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Inevitable Trends and Technologies of Libraries and Information Science

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Abstract:

This paper attempts to describe brief outline about latest trends, tools and technologies which are being started used in management and service areas of libraries. The emergence of ICT and its effect and impact via new technologies in libraries can be understood after going through this paper. The paper tries to pick such technologies which are becoming very famous among library and information science professionals due to its positive potential to implement and use it in LIS field. This paper tries to show how computer, mobile, internet and related technologies have capacity to go deep inside of library and information sector and having excellent power to manage libraries, library resources and can serve its users.

Keywords: ICT, RFID, Cloud Computing, RDA, Library Technologies, Big Data, AI, Expert System.

1. Introduction

Information and communication technology (ICT) has changed the way libraries used to serve their users and manage their resources. There is no field of knowledge and work having no impact of ICT. The use of information technology has become inevitable for quick, smooth, accurate and error free compilation of work in almost all organizations. The ICT has provided smart and extraordinary capacity to libraries and librarians to do their work in effective and in efficient way. This is not only saving time, effort and money of libraries and librarians but also giving them opportunities to learn new skills, create new dimension of services, creating smart managerial ways to run libraries, exploring extraordinary high tech services like AI (Artificial Intelligence) based services. In Jan 2020, India had nearly 688 million active internet users across the country. This figure is projected to grow to over 974 million users by 2025. In fact, the number of internet users was estimated to increase in both urban as well as rural regions, indicating a dynamic growth in access to internet. The above details regarding use of internet is an excellent example of power and potential of ICT to impact every field of knowledge and work. In this regard Libraries are not at all an exception. The use of cloud computing, social networking sites (SNS), web 3.0/4.0, RFID, QR code, RDA, web OPAC, Z39.50, online webinars by libraries/experts for professionals and users, artificial intelligence (expert Systems for Libraries), digital/virtual libraries, e-DDS, institutional repository (IR), electronic theses and dissertations (ETD), open source software or the OSS, bulletin board system, library automation etc. are name of some trends and technologies emerged after emergence of ICT in libraries/knowledge resource centre/information and media centers.

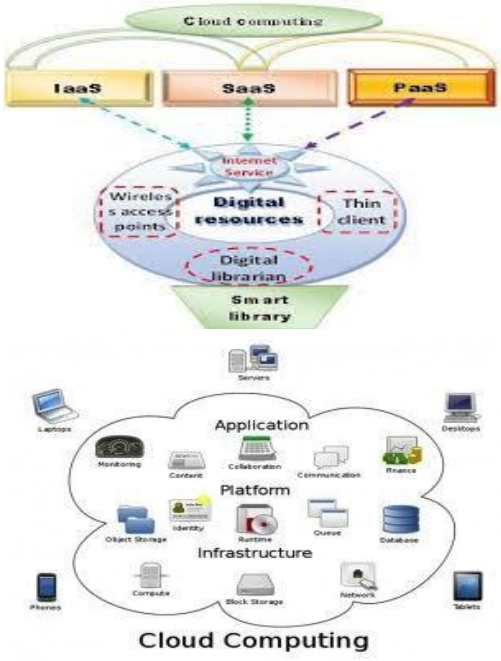
2. Impact of ICT on Libraries

ICTs enable libraries to locate store, retrieve and disseminate information and automate,

manage and serve library users. ICT tools such as CD-ROM, internet based services such as e-mail, online education, eDDS, cloud based services, BBS (Bulletin Board System), web OPAC, webinars etc are used in libraries for dissemination of information. In addition, digitization of information resources which involves converting print resources to electronic form is also carried out, using ICT. So we can easily understand that the adoption of ICT to provide smart services is inevitable. Although there are many such technologies getting adopted and R&D are going for their smart and feasible implementation in LIS system and services but we will have a brief look on some important trends and technologies which is becoming famous in libraries and among librarians and information/media officers/managers of India and world and being used enthusiastically to manage libraries and serve its users.

