CHAPTER – I

INTRODUCTION

1.0 Introduction

This study begins with an enquiry. What it implies that libraries are considered unique social institutions, the organization being reckoned as precious and legendary? It is because “Libraries have survived from more than a thousand years (Witten and Bainbridge, 2003)\(^1\). The two cultural heritages for the preservation of knowledge and antiquities established long ago are the Libraries and Museums respectively. They have survived all kinds of calamities, invasions and destruction through fire and other human and non-human creators. The Librarian and the Curator have devised means to preserve them, as “Preservation for Posterity” was an old adage but “preservation” is now assuming a new role with the advent of digital technology. So the “Digital Library” concept emerged worldwide. At the beginning the professional librarians just acted as preservers or curators of the collection of several forms of information resources like manuscripts, books, and other documentary forms held on palm leaf, handmade paper and stones, and others. The gradual inculcation of organizational features to library added some new functions and then the same functions were changed to the traditional roles and functions in the form of acquisition, technical processing (cataloging and classification), circulation or delivery of document and then information dissemination through search and retrieval process (Adam & Yesha, 1996)\(^2\). The preservation though was more or less confined to museums, libraries are adopted this function to conserve the knowledge entities the books and others through binding and other reinforcement techniques to preserve and make them available to the user community. The libraries since their very inception have been impacted by
contemporary technology and adopted them for the benefit of their clientele. The succession and revolution of activities of library and its basic services that were changed drastically brought by Information and Communication Technologies (ICTs), of today which has been incredible and has extremely provoked the basic purpose and appearance of new library type which is familiar with its predictable future as virtual library or library without walls (Erway, 1996)\(^3\).

The contemporary advances in ICT have brought significant changes in creation, access, use and management of information products and services. The transition has been from many frontline developments in the storage, organization and access to information products and services like the first being the invention of movable type printing which has been surviving very strongly even to this day (Salton, 1968)\(^4\). The next change came only in early 20\(^{th}\) century which saw the advent of microforms which was perceived then as permanent solution to the libraries storage and dissemination problems. This lived for short period and then emerged the optical storage and retrieval facilities supported with computer technology. Despite high volumes of storage and efficient search and retrieval techniques it was set only as a secondary storage to complement print media. This continues till late 1990s and thereafter to serve the causes of library services to its users (Ying, 2003)\(^5\). The World Wide Web and Internet has totally transformed the scenario and being considered as a total solution to all transient issues of libraries in regard to storage, organization, remote access, search and transmission of information to all corners of the globe. This is a landmark and a milestone in the technology application in libraries and now is termed as digital era or digital age. This has also provided wider opportunities in archiving and accessing knowledge in the digitized form besides conservation and
preservation of the traditional knowledge. As it goes on there is a significant change in the design, access, use and organization of information (Smith, 2006)⁶.

The preceding description is a profile of the evolution of the technology used by libraries for information storage, organization access and transmission and hopefully the digital era would continue to serve the cause for more years to come and the Digital Library is the nascent incarnation of the library. The digital library is not predicted to be transient and many initiatives are originally started with projects which extended to a group of collections which are later called as digital libraries have now moved from reference sources to the full text information resources in all forms and media (Dillon, 1999)⁷. The digital library though is very familiar to Library but its scope is also extended beyond the library materials like artifacts, museums, archives and antiques. The Raman Research Institute, Bangalore is one of the study institute under consideration, has a Museum in the name of Sir C.V. Raman. So in this context the digital library of collections of this museum can be one of the initiatives to convert the antiques and rare materials in digital form. So the study has therefore has undertaken to study the digital library initiatives of in the selected Research Institutions and R and D Organizations in Karnataka State. In the case of research institutes and R & D organizations in India, the majority of them are funded by the Central and State Governments. Those institutions have made a significant contribution to the transmission of knowledge and to research in all fields and disciplines. Research Institutes have played a leading role in transforming the country into a modern intellectual and technologically-advanced country (Mittal & Mahesh, 2008)⁸. Research institutes supports the needs and aspirations of research students and scholars. The libraries of these institutions also play a vital role in acquiring and disseminating information for academic and research activities. Digital libraries are a
way of making research data and information available to faculty, researchers, students, and others at the research institutions and worldwide.

