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Information and Communication Technology (ICT) in Libraries: A New Dimension in Librarianship

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Abstract: Effectiveness of a library service is now largely depends upon the Information and Communication Technology (ICT). This study attempts to explore the gradual advancement of modern technologies in libraries distinguishing old and new technologies. The study endeavors to identify various components of ICT which are used or being used in libraries and information systems. The study identifies exact reasons to use computer and related technologies in libraries. It also delineates the functions, impacts and challenges of ICT based library system.

Key words: ICT, medlars, MARC, OCLC, OPAC, CD-ROM, CDS/ISIS, teleconference, artificial intelligence, internet

INTRODUCTION

Information and Communication Technology (ICT) is a comprehensive concept and parallel concept with Information Technology (IT), that denotes not only a single unit of technology but an assemble of technologies like telecommunication equipments, data processing equipments, semi conductors, consumer electronics, etc. The concept has brought a phenomenal change in the information collection, preservation and dissemination scene of the world. For the profession of librarianship, this turn of the events is a blessing in disguise[1].

The emergence of IT is one of the wonderful gifts of modern science and technology which has brought tremendous changes in Library and Information Science. Application of IT to library and information work has revolutionized the traditional concept of libraries from a 'store house of books to an intellectual information center' connoting the concept of electronic library. It has opened up a new chapter in library communication and facilitated global access to information crossing the geographical limitations[2].

Using ICT, libraries are also playing a very important role in facilitating access to global information and knowledge resources[3].

BJECTIVES OF THE STUDY

This study is designed and carried out with the view to determine the following objectives:

- to explore various components of ICT used in libraries
- to trace the advancement of ICT in libraries;
- to compare old and new technologies;
- to identify the reasons for introducing ICT in libraries;
- to explain the functions, impacts and challenges of ICT based library services.

MATERIALS AND METHODS

This study is based on the review of primary and secondary literature, which includes books, journals, documents, seminar papers, etc. Relevant literature were also collected and consulted through Internet browsing.

ICT: CONCEPT AND MEANING

ICT incorporates a range of technologies used to support communication and information. ICT includes both networks and applications. Networks include fixed, wireless and satellite telecommunications, broadcasting networks. Well-known applications are the Internet, database management systems and multimedia tools. By implication, a holistic understanding of ICT necessarily includes consideration of telecommunications policies, information policies and human resource development policies.

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Information and Communication Technology (ICT) is a diverse set of technological tools and resources used to communicate and to create, disseminate, store and manage information[4].

Marcelle argues The ICT sector is a heterogeneous collection of industry and service activities including information technology equipment and service, telecommunication equipments and services, media and broadcast, Internet service provision, libraries, commercial information providers, network based information services and related professional specialized services[5].

Hamelink provides a useful and clear definition of ICT indicating, ICTs are those technologies that enable the handling of information and facilitate different forms of communication. These include capturing technologies (e.g. camcorders), storage technologies (e.g. CD-ROMs), processing technologies (e.g. application software), communication technologies (e.g. Local Area Network) and display technologies (e.g. computer monitors)[6].

So, we can define ICT as 'the use and application of computers, telecommunications and microelectronics in the acquisition, storage, retrieval, transfer and dissemination of information.

COMPONENTS OF ICT IN LIBRARIES

Chisenga[7] quoted that ICT came about as a result of the digital convergence of computer technologies, telecommunication technologies and other media communication technologies.

Patil, Kumbarand and Krishnananda[8] categorized the components of Information Technology (IT), which frequently used in library and information center are as follows:

- Computer Technology
- Communication Technology
- Reprographic, micrographic and printing technology.

Rahman[9] stated that ICT is the fusion of two important technologies: electronics and communications. We can sum up the components of ICT on the basis of the concept of Chisenga, Patil, Kumbarand and Krishnananda and Rahman.