3. Cloud computing: Cloud computing is a new phenomenon. Many individuals and organizations are adopting this technology model for IT services. The benefit is that by adopting this technology they remain saved from hosting and operating multiple servers over their own network. It saves them from the burden and risk of constantly hardware failure. They need not worry to install software, upgrading or backup issues. It also saves the cost of the organization. Cloud computing refers to "the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a metered service over a network typically on internet". There are basically three models of cloud computing, Software as a service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). The following possible fields were identified where cloud computing services and applications may be applied as searching library data, file storage, searching scholarly content, website hosting etc. Cloud computing technology offers great opportunities for libraries to build community power by establishing networks among the library and information science professionals and interested information seekers by using social networking tools. In library automation polaris provides variant cloud based services such as acquisitions, cataloguing, process system, digital contents and provision for inclusion of cutting edge technologies used in libraries for library automation. Dura cloud provides complete solutions for developing digital libraries and repositories with standard interface and open source codes for the both softwares.

Example of libraries based on cloud computing: • OCLC • Library of Congress • Columbia Public Library • 3 Exlibris • Polaris • Scribed • Discovery Service • Google Scholar • Worldcat.



typically the internet".

(Image Courtesy: semanticscholar.org)

(Image Courtesy: oedg.org)

4. Social media connectivity and Libraries: Social media are a collective term for the online tools and services such as blogs, wikis, social networking sites, photo and video

sharing communities, social bookmarking, podcasts, discussion forums, RSS feeds etc.

Due to the popularity of social media, library professional cannot keep themselves aside from the use of social media in the LIS domain. It is a great challenge for the librarian to capture the attention of the remote users who are using social media like Social news (Dig, Propeller), Social Bookmarking (Del.lcio.us, Blink list), Social Networking (Face book,Tumblr, QzoneMySpace, LinkedIn etc), Social Photo and Video Sharing (Instagram,YouTube, Flickr) and Wikis and who are reluctant to visit the library physically. So many libraries of India and around the world are giving facility to their users to use social media through library‘s website. By exploiting social media the library can give extra facility to reach its services to its web users, and offer them to communicate with the library.

Libraries can use social media platforms to post insights into specific materials and collections, to educate as well as promote what is available. Libraries by using social media can also share events and pictures, educate people about services, highlight their collections, and support other libraries. Growing followers and finding staff support are some of libraries' biggest social media challenges.

Image Courtesy: Onlinetraining.tsl.texas.gov

5. RFID: Radio Frequency Identification: It is the technology that uses radio waves to identify individual items automatically. The objective of any RFID system is to carry data in suitable transponders, generally known as tags and to retrieve data, by machine readable means, at a suitable time and place and to satisfy particular application needs. RFID system has mainly four components: 1. RFID tags / transponder that are electronically programmed with unique information 2. Readers or sensors to query the tags. 3. Antenna. 4. Server on which the software interfaces with the loaded integrated library software. 5. RFID label printer 6. Handheld reader 7.Self check units 8.External book return 9.Staff and conversion station.etc.

RFID library management system consists of books, each attached with an RFID tag, RFID reader, computer network and software. Library staff handle lending, returning, sorting, tagging etc. of books, using RFID tags in this library system. A person can locate RFID library books marked with a RFID tag, using the RFID reader which identifies and locates the book. When the book is carried to the counter, the library staff can either activate or deactivate the electronic article surveillance bit in the book's tag. If a book is borrowed, then the surveillance bit is deactivated. Borrowing and returning of books can be fully automatised with the help of self check-in/out systems. This system requires installation of special software. RFID technology is not only emerging but also more effective, convenient and cost efficient technology in library security. This technology has slowly begun to replace the traditional bar-code on library items.

6. QR Code (Quick Response Code): The QR code technology is just like the barcode technology. The difference between barcode technology and QR code technology is that barcode technology can handle the information only in horizontal direction and QR code technology can handle the information in both horizontal and vertical direction. There are two types of QR codes; one is static QR code, which is a one-time job.

