" with fellow users and an opportunity to "shape & develop" their careers. Libraries also support serendipity and Inter-disciplinary research. Some of live examples of serendipity research are as follows:

- German chemist Friedrich August Kekulé (1865) discovered the ring shape of the benzene molecule after having a day-dream of a snake seizing its own tail.
- Alexander Fleming noticed a petri dish containing Staphylococcus culture, which was mistakenly left open and was contaminated by blue-green mould (fungi), which, in turn, inhibited bacterial growth around the mould.
- A pharmaceutical company in US had identified a number of chemical formulations that were inherently unstable. If these chemical formulations could have stable states, they could be potential candidates for curing number debilitating diseases. The vice president of the company Mr.

Alpheus Bingham convinced his board of governors to invite solutions to these problems through Web. The solution to the problem of unstable formulations and their possible stable states were invited through the website of the company on payment basis. The company could find stable states for most of the formulations, however, the solution came not from the chemists or pharmacists, but from scientists from other disciplines such as molecular biologist, crystallographers, agriculture scientists, genetic engineers, etc. It was presumed that chemists and pharmaceutical scientists knew the fact that these formulations are inherently unstable, therefore, they did not research for their stable states, whereas other scientists did not know this fact, as such, they deployed different means to find a stable formulation of chemicals that were inherently unstable.

7.0 Features of Future Libraries

The libraries of future will have a changed role to play in an academic institution. As such, libraries of future are required to imbibe a number of features to cater to the requirements of its changed role. Some of the most important features of future library would be as follows:

7.1 Social Space

Comfortable and dynamic space conducive to problem-based learning, discussions and interaction between users. Library space, being prime locations in an institution, will increasingly be used less for storing books, journals and other documents and more for other purposes such as discussion rooms, multimedia facilities, gaming rooms, product development facilities, etc. As such, libraries should re-develop available spaces, phase-out legacy print collections and provide increasing provide access to electronic resources.

7.2 Library Everywhere

Library resources and services should be available anywhere and everywhere. As such, library should provide faster Internet connections, in-campus as well as off-campus access to resources using access management technologies such as Shibboleth, EZproxy, etc. The library should also provide outreach activities to the depth and breadth of the university community and migrate its resources from print to electronic format. The library should increasingly provide services such as electronic reference service, real-time reference service, SMS service, RSS feeds, etc.

7.3 Digital Lives

Libraries are required to reposition themselves, their resources and services where the users are. Libraries should create 'Face Book' sites to facilitate

information searching and social exchanges and integrate their discovery services with Google and open their catalogue to Google.

Moreover, libraries would be required to broaden the catalogue of resources that they provide to support teaching and learning. Libraries, till recently, were providing access to materials that they owned within four walls of their libraries. However, increasingly libraries are providing access to resources available beyond the four walls of library in digital form. The librarians will have to assume the role of providing integrated access to range of digital information available to users through licensing agreements or through open access. Besides, providing integrated access to electronic resources that are subscribed or those that are available in open access, the libraries should increasingly provide integrated access to non-traditional resources such as online-learning materials, multimedia educational material, educational blogs maintained by experts, etc. Libraries should also facilitate collaborative creation of content through Wikis and blogs and provide platforms to its users for online discussions. The Library web site should provide facility for "My Accounts / My Space" to users and have their presence on social networks. As such, librarians and library staff should develop skills and expertise required for their new Avatar.

7.4 Research Involvement

Future libraries will be required to figure out means and methods that can be used to support faculty and students in their research and education. The library stands at the hub of the academic activities drawing faculty and students in the process of garnering knowledge and contributing to the existing pool of knowledge. In the changing environment, however, librarians and libraries are required to alter their identities in relation to the changing modes of knowledge creation and dissemination. They are required to reposition the hub and figure out the kinds of services that they can provide to students, researchers and faculty to enhance their research productivity. Librarians are not trained explicitly to bring about such changes in library organization and culture. However, the only survival kit for libraries in the changing environment is to provide proactive support to the work of faculty and students. Some of the important jobs that the library can undertake to further research and development work of an institution are as follow:

- Develop and maintain an institutional repository preserving the University's research output and add features and functionalities to incentivize student and researcher to upload their research work into the repositories. Such features may include reporting number of downloads and citation received by a paper available in the repository, API score of a faculty, linking a researcher's work with their identities, such as ORCID, Vidwan ID, Scholar's ID, as well as their profiles in Google Scholar.
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- Launch new services and systems to support research and scholarship in order to establish deeper collaborations with faculty
- Set-up a Unit in Library with dedicated library staff member as liaison to faculty so as to help them in project writing as well as in identify sources of funding and writing of projects.

7.5 Print Value

Future libraries would increasingly subscribe to electronic resources, digitize their legacy documents and phase out the print collection. However, the value of print cannot be ignored. Digitized print collections will have to be moved to dedicated storage facilities to preserve the collection for long-term in a controlled environment. Such dedicated central storage facilities will have to be created for a group of libraries with individual member libraries contributing their print assets to this physical repository. The collections deposited in such storage facilities can be borrowed by the member libraries or can be withdrawn by donating library, if so required. The member libraries may also have enhanced ILL and document delivery services built around their print as well as electronic collections. The member libraries may also take collaborative digitization project for digitizing their collections since it requires intensive funding that may go beyond financial abilities of individual institutions. It may be noted that in the project on Digital Library of India out-of copyright books, manuscripts and other documents were digitized in several libraries in India with funding from Mellon Foundation. These digitized collections are available online in open access.