Now a brief account of these Information and Communication Technologies is discussed below:

Computer technologies: The dramatic development in the information transmission process in every field of human endeavor has been made by the widespread use of computer technology that can further be divided into following categories:

Workstations: These are expensive and powerful computers used mainly by engineers and scientists for sophisticated purposes. These include following:

Mainframe computers: Mainframe computers are fast, large capacity computers, after the super computer, occupies a specially wired, air-conditioned room is capable of great processing speeds and data storage.

Super computers: Super computers are high-capacity computers that are the fastest calculating device ever invented. It may have a vector processing design or massively parallel processing design.

Mini computers: Mini computers are refrigerator-size machine that are essentially scale-down mainframes. Mini-computers are becoming more important as servers in networks.

Personal Computers (PCs): These are desktop, floor-standing, or portable computers that can run easy-to-use programmes such as word processing or spreadsheets.

Microchip technology: A microchip is a tiny piece of silicon that contains thousands of micro-miniature electronic circuit components, mainly transistors. The microprocessor of microcomputer, which process data, is made from microchips.

Artificial Intelligence (AI): AI is a group of related technologies that attempts to develop machines to emulate human like qualities, such as, learning, reasoning, communicating, seeing and hearing.

Software technology: Software consists of the step-by-step instructions that tell the computer what to do. Many software packages for various applications in the field of library and information services and management are commercially available. Some of the important library packages available are[10]:

Cds/isis (computerized documentation system/integrated set of information system): This public domain package of library software developed by UNESCO is a menu driven generalized information storage and retrieval system designed specially for computerized management of structured database. The windows version of CDS/ISIS is called WINISIS.

In magic: In this study, the major functions include cataloguing, acquisitions, circulations, serials, on-line catalogue, retrieval, etc.

Book: This software system which supports all the major library functions including circulation control, acquisition, serial control, etc. This software is in COBOL language.

Minisis: This study is for use in creating, maintaining and searching library and information databases.
Supports both text and index searches, controlled indexing terms.

Libsys: It is the most comprehensive library software. It supports almost all activities relating to acquisition, cataloguing, circulation, serials and articles alert.

CD-ROM technology: CD-ROM is an acronym that stands for Compact Disc Read Only Memory. It is an optical disc of 120 mm diameter and a hole of 15 mm at the center with thickness 1.2 mm. Data is recorded in digital form using laser beam. CD-ROM is used to hold prerecorded text, graphics and sound.

Communication technologies: Communication or telecommunication technologies are used to transmit information in the form of signals between remote locations, using electrical or electromagnetic media as carriers of signals. Communication technologies comprise the following:

Audio technology: The outmoded AM (Amplitude Modulated) radio receivers are being replaced by the modern FM (Frequency Modulated) receivers. The recent development is the production of Compact Discs (CDs). Audio technology can be used in libraries and information centres for a wide variety of purposes such as story telling to children, imparting education, knowledge, recreation, etc.

Audio-visual technology: AV technologies are those by which things can be understood by listening as well as seeing. AV technologies include the following:

Motion picture: It can be used in library as one of the instruments of mass media communication. It is the dynamic source of information, education and recreation.

TV: Television is one of the traditional and old information and communication technologies which was dominated by major of station in its formative period.

CATV (Cable Television) system: It is a wired communication system of high capacity that flows from a central source through a major distribution cable to neighborhood lines and finally to the line into the house.

Videodisc: Videodiscs can be used to disseminate computer programmes, digital databases, educational video programmes and a range of electronic publications.

Videotext: Videotext is a newer technology, but as in the on-line information retrieval, the information is stored in computer files and accessed through a telecommunication link.

Teletext: Teletext is a one-way service to a large number of simultaneous users, where pays of information from a central database are broadcast as part of the regular television signal.

Telephone: The telephone is one of the longest established methods of electronic information transfer especially to transfer the voice which can be a strong means of disseminating information and keeping of what is being happened concerned organization and outside as well.

Cell phone or mobile phone: Mobile telephones are based on the cellular radio technology. Mobile phone provides the facility to dial connections anywhere in the world. As the user of mobile telephone moves from cell to cell the radiotelephone link switches from one central transmitter/receiver to a second while the call continues, uninterrupted.