Once this type of code is generated then, we can't change the code again. The second one is dynamic QR code, which is editable.

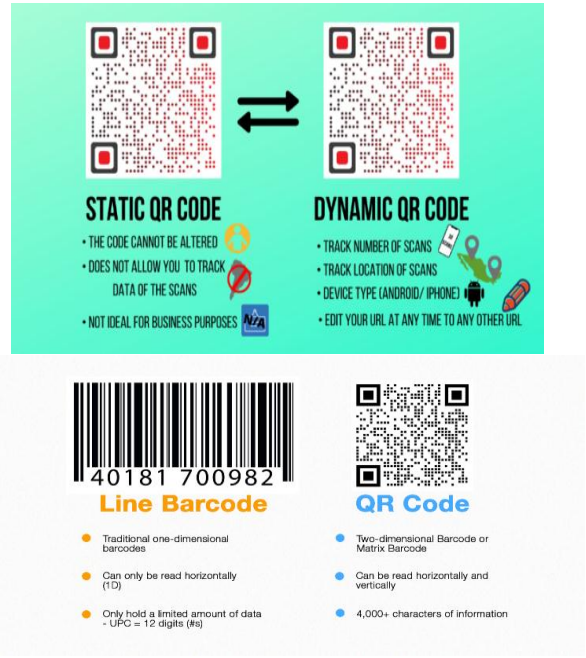


Image Courtesy: Google image

QR code technology is widely used as a medium to deliver a message to end users. The QR codes are mainly used by libraries for the purpose of promoting their services and providing quickly access to their resources. QR codes are also used in libraries to communicate the users to their documents/information that they want, it can also be sued in place of barcode, on library member card, use to provide links and videos to promote library system and services, access of 24x7 video links of library and orientation videos can be shared.. In the ICT and mobile technology era this technology is boon for libraries to get extra reach to its regular and potential users. The new technology like QR code demands the changes of information handling in the library. The user would have easy access to most current and necessary information related to the library by using QR code. So to make the effective use of QR code among the users' community, library professionals must organize user awareness program, orientation program and make themselves aware with such emerging technological assets to disseminate quality services and information access in new way.

7. Resource Description and Access (RDA): Libraries are bound to adopt ICT based knowledge organization tools in this ICT era. The newly emerged bibliographical record formats and descriptions are adaptation of ICT to provide easy access of library resources to its users. RDA emerged from the International Conference on the Principles & Future Development of AACR held in Toronto in 1997. It is published jointly by the American Library Association, the Canadian Federation of Library Associations, and the Chartered Institute of Library and Information Professionals (CILIP) in the United Kingdom. Maintenance of RDA is the responsibility of the RDA Steering Committee (RSC). Resource Description and Access (RDA) is a standard for descriptive cataloging initially released in June 2010 providing instructions and guidelines on formulating bibliographic data. As of 2015, RSC is undergoing a transition to an international governance structure, expected to be in place in 2019. RDA stands for "Resource Description and Access" and is the title of the standard, which is the successor to AACR2. Resource Description and Access (RDA) is a standard for descriptive cataloging providing instructions and guidelines on formulating bibliographic data. Resource Description & Access (RDA) is a set of cataloging instructions based on FRBR and FRAD, for producing the description and name and title access points representing a resource. RDA offers libraries the potential to change significantly how bibliographic data is created and used. RDA is a standard for resource description and access designed for the digital world. It provides (i) A flexible framework for describing all resources (analog and digital) that is extensible for new types of material, (ii) Data that is readily adaptable to new and emerging database structures, (iii)

Data that is compatible with existing records in online library catalogs. RDA is a package of data elements, guidelines, and instructions for creating library and cultural heritage resource metadata that are well-formed according to international models for user-focused linked data applications. RDA goes beyond earlier cataloging codes in that it provides guidelines on cataloging digital resources and places a stronger emphasis on helping users find, identify, select, and obtain the information that they want. RDA also supports the clustering of bibliographic records in order to show relationships between works and their creators.