The digital information is broadly grouped into two categories, born digital and digital Archives. The extent of born digital in comparison with digital archives is less in magnitude. The creation of born digital is an ongoing process and the archival is a retrospective work. It is possible that the study would be desirous of examining the several initiatives of both born digital and digital archiving work (Gartner, 2008)\textsuperscript{9}. However it is necessary to know what constitutes “Digital Library Initiatives” under the each of the two categories of digital documents. The digital library initiatives also vary from library to library as the objectives and functions of each type are different. It is therefore intended in this content to prepare a specification on digital library initiatives taking into purview also different types of libraries. This check can be subjected to scrutiny so that a benchmark on digital library initiatives can be established for different library environments (Salton, 1968)\textsuperscript{10}. This would be then juxtaposition to those activities with the activities undertaken by the institutions and organizations under study. The study has made an attempt to prepare a specification of digital library initiatives undertaken in general and the Research Institutions and R and D Organizations in particular.

1.1. Backdrop of the Study

The traditional library and information centers have been living for several centuries and serving generations of stakeholders. The librarians have been custodians, curators and service providers with the changing objective of the library in consonant with the needs and demands of its users (Arms, 2000)\textsuperscript{11}. The technology has been an influencing factor in this context, as the revision of user perception and
behavior to information is being researched since decades. The technology purse is relative to its time of inception and development. The use of 5 x 3 Card to develop the card catalogue in library in the service of the user can be considered as one of the earliest adaption of technology by the library. In the early implementation of Card catalogue also several studies were done on the catalogue use study (Sridhar, 1986)\textsuperscript{12}. In the present era of digital libraries studies on use of OPAC and Web OPAC have come into being in place of card catalogue. So each entry point of technology in the library has subject of study. The digital library is newer and ongoing process and its study merits in the present context. The ICT has been responsible for several new initiatives, like library automation and networking, electronic library and one such initiative in the digital library now being underway by several libraries around the world and India is no exception to this (Jeevan, 2004)\textsuperscript{13}. The basic traditional responsibility of professionals and their functions are just sketch the draft of acquisition, cataloging/indexing, information dissemination and preservation has specified the way of beginning to the requirement of access to resources that they cannot possess (Lesk & Michael, 1997)\textsuperscript{14}. The development and renovation of library occupation and services that were convey by Information and Communication Technologies (ICT) had been incredible and had extremely subjective those basic occupation that the materialization of a new library type is expected.

The position of conventional libraries as the mediator among information center and patrons had been exceptionally confronted by the development of digital libraries that can be executing the global library user group at an exponential rate. Information centers had been digitizing their sections from their collected works for last twenty years (Kaufman & Ubois, 2007)\textsuperscript{15} and the function of conventional library as the principal supplier of information to its user groups and they becoming less and
less unique (Saeed, 2006). This growth might create as a hazard to the occupation if not take action consequently by the conventional libraries. The increase of virtual libraries as marked by the initiation of World Digital Library in April 2009 is an indication of growth and the degree of digitization works universally. The western countries have taken giant steps in this context, for example the “Universal Digital Library: Million Book Collection” a project undertaken by the Carnegie-Mellon University in USA and its partners worldwide (Bawden & Ian, 1999). So several projects are going on all over the world, and India emerging as an IT giant in recent years and libraries have also contemplating to initiate digital library projects by different institutions and organizations especially the Research Institutions and R and D organizations. A study to know the pace of digitization work undertaken by different organizations would help to find the gaps in this field and to make a comparative assessment of the work between India and the world.

1.2. Research Institutions and R & D Organizations in India: an overview

The establishment of Council of Scientific and Industrial Research and Development in 1942 is the first initiation of Research and Development program in India. The University Grants Commission is the second body which made a commencement of academic research in India and for the establishment of Research Institutions. The table-1 in chapter -3 gives various parent organizations under which several Research Institutes, R and D organizations have been established. All most all of them have good library and information centers, and particularly after the success of National Information System for Science and Technology (NISSAT), many of them have planned and developed specialized library and information systems. So they have a good Library and Information resources, infrastructure including the ICT facilities. The Research and Development (R & D) organizations and higher
educational institutions are the potential users of the most information resources, either in the form of 'born-digital' materials or the archival digital resources.