8.0 New Roles for Librarians

Now that we have examined features and functionalities of libraries of future, it is clear that the library staff of the future are required to possess a different mix of skill sets in the age guided by “access” that are very different from those that were imbibed into them in the age of “acquisition”. Lets delve into the new role of librarians and library staff in the changing environment.

8.1 Providing Quality Learning Spaces

There will be increasing demand on library space since it occupies a prime locations in an institution. The library space will have to be reorganise to promote learning, interation and collaboration amongst students, researchers and faculty. Since repurposing library space is one of the key features of future libraries, it would be essential to re-develop available spaces, phase-out legacy print collections and provide access to electronic resources.

8.2 Creating Metadata

Librarians were the first inhabitants of the World Wide Web with their natural instinct to organize and structure the information sources scatter over thousands of website on the Internet. The librarians started creating virtual libraries and pathfinders consisting of links to important electronic resources available on the Internet for a fee or for free. Librarians possess instinctive skills in knowledge organization using thesaurus and subject headings as standard vocabulary. It may however be noted that major developments in metadata creation has taken place outside of libraries, in the commercial database or portal world, and this trend is likely to continue unless the librarians take up the task on to themselves to break this trend. As such, it would be desirable that the libraries build partnerships with research community in digital library, metadata creation and extraction, semantic web applications, etc. However, this would demand new skill sets since the role of librarians with respect to metadata will be vastly different from their old cataloging role.

8.3 Offer Virtual and Real-time Reference Services

Providing virtual and real-time reference services to individual users may fit into the emerging knowledge environment wherein libraries would increasingly have their collections in digital format accessible to their users within the campus as well as outside the campus. As such, the users may have lesser requirement and opportunity to visit the library. Virtual and real-time reference service may also incorporate features of push technology where-in users may be prompted to subscribe to library feeds on various subjects and collections. The library may also offer their service to configure subscribed databases and full-text e-journals for alerting and RSS Feed services as per the subject profiles of individual users. The library website should incorporate appropriate icons for virtual reference service (Ask-a-Librarian) and real-time reference service (Chat-with-Librarian). The library website may also provide link to payment base services offered by other agencies.

8.4 Teaching Information Literacy

Imparting information literacy programme would continue to be relevant in libraries of the future. However, information literacy in e-environment would become more closely geared to users' needs and skills for supporting self-navigation and self-usage of online electronic resources, databases, subject portals, etc. The librarians will have to develop their information literacy skills and tune it according to requirement of individual users. They would be required to impart regular awareness programme to users for promoting usage of e-resources and undertake programmes for educating users in new technologies useful to them such as Wikis, RSS Feeds, Semantic Web, Listservs, Blogs, Mash-ups, etc.

The users should also be made aware of research output indicators that are used to measure impact of research being carried out by individual scientists or their organizations such as Impact Factor, SJR, H-Index, i-10 Index, citations and mean citation score, etc. Researchers may also require extensive training in citation searching and use of reference management software such as Zotero and Mendeley.

8.5 Choosing Resources and Managing Licenses

Collection development process in electronic environment has shifted the role of librarian toward managing licenses since growing share of libraries' budget is used for providing access to scholarly resources through licensing agreements with publishers of electronic journals, databases, and other digital resources. The librarians will have to train themselves for reading between the lines and take utmost care of institutional interest. Each word in the license document will have to be well defined to avoid ambiguity. The clauses in the license document should cover all relevant terms and conditions such as perpetual access, geographic jurisdiction, payment clauses, annual increase in rates of subscription, back file access, discontinuation of individual journal titles, platform fee, etc. The library or parent organisation may also engage services of a legal expert if required.

8.6 Collecting and Digitizing Archival Materials

Digital archives may represent almost every type of medium of communication, physical (print), artifacts, born digital, digital images, etc. Collecting and digitizing archival materials offers a significant opportunity for libraries and librarian to assume the role of curating digital content. The librarian may assume the role of curator of an institute by setting up institutional repository and collecting and curating all documents generated in an institute including published and non published materials.

8.7 Maintaining Digital Repositories

Although maintaining digital repositories requires skills that may go beyond the skills of librarians, however, if librarians take the responsibility of maintaining IRs, it may provide a solid foundation for the future of academic libraries. Besides, setting up an institutional repository, librarians may also take up the task of setting up domain-specific institutional repository in a given discipline as per overall subject mandate of his/her institution. Institutional repositories may also be set up for a given type of resources such as theses, reports, standards and protocols. The librarian may also contribute towards providing additional features to the repositories as mentioned in the features of future libraries.

8.8 Contributions in Research Assessment and World Ranking of Universities

Research assessment can play an important role in improving performance and quality of academic institutions. The process of research assessment of an institution and world ranking of universities requires management of research data called Research Data Management (RDM). The library is considered as a natural place for RDM work because the library has been in the business of managing and curating research output for a long time as its core activity.

The OCLC, in its report published in 2009 (Key Perspectives Ltd., 2009), concluded that the libraries in academic institutions play a significant role in the research assessment process through institutional repositories and database of institutional research output.

8.9 Promote Open Access

Open access is gaining acceptance all over the world because of unprecedented escalation of prices of scholarly publications. Promoting open access resources and open access publishing is an important role that a librarian can assume.

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