CASE: Selected plays of a Panjabi language author translated into Hindi language.

Bibliographic Record

050		4	ǂa PK2659.G864 ǂb A6 2012
082	0	4	ǂa 891.422 ǂ2 23
100	0		ǂa Gurasharana Siṅgha, ǂd 1929-2011, ǂe author.
240	1	0	ǂa Plays. ǂk Selections. ǂl Hindi.
245	1	0	ǂa Pratinidhi nāṭaka = ǂb Pratinidhi natak / ǂc Guraśaraṇa Siṃha ; anuvāda evaṃ cayana, Paramānanda Śāstrī.
246	3	1	ǂa Pratinidhi natak
250			ǂa Prathama saṃskaraṇa.
264		1	ǂa Pañcakūlā : ǂb Ādhāra Prakāśana, ǂc 2012.
300			ǂa 320 pages ; ǂc 23 cm
336			ǂa text ǂ2 rdacontent
337			ǂa unmediated ǂ2 rdamedia
338			ǂa volume ǂ2 rdacarrier
500			ǂa Plays.
520			ǂa Selected plays of Gurasharana Siṅgha, 1929-2011, Panjabi author, based on politics and society
546			ǂa In Hindi; translated from Panjabi.
600	0	0	ǂa Gurasharana Siṅgha, ǂd 1929-2011 ǂv Translations into Hindi.
700	1		ǂa Śāstrī, Paramānanda, ǂd 1962- ǂe translator, ǂe compiler.

Image Courtesy: https://resourcedescriptionandaccess.blogspot.com

8.AI (Artificial Intelligence) in Libraries: In computer science, artificial intelligence (AI) is an important topic. In this context, the focus is on human behavior and how machines can imitate intelligent human behavior. AI involves amongst other expert systems (ESs), fuzzy logic, artificial neural network, evolutionary algorithms, case-based reasoning, image processing, natural language processing, speech recognition and robotics. AI techniques or tools have been utilized in many areas such as business, management, medicine, military etc. Library and information science also have utilised intelligent systems. "Library management and its activities apply repetitious and time-consuming activities. Hence, in order to increase efficiency and effectiveness, many libraries are moving toward automation of their activities" *(Dwivedi et al., 2013)*. AI techniques give more accuracy to the automation of libraries. A lot of research has already been done of the various uses of AI technologies in libraries by various experts. *(Lancaster and Smith, 1990), Hsieh and Hall (1989) , O'Neill and Morris (1989), (Payne and Bradbury, 2002)* etc.

AI applies to different sciences. In the library and information science, it is more used in scientific databases and library systems, such as behavioral science, social sciences, psychology, management and library and information science. It is related to some of the systems that apply different forms of intelligence such as learner systems, inferior systems, systems with natural language understanding or natural language interpretation, systems with visual scene perception and systems that perform other types of feat that require human types of intelligence *(Bavakutty and Salih, 2006)*. In this branch of the science that involves machines, solutions are utilized to solve complex problems of human behavior. We can present computer-based algorithms based on human behavior and knowledge in using systems. "It is an interdisciplinary field making use of concepts from various fields like cybernetics, information theory, psychology, linguistics, logic, etc. it can be used to simulate human behavior and for computer alled instructions, ES, robots and for NLP. It can also be used for intelligent retrieval from databases" (Bavakutty and Salih, 2006). In this way, computer software and the use of various computer-based products help in the operation of various types

of libraries and their public services and the generation of output products. Automation implies the degree of mechanization where the routines and receptive jobs or operations are left to be performed by machines with little or no intervention by human beings. In view of the various features of a modern computer system, we find that it has been applied in several areas of library work. Book acquisitions, cataloging, serials control, and circulation, information retrieval and dissemination, interlibrary loan, cooperative acquisition and cataloging have been automated in the library *(Lakshmikant and Vishnu, 2008).*