Apart from CSIR and UGC many other national bodies like, Indian Council of Medical Research (ICMR), Indian Council of Agricultural Research (ICAR) and Defense Research Development Organization which are the major were others is science and so in social sciences it was, Indian Council of Social Science Research (ICSSR) all responsible for the establishment of Research Institutions and R & D Organizations in India. The Department of Atomic Energy and the Atomic Energy Commission has many nuclear production centers and also research and development organizations, such as the Atomic Minerals Division at Bangalore. Atomic Energy Commission has nearly 30 supporting organizations and institutions and laboratories spread all over India. On the social sciences area the Indian Council of Social Science Research, New Delhi has spearheaded the Social Science research in India, and is spread in Five Regional Centers. These research institutions, and R and D organizations and laboratories have pioneered many projects and programmes which are serving round the scientific community in the country.

1.3. Research Institutions and R & D Organizations in Karnataka

In Karnataka also the wings of the Research Institutes and R & D Organizations which are opened under the CSIR, ICAR, ICMR, UGC, ICSSSR and DRDO bodies are situated. For instance, the National Aerospace Laboratories (NAL), Bangalore, under CSIR, the Gas Turbine Research Establishment (GTRE), Bangalore under DRDO and the Research Institutions like Raman Research Institute (RRI), Bangalore, Defense Food Research Laboratory (CFTRI), and Mysore so on.
All the Research Institutes and R&D Organizations are funded by the central government under different category. Historically, the first original preliminary effort of research activity in Karnataka was spearheaded by the Indian Institute of Science IISc with the great spirit of innovation, followed by number of institutions like Raman Research Institute(RRI), Indian Space Research Organization(ISRO), National Aeronautical Laboratories (NAL), Jawaharlal Nehru Advanced Scientific Research Center, Indian Institute of Astrophysics(IIA), etc., are initiated with the intention of conducting research activities. When it comes to research activities in Library and Information Science the very beginning was the DLI to preserve Indian heritage that is contained in books, manuscripts, art, and music a pilot project to scan some 10,000 books was initiated at CMU and then followed up at IISc, IIIT, and other organizations. The vision is to preserve all the knowledge of the human race in digital form and make that content searchable, independent of language and location, and to ensure that the cultural heritage of countries like India is not lost during the transition from paper to bits and bytes, as they were lost during a former transition of cultural content from palm leaves to paper.

A brief profile of the selected Research Institutes and Research and Development Organizations for the study has been presented before starting the data analysis to bring out the findings of the study in the chapter-5.

1.4. Digital Library: Conceptual Framework

Digital Libraries (DLs) are computerized, online information systems which organize and store information and knowledge, to view, retrieve and (re)use at any time and at any place. The digital libraries as “libraries online”: take traditional “brick-and-mortar” libraries with digitized content, computerized services, and
Internet connectivity (Arms, 2000)\(^{18}\). Now one has the same abilities as were present before, but also the potential to eliminate scarcity, reduce staff and physical plant overhead, have content available at all times and from anywhere in the world, have powerful near-instant searching, and have multiple dimensions of organization. Digital libraries can also be places for creating new content, adding value to existing content, and making practical use of existing content (Lesk & Michael, 1997)\(^{19}\). Digital libraries can be interconnected and importantly, digital libraries can specialize, hosting discipline-specific collections which would never make economic or logistic sense for a traditional, physical library. Along this vein, digital libraries can resemble portals, acting as gateways to certain fields of interest, and digital libraries can actually be a locus for online interaction within the communities they serve.

Digital libraries evolved out of the outgrowth of traditional libraries with the transition from card catalogs became computerized and replaced them with Online Public Access Catalogues (OPACs). The advent of the Internet in the mid 1990s, OPACs were connected to the Internet and Library patrons could use WWW as gateways to OPACs thus the Web-OPACs merged which were very basic, limited digital libraries. Modern digital libraries typically add full text content, such as papers or books downloadable in formats like PDF, and also all audio-visual and multimedia content formats. (Jeevan, 2004)\(^{20}\). Whether or not the full content of resources is present in DLs, some representation of the resources are present upon which are layered rich services, which attain some of the ends mentioned above. A few of the means of achieving them are to provide multiple views and organizations which are abstracted above the content, allow the patrons to do things with resources (like build learning objects made of composed or sequenced DL resources), or add superimposed
information which can be of benefit to other patrons (such as annotations, ratings, and reviews) (Bawden & Ian, 1999).\textsuperscript{21}

The backbone of any Digital Library are "data about other data" or "metadata", the five primitive elements or ingredients of digital library called “5s of digital library”, Software, copy right issues, Databases with user friendly interfaces for searching and administrative purposes which can index full text documents for fast access through the Open Archive Initiative and of course high speed networks. These are all pillars to put up a superior digital library and are in brief described below.