Fax (facsimile transmission): It is a method of converting an image into electronic signals that can be transmitted over a communication link and converted back into an image at the receiving end.

E-mail: E-mail is a system of exchanging message in electronic format. It is the most used tool on the Internet. It has brought a revolutionary changes in communication because any type of information such as personal notes, letter, documents, publication, computer program, even pictures and sound can be sent to or received from anywhere of the world within a fraction of a second at a very cheap rate through electronic signals called SMTP (Simple Mail Transfer Protocol).

Voice Mail: Voice mail acts like a telephone machine that digitizes the incomings voice message and store for retrieval later. It is an alternative system of e-mail.

Teleconference: Teleconference is a meeting among people remote from one to another who are linked by a communication device such as a telephone, television or computer. There are following five types of teleconference: Audio teleconference Video teleconference Computer teleconference or Computer conference Document conference Personal videoconference.

Satellite technology: Satellites are, infact, formed of microwave transmission in that satellites, which are positioned in space approximately 22,300 miles above the earth, represent relay stations for earth round communication.

Internet: Technically the Internet is a junction of a number of hardware and software resources or equipments to construct the infrastructure and to perform multiple functions. It is treated as a virtual library where world's information resources are gathered for the use of the clientele. It has broken down the distance barrier in communication. It has greatly influenced the practice of librarianship. Access to information through Internet has changed the total scenario of librarianship.

Network technology: The important function of network is to interconnect computers and other communication devices so that data can be transferred from one location to another instantly. Generally computer network is of following two types:

WAN (Wide Area Network): WAN is a communication network that covers wide geographic area such as a country, or state.

LAN (Local Area Network): LAN is a communication network that covers limited geographic area such as campus, or building.

REPRODUCTION TECHNOLOGY

Reprographic technology: The term reprographic is used to identify that field of information processing which concerns with technologies and equipments for the reproduction of documents.

Micrographic technology: Micrographic is that field of information technology which concerns making use of microforms. Microform is a generic term for all information carriers which use microfilm or similar optical media (including study) for the high-density recording and storage of optically encoded information in the form of micro images of printed document, bit patterns or holograms.

Printing technology: A printer is a device that converts computer output in to printed images. There are a number of different kinds of printers used in library such as Dot Matrix Printers, Laser printer, Inkjet, Bubble-Jet, etc.

CONCEPT OF ICT IN LIBRARIES: A GRADUAL DEVELOPMENT

Library and information centers entered into information and communication technology era in 1960s with the availability of general purpose computers for performing traditional library activities. Some of the significant developments regarding ICT in libraries during that period are as follows[11]:

- The MEDLARS (Medical Literature Analysis and Retrieval System) project to mechanize the handling medical literature at the national library of medicine, USA;
- The pioneering work on serial control by the Southern Illinois University of California at San Diego.
- Initiation of project MARC (Machine Readable Cataloguing) by the Library of Congress to provide a format for cataloguing.

Table 1: The devices and systems available to manipulate the resources of information

Operations	Information technology Device/System
Capture	Remote resource sensing satellite
	Radar system
	Electronic camera
	VCR system, Video disks
Transportation	Coaxial cable, Optical fiber cable
	Microwave link, Communication satellite
	Satellite phone, Cellular mobile radio, Laser beams
	Facsimile transceivers, Video phone
	Electronic teleprinter, Modem, Multiplexer
Storage	Memory chips
	Hard disk/Magnetic tape/Drum/Floppy disk
	Holography
	Laser emulsion, Microfilm
Processing	Integrated circuits, Microprocessors
	Computer Software/Peripheral equipments.
Retrieval	High definition television
	Teletext/Videotext, Pay Television system
	Online database.