AuRoSS (autonomous robotic shelf scanning system), a robot that can navigate and scan library shelves for misplaced books. Using RFID and and laser mapping technology to scan shelves with 99 percent accuracy. (Image *Courtesy to : https://www.libraryjournal.com/)*

9. Expert Systems in libraries: Expert systems (ESs) are computer-based systems that simulate human decision making. They can integrate with information systems to improve their accuracy and performance (Singh *et al.*, 1996). Various librarian ES has been developed. Waters (1986) designed the National Agricultural Library's microcomputer-based ES to help users in obtaining answers to simple reference questions. In general, they ask questions from the user and take the user's answer as input, then explain the rationale for decision results. In general, these systems consist of two main elements: A knowledge base and inference engine. The knowledge base encompasses all the information needs that human/librarian experts are using to decide. This information is presented in the knowledge base as facts and rules. ESs can make much better decisions than librarian decision makers because their knowledge base can involve the experiences of a team of the best experts. The manner of librarian experts to make decisions is emulated for the design rules of the knowledge base. The rules are consisting of two main phases: "if phase" and "then phase." The "if phase" is consisting of conditions, and the "then phase" is consisting of results. ESs are distinguished from other computer systems with the application of reasoning through the inference engine. The inference engine simulates human decision makings based on the knowledge base and a rule base.

Many of the library's activities are specialized. For this reason, library software should be used to improve the library's performance. The efforts have been made in this regard. Denning and Smith (1994) had a survey on the "Electronic Library Search Assistant." Kruk and Krawczyk (2004) studied about intelligent resources search in virtual libraries. Devadason and Vespry (1996) studied about planning for the library staff. It encapsulates the expert knowledge of a library staff planner. They presented the LISPA (Library and Information Center Staff Planning Advisor). By reviewing the research and literature, specialized library systems can have the following applications in the area of providing library and information services

- Knowledge-based indexing (Amin and Razmi, 2009);
- Natural Language Processing and abstracting (Albayrak and Erensal, 2004);
- Reference work (Amin and Razmi, 2009);
- Cataloging (Weiss, 1994) and (Amin and Razmi, 2009);
- Online information retrieval (Bellman and Zadeh, 1970), (Sacchanand and Jaroenpuntaruk, 2006) and (Bavakutty and Salih, 2006);

- Using intelligent interfaces in online information storage and retrieval systems;
- Information needs analysis and representation, including different services, such as classification, indexing and abstracting;
- Reference services;
- Development of collection;
- Hypertext and hypermedia (Bavakutty and Salih, 2006)

10. Web 4.0/Library 4.0 (Intelligent Library): Before having a brief idea about web 4.0. It is important to know about web 1.0 to web 3.0. Web 1.0. In the World Wide Web's first decade (1990–2000) the web represents the web 1.0, which, according to Berners-Lee, is the "read-only web." In other words, the early web allowed us to search for information and read it. There was very little in the way of user interaction or content generation. An example might be a personal web page that gives information about the site's owner, but never changes. In the second decade (2000–2010), web 2.0 a simply improved version of the first worldwide web, characterized specifically by the change from static to dynamic or user-generated content and also the growth of social media. Web 2.0 internet applications allow sharing and collaboration opportunities to people and help them to express themselves online. In the Web's third decade (2010–2020) web 3.0 is a dynamic, it is the next generation of internet technology that heavily relies on the use of machine learning and artificial intelligence (AI). It aims to create more open, connected, and intelligent websites and web applications, which focuses on using a machine-based understanding of data. The next step (2020–2030) will be Web 4.0, with intelligent personal agents and intelligent machines.