1.4.1 Metadata

Critical to the existence of digital libraries is metadata, which comes in structural and descriptive types. In both cases, metadata refers to the resources (or digital objects) within the DL. Structural metadata is internal to digital objects; it determines how programs or people versed in interpreting that type of object go about this interpretation. Descriptive metadata is summary information about the entire digital object; it allows the digital library to do intelligent things with the object without understanding its content (Jain & Babbar, 2006).\textsuperscript{22} Some examples are to place the objects in categories, perform much focused searches (i.e., within titles and abstracts), partition them into browsable sets based on values for certain metadata fields (like “author” or “publication”), and more. The richness of services is directly connected to the richness of descriptive metadata. Because of this, as digital libraries evolve, descriptive metadata will continue to get richer.

1.4.2 5S of Digital Libraries

A framework called 5S has been proposed by Goncalves et al., (2004)\textsuperscript{23} and Fox to analyze digital libraries and help guide their growth and evolution Fox
5S stands for structures, streams, scenarios, spaces, and societies, which are considered the five primitive elements or ingredients of a digital library. In 5S theory, all of these elements are given formal mathematical definitions, but their meanings are very intuitive. Structures refer to data structures and organizational structures. Streams are sequences of bits, which combined with structures, form digital objects. Spaces refer both to mathematical spaces (like probability and vector spaces) in the algorithms behind the digital library as well as visualization and attentional spaces (Bawden & Robinson, 2005). Scenarios refer to situations, and sequences of actions actors might undergo in them (in the context of the digital library). And societies refer to the community or communities using the digital library and taking part in the scenarios; who both give it purpose as well as requirements regarding workflow, authority, control, and access (Chowdhury et al. 2002).

1.4.3 Electronic Theses and Dissertations (ETD)

Electronic Theses and Dissertations (ETDs) is the useful link where one can access the full content of thesis and dissertation online published at any part of the world. Electronic Thesis and Dissertations (ETDs) workshop was organized in 1987 to the description of research with a technical focus on standards (Paul & Jain, 2008). It was only after a decade the realization on emphasizing the graduate students to use ETDs, and encouraging students to prepare electronic documents and to use digital libraries- NDLTD came into existence. Virginia Tech team was able to build a solid foundation of library-developed process, to facilitate a beta program in Southeast with the financial support of South Universities Research Association (SURA), with the additional support from FIPSE and contributions from a number of sources, especially Adobe, IBM, and Microsoft, have enabled expansion from national to international levels. Public forums afforded by the Coalition for Networked Information (CNI), the
Council of Graduate Schools (CGS), and many other groups, have made the idea of an ETD initiative on a familiar topic to hundreds of leaders at diverse universities (Mittal & Mahesh, 2008)\textsuperscript{28}. The electronic thesis and dissertation (ETD) movement is truly becoming a global phenomenon.

NDLTD, UMI, has the world's largest microform archive of theses and dissertations and has launched its ProQuest Direct service of scanning (at 300 dpi) and using optical character recognition software to convert the scanned documents into text files (into PDF). Many groups, including CGS, have established committees to explore the concept of ETDs. Institutions involved in NDLTD are all working toward documenting students prepared ETDs. The contents of the Virginia Tech WWW site are distributed on CD-ROM to institutions that join the NDLTD. A number of other NDLTD members already have online documents, including: Naval Postgraduate School, NC State University, and University of Virginia.