Source: Communication media and electronic revolution, 1996

Table 2: Comparison between old and new technologies

Functions	Old technologies	New technologies
Text entry, editing and composing	Typing, Type setting	Electronic word, Processing OCR scan
Replication	Printing	Computer terminal, Display, Print, Videodisc mfg.
Storage	Shelving	
	Cataloguing	Digital mass store, videodisc
Searching, selecting, retrieving	Catalogue search, browsing	Computer database software
Communication	Mail, freight, Personal travel	Computer network, Teletext, CATV, satellites, videodisc

Source: Cited from Nasir Uddin, 2001

The next era of ICT based library began in the late 1960s to a great extent with the success of INTREX and the MARC projects. During this online, real time interactive computer systems were introduced in the library and information field.

In 1967 both OCLC and BALLOTS became operative. In the early 1970s, Online Systems were in operation in several libraries, for example, Bell Telephone Laboratories, Eastern Illinois University etc.

In a guidebook for young professional librarian, Rowley and Lea[12] pointed out that Information Technology (recently called ICT) is a comparatively a recent term to be found in the literature of library and information science. It is first appeared in 'Library and Information Science Abstracts' (LISA) in 1975, but didn't assume regular use until the early 1980s. Libraries and information centers have witnessed landmark development in ICT culture during last decade of the last millennium. These major developments of ICT can be expressed in the following manner[13]:

Branscomb[14] one of the pioneer who played leading role to transfer the concept of traditional library into ICT based library, have compared traditional library functions with new technology based library (Table 2).

WHY IS ICT NEEDED IN LIBRARIES?

Various factors have contributed to bring about change from traditional to ICT based library operations. Basically ICT is needed in libraries for the following two main reasons:

In terms of various problems faced by the traditional library systems: The manual performances of library functions were getting difficult because of the following main reasons:

- The size of recorded information is ever growing whereas space available at the disposal of each library is limited. No library can think of getting additional space every year, although the collection will grow continuously;
- Due to knowledge explosion, the society is faced with multifaceted and multidimensional information to such an extent that not only its storage has created challenge, but the organization of this bulk of information has also become unwieldy;
- Library operations, due to potential growth of information, could take many hours to perform manually;
- Due to information explosion, all sorts of house keeping jobs and information works can be performed by manually with less effective and less accuracy.

In terms of various facilities provided by computers and related technologies: The advantages of using computers and other telecommunication media/devices in managing libraries are manifold. Some of the advantages are as follows[15]:

Speed: A computer can carry out an instruction in less than a millionth of a second. Searching of information, compilation of bibliographies, preparation of current awareness bulletins, indexing and sorting can be processed by a computer in a few hours.

Storage: Human brain can store pieces of information to some limitation whereas computers can store voluminous data.

Accuracy: Computers can perform functions very accurately.

Reliability: Computers and all related technologies have long life if maintained properly. The data gathered in it are reliable.

Repetitiveness: A computer can be used repetitively to process information.

Compactness: The present day computers are laptop/waptop/palmtop, which do not occupy more space.

FUNCTIONS AND BENEFITS OF ICT BASED LIBRARY SYSTEM

Traditionally, computers in libraries have been used and in most cases are still being used to automate the following functions[16]:

- Acquisition and budget
- Cataloguing and short loans
- Circulation
- Serial control (Periodicals)
- Provision of access to online catalogue.

Since the 1950s, use of ICT in libraries has basically gone through four stages, corresponding to the major reasons for automating[17]:

- Improving the efficiency of internal operations
- Improving access to local library resources
- Providing access to resources outside the library
- Interoperability of information systems.

ICT is used in various fields of library activities. Some of the areas where new technologies can perfectly be used are as follows[18]:

Acquisition:

- Acquisition/Accession list
- Order file/report

Serials management:

- Serials cheek-in/out and claiming
- Union/holding list

Cataloguing/classification:

- Catalogue card/label production
- Retrospective conversion
- On-line catalogue

Circulation:

- Issuing
- Inter library loan
- Reservations
- Over dues

Audio-visual management:

- AV acquisition/cataloging

Management:

- Accounting/budgeting
- Word processing/mailing
- Scheduling/planning
- Statistics/report

Information storage/retrieval:

- Database construction
- Online database searching
- Down loading/uploading
- Indexing and abstracting

Reference/Information services:

- Bibliographic listings
- Library instructions
- Public access/computer literacy.