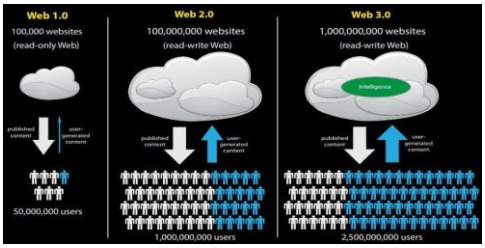


Image Courtesy: blockgeeks.com

Library 1.0 is associated with Web 1.0 in the same way Library 2.0, 3.0, and 4.0 are linked to their corresponding versions of the web. A huge body of research discusses library versions in the field of Library and Information Science. The term "Library 1.0" began to be used for comparison when the term "Library 2.0" was introduced by Michel Casey. Library 2.0 refers to the application of Web 2.0 tools to library services. Library 2.0 is generally perceived as the application of the interactive, collaborative, and multimedia web-based technologies to library services and collections *(Maness, 2006*). *Farkas (2005)* explains that Library 2.0 is about allowing user participation through writing reviews and tagging in the catalog and making users' voices heard through blogs and wikis. Library 2.0 are "entirely" user centered, it is the library which is everywhere. The term Library 3.0 refers to the use of emerging technologies such as the semantic web, cloud computing, mobile devices and established tools like federated search systems, to facilitate the development, organization and sharing of user-generated content through seamless collaboration between users, experts and librarians. *Kwanya, Stilwell, and Underwood (2013)* defined Library 3.0 as intelligent, organized, a federated network of information pathways, apomediated, and "my library". Library 3.0 seems to be a hybrid between the 1.0 and 2.0 models and reasserts the librarians in the information value chain as mediators. Many scholars agreed that Library 4.0, as a future library, will become an intelligent library where not only inference and research are available, but the system will analyze information by itself and discuss findings with

users like a colleague (*Chauhan, 2009; Jenkins, 2011; Aghaei et al., 2012; Sharma, 2012; Fowler & Rodd, 2013).* In other words, we can assume that Library 4.0 will bear many similarities to web 4.0 and incorporate many of the same concepts and technologies. Through that logic, we can imagine an environment that fuses platforms, services, and large amount of content (massive web), a library that allows librarians, users, and machines to coexist (symbiotic web), technology that allows humans and machines to read, write, execute, and concur at the same time (read–write–execution–concurrency web), and a library that thinks, makes decisions, and provides library services using reasoning (intelligent library).

11. Big data and Libraries: "Big data is defined as a term for data sets that so large and complex that traditional data processing applications are inadequate to do analysis, capture, store, data curation, sharing, transfer and so on." Nowadays Libraries are offering online resources and services. Libraries are also using social media outlets such as Facebook an Instagram to promo their services and programs. Librarians with the help of emerging technologies and tools such analytics software are able to collect more online data, analyse them for adding value to their services. Thus Libraries can use big data to make better decisions regarding collection development, updating public spaces and tracking the use of library materials. Librarians can be involved in big data by developing skills such as enable data discovery and data retrieval, maintain data quality through cataloguing, indexing, archiving. management, preservation and representation. They can make big data sets more useful, visible and accessible by creating taxonomies.

Image Courtesy: extraordy.com
Image Courtesy: analyticssteps.com

12. Conclusion:

Librarians are perfectly compatible with the new tools, trend and technologies and with the arrival of such cutting edge technologies. Libraries and librarians are becoming smarter day by day. Now libraries and librarians are having all the necessary qualifications and basic skills to play an active part in this progression and adoption of such smart and advanced tools for libraries. Their expertise in alerting, tagging, cataloguing, customizing information, and in judging and selecting information sources will help to follow the evolution of a different smart and intelligent libraries and users' needs. Librarians can and must follow the continuous progression of the generation trends and technologies.They must view them as new opportunities, not as something they need to be afraid of getting involved in. They need to keep an eye open for emerging trends and changes in users'

expectations and determine how they can meet those expectations. They also need to work together to share ideas and experiences, to implement developments, and learn from each other. Of course they can rise to the challenge of the latest ICT based web era information society—it is just a question of re-casting, designing themselves yet again.

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