1.4.4 Open Source DL Software

Open source first evolved during the 1970s. Richard Stallman, an American software developer who believes that sharing source-code and ideas is fundamental to freedom of speech, developed a ‘free’ version of the widely used ‘Unix’ operating system; this was designed to ensure that the source-code would remain openly available to all (Munshi, 2003)\textsuperscript{29}. It was not intended to prevent commercial usage or distribution. This approach was christened ‘free software’. In this context ‘free’ meant that anyone could modify the software. However, the term ‘free’ was often misunderstood to mean ‘no cost’. Hence ‘open source software’ was coined as a less contentious and more ‘business-friendly’ term (Singh, 2002)\textsuperscript{30}. 
The vertebrae of a digital library is the software which is going to use, it plays a very significant role in building and managing digital library in an appropriate way. Some of the major software’s are D-space, Green stone, NewgenLib, BiblioteQ, Emilda, Evergreen, Koha, OpenBiblio, PMB etc, even though wide range of technology/products are available, it is necessary for us to keep watch on the technology developments and to choose appropriate software depending on the needs.

1.4.5 Copyright Issues

Exploitation rights raise potential issues of ownership in the use and reuse of scholarly material. In the traditional publishing model exploitation rights are generally transferred in full to the publisher. This means that reuse, defined most often as the republication and/or redistribution of the original article by someone other than the publisher, is limited or dependent on the publisher's permission (Rao, 2005)\textsuperscript{31}. This limits access to the material for author and reader alike. Exploitation rights are in themselves a bundle of rights, and they reflect the needs and requirements of the parties involved, as well as the mode of exploitation. In scholarly communication the exploitation options for research articles are in fact rather limited: the two main options are reuse for educational purposes and for commercial purposes. The right to reuse is the key to the definition of Open Access: effectively, Open Access means free online access and permission to use the information for any responsible purpose (Arora, 2001)\textsuperscript{32}. There are three choices with regard to copyright ‘retain it’, 'share it’ or ‘transfer it’. \textit{Retain it - an early Open Access copyright model} - allows authors to retain their copyright and restricts reuse to educational purposes. \textit{Share it - with a Creative Commons license} - This license guarantees to the author the moral rights – the right to be cited through a proper citation – but otherwise gives broad permission to use and reuse the article, including for commercial purposes. \textit{Transfer it (partly) -}
tradational journals that go Open Access - This license that keep the copyright with
the author, but the author transfers all commercial exploitation rights to the publisher

1.4.6 Open Archives Initiatives

Open Access Archiving (OAA) is a mechanism for making scientific output
(papers or articles) accessible as a parallel supplement to the usual scientific
publication process. It is accomplished by depositing a copy of the published work in
an Open Access Archive (for example, in an institutional or subject-based repository).
In this paper, the terms “archive” and “repository” are taken as equivalent. Archive
has historical precedence in this context – for example, the Open Archives Initiative
and the ‘self-archiving initiative’; repository is a more recent term intended to avoid
irrelevant connotations of bulk storage and preservation for documents whose primary
utility is “archival” rather than the immediate access and usage that is the primary
rationale for Open Access (Urs, 2008)33.

In the self-archiving model, authors provide OA to their own research output
by depositing it into an OA archive. As part of this process, the author (or designee)
must upload a copy of the paper and also enter some simple metadata (author, title,
publishation, date, etc.) that describes the paper, making it interoperable with papers
self-archived in other OA archives, and allowing the metadata to be harvested,
citation-linked, and searched seamlessly as if all papers were in one global archive.

1.4.7 Open Access Journals

After self-archiving, the second major OAI strategy is open access journals.
Open access journals allow authors to retain their copyrights, but may require that
they agree to license their articles with the Creative Commons Attribution license or a
similar license.
Open access journals are primarily electronic journals (print editions are sometimes offered as an optional fee-based add-on). Once the first electronic copy of a journal has been created, the costs of distributing it on the Internet are negligible compared to the costs of distributing additional print copies of a conventional journal (Prasad, 2007)\textsuperscript{34}. Open access advocates also note other cost savings implicit in their approach, such as the elimination of the need for access controls. Still, open access journals cost money to produce and distribute, especially since they are peer-reviewed and edited like conventional journals (Devika, 2003)\textsuperscript{35}. Various funding strategies are in use, but the most common are direct author fees, institutional memberships to sponsor all or part of author fees, funding agency payment of author fees, grants to open access publishers, institutional subsidies (such as paying the salaries of journal editorial staff), and priced add-ons (such as recommendation services, current awareness services, or print editions).