ICT -BASED USER SERVICES

Some library users are adopting electronic habits, making increasing use of the new ICT including computers, the Internet, the Web, Intranet, Extranet and other technologies. As a result, library users are placing new demands on their libraries. They require access to the latest information, updated information resources and access to ICT facilities that they could use in their work.

Use of ICT in libraries enhances users' satisfaction. It provides numerous benefits to library users. Some of the benefits are[19]:

- provide speedy and easy access to information
- provides remote access to users
- provides round the clock access to users
- provides access to unlimited information from different sources
- provides information flexibility to be used by any individual according to his/her requirements
- provides increased flexibility
- facilitates the reformatting and combining of data from different sources.

Libraries are also providing various ICT-based services to their users, including the following[20]:

- Provision of Web access to OPACs
- Electronic document delivery
- Networked information resources
- Delivery of information to users' desktops
- Online instructions
- Online readers advisory services

Web access to OPACs: Libraries are providing access to Web-based Online Public Access Catalogue (OPAC) interfaces. This is making it easier for OPAC users to learn and use these resources since they only have to learn how to use one universal access client, the Web browser.

Electronic document delivery: Libraries are implementing ICT-based interlibrary lending system using electronic networks to deliver copies of journal articles and other documents in digital format [mainly in Portable Document Format (PDF)] to library users' desktops.

Networked information resources: Libraries are providing their users with access to networked information resources, i.e. databases, electronic scholarly journals, encyclopedias, public government information, etc, provided by various publishers or suppliers.

Information delivery to users: Library and information users are now getting access to electronic information resources from the computer desktops in the computer laboratories, Internet cafes, offices and even at home. This is resulting in librarians and other information specialists investigating and implementing systems that can deliver customized information to users' desktop computer environment, irrespective of their geographical location.

Online instructions: Libraries are also implementing online based bibliographic or library use programmes. These include online tutorials on searching online resources and virtual tours of library collections.

Online readers advisory services: Libraries are implementing Web-based versions of readers' advisory services and reference services. These include services such as informing users via the Web about new acquisitions, providing reviews and recommendations, providing facilities for readers to interact with the reference staff (Virtual Reference Desks), etc.

IMPACT OF ICT ON LIBRARIES AND LIBRARIANS

Computer has brought in a new impact to the library and information usage. In libraries, information technology has assisted library professionals to provide value added quality information service and give more remote access to the inter-nationally available information resources[21]. Today's highly sophisticated information technology to facilitate the storage of huge amounts of data or information in a very compact space. Information technologies promise fast retrieval of stored information and revolutionize our concept of the functions of a traditional library and a modern information center. Recently technological developments have dramatically changed the mode of library operations and services[22].

Modern ICT is impacting on various aspects of libraries and the information profession. Advancements in ICT and the wide spread use of ICT is resulting in digital information sources and digital media replacing and becoming the dominant form of information storage and retrieval.

The term library no longer refers only to physical buildings located in a specific geographic location but also to electronic or digital or virtual libraries that can be accessed from anywhere. Library collections consist not only of physical information resources such as books, periodicals, videos, films and many more, stored in physical library buildings, but also include digital resources. Access to digital information resources is not restricted to specified hours and days of the week at one physical library building. The proliferation of digital information available over the Internet, intranets and extranets is resulting into libraries and information centres losing their former place as the focus of the information environment in many organisations. Libraries are becoming one of the many information systems available to information end-users[23].

ICT also survives and makes true the rules of Library Science-'Every reader his/her books/information,' 'Save the time of the readers' and 'Library is a growing organism'. ICT with its tremendous information sources, rapid transmission speed and easy access ensures the satisfaction of the user with complex demand, break down the distance barrier and shortened the time required and ensure the right information to the right reader at the right time. It also increases and solves the library's demand of collection development. It is really an excellent tool for the library and information centres.

NEW SKILLS AND KNOWLEDGE REQUIRED FOR INFORMATION PROFESSIONALS

Information sources and services being provided by libraries to their users need to adapt to the electronic information environment being experienced by most information end-users. In addition to the traditional library and information management skills, librarians now need to possess additional skills and expertise, more so in the use of modern information and communication technologies, automated information service, electronic publishing, digital information management and knowledge management[24]. New informational professional should acquire technological systems thinking, commitment to continuous improvement of skills, techniques and strategies and sensitivity to network environment[25].

In modern ICT based library services, the information professionals handle various types of activities in relation to the use of computers and other new information technologies. Some of these are: handling and developing information storage and retrieval systems of specialized/local data and materials, managing different types of housekeeping operations, carrying out on-line searches for information users using modern equipment, exchanging local databases and sharing of resources through networking[26].

For the modern information services, technically qualified personnel will be required to provide access to databases and databanks and to work in the exploitation of the resources of libraries. In a studyless system, the information personnel, who are familiar with the resources

available in machine-readable form and with vocabularies, query languages, indexing and search strategies will be needed to exploit these resources most effectively and efficiently[27].

ICT IN LIBRARIES: VARIOUS CHALLENGES

The use of ICT in libraries has raised a number of challenges. These include[28]

- Changing role of libraries and librarians
- Funding for libraries
- Copyright management
- Information access
- Preservation of digital information resources
- Legal deposit

Changing role of libraries and librarians: More and more library users are using digital technologies and have access to global information resources via the Web. Unfortunately, the huge amount of information available on the Web is generally overwhelming information users. Further, a large number of Web users are still not able to use the Web efficiently.

Funding for libraries: Due to severe budget cuts and high prices for books and journal subscriptions, libraries are faced with no options but to reduce expenditures on books and journal subscriptions.

The introduction and use of ICTs in libraries has not made the situation any better. Money is required to maintain and upgrade the equipment and software, pay software license fees, pay for access to electronic journals and online databases, pay for Internet connections, etc

Copyright management: Digitization and provision of access to digital collections accessed via electronic networks, especially the Internet, is presenting bigger challenges to librarians. Unlike print-based documents, digital-based information resources can be accessed from anywhere via electronic networks, copied several times, manipulated (i.e. edited, modified, repackaged, etc) or deleted.

The ease at which digital information resources can be copied and manipulated may result in governments, under pressure from information producers, to put in place rigid copyright laws in which the rights of the right-holder are increased at the expense of users and this may affect the provision of access to digital information sources in libraries.

Information access: Whereas libraries generally contain and provide access to selected information resources, this is not the case with information accessed on the Web. Distribution of pornographic materials and information produced for deliberate disinformation is very easy to do on the Web and this presents problems to many librarians on how to exclude access to such types of information, especially on Internet workstations located in libraries.

Preservation of digital information resources: The print-based library and archives environment, as opposed to the digital information environment, has evolved over centuries.

Preservation methods and formats for print-based documents have also been developed and tested. There are print-based documents that are over 2000 years old in the world today and can still be read. The digital information era is in its infancy and already some of the information is stored in formats or media that cannot be accessed or read.

Legal deposit: In the print-based environment, producers of publications are required by law to deposit copies of their documents with the national library or national archives, or any agency designated to receive and preserve such publications. In the digital information environment, the situation in many countries is still not clear as to who is responsible for the long-term preservation of digital information resources.

CONCLUSION

Today computer and related technologies has brought revolutionary changes in the whole world of information. Perhaps, this is the most exciting period in the history of human race when world's most population is shifting from 'techno-illiterate' to 'techno-literate'. The society is undergoing a kind of transformation. With the passing of each day, we find that 'Information and Communication Technology (ICT)' has affected almost every sector of our life, bringing a change in the case of people's think, interaction, etc. This revolutionary change is also true in the case of libraries and information centers. Libraries and information centers can hardly function today without computers and information technologies. In the modern world the library and information professions have been changed and adopted itself to the developments of Information and Communication Technology. These technologies have acquired the do-or-die prominence; those who go with the advances will survive and others will become obsolete. A well-equipped library with the facilities of modern information

infrastructures and technologies could satisfy the maximum demand of the present technology conscious users.

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