Open access journals may be included in index and abstract services. The Directory of Open Access Journals (DOAJ) is a major finding tool, which permits searching at the article level for some journals. Three organizations play a major role in the publication and archiving of open access journals: BioMed Central, the Public Library of Science (PLoS), and PubMed Central. Established in 2000, BioMed Central is a for-profit publishing company that publishes over 100 open access biomedical journals.

1.5 Digital Libraries: Some Definitions

The definitions for Digital Libraries (DLs) attempts to model different facets of existing systems in order to create a well-defined subspace of the set of all computer systems. Some definitions choose to enumerate the services offered by DLs,
such as searching and browsing, as being necessary and/or sufficient to distinguish a DL from a non-DL. Other definitions try to fit DLs into formal frameworks that may support a rigorous mathematical model. On a different plane, some definitions will place emphasis on the human-centric aspects while others may stress the machine-oriented aspects. The Digital Library Federation (CLIR, 1998) takes a typical approach by covering as many of the different aspects as possible while choose a more minimalist approach (Kalinichenko & Leonid, 2002)\textsuperscript{36}.

Digital libraries do not, however, have any single precise definition, and the many disciplines and practitioners involved tend to emphasize different aspects when engaging in research and development. In their introduction to the first issue of the International Journal on Digital Libraries, Adam and Yesha (1996)\textsuperscript{37} explains the main theme of digital libraries with the following.

\textit{Digital Libraries are concerned with the creation and management of information sources, the movement of information across global networks and the effective use of this information by a wide range of users}.

This definition captures the motivation for many research and development efforts, but is highly general in the sense that it does not clearly distinguish digital libraries from other kinds of information systems. After all, not all information systems are digital libraries. A more specific definition is given by Borgman (1999)\textsuperscript{38}.

\textit{Digital libraries are a set of electronic resources and associated technical capabilities for creating, searching, and using information. In this sense they are an extension and enhancement of information storage and retrieval systems that manipulate digital data in any medium (text, images, sounds; static or dynamic images) and exist in distributed networks. The content of digital libraries includes data, metadata that describe various}
aspects of the data (e.g., representation, creator, owner, reproduction rights), and metadata that consist of links or relationships to other data or metadata, whether internal or external to the digital library.

Stephen Griffin (1998)\textsuperscript{39} define digital libraries with the following:

...digital libraries provide for collection development, organization, access, annotation and preservation, and deal both with information in digital form as well as digital management of information residing on physical media.

A different description is used by the Association of Research Libraries based on a review of digital libraries by Karen Drabenstott (1994)\textsuperscript{40}.

- The digital library is not a single entity.

- The digital library requires technology to link the resources of many.

- The linkages between the many digital libraries and information services are transparent to the end users.

- Universal access to digital libraries and information services is a goal.

- Digital library collections are not limited to document surrogates: they extend to digital artefacts that cannot be represented or distributed in printed formats.

1.6 Trends in Digital Library Research

The area of digital library has given rise to unprecedented research interest, as the nature of work and functionality of digital library is both complicated and challenging to the academic and research world. Accordingly several research projects have emerged and interesting results have been recorded. Digital libraries are data intensive and hence a major part of the research focuses on software systems that
manage the storage and provide access to information. These systems are built by following a typical software engineering lifecycle, with an increasing emphasis on architectural models and components to support the process (Devika, 2003)\textsuperscript{41}. 

One of the important frameworks suggested for naming digital objects and facilitating their access through machine interface was by Kahn and Wilensky (Khan & Robert, 2009)\textsuperscript{42}. This Repository Access Protocol (RAP) provides an abstract model for the services needed in order to add, modify, or delete records stored in a digital library. Dienst (Lagoze & Davis, 1995)\textsuperscript{43} is a distributed digital library based on the RAP model and used initially as the underlying software for the Networked Computer Science Technical Reference Library (NCSTRL). Multiple services are provided as separate modules, communicating using well-defined protocols both within a single system and among remote systems.

Other notable pre-packaged systems are E-Prints from the University of Southampton, DSpace from the Massachusetts Institute of Technology & HP alliance team and Greenstone (Witten et al., 2000)\textsuperscript{44} from the University of Waikato. All these provide the ability for users to manage and access collections of digital objects. Software agents and mobile agents have been applied to digital libraries to mediate with one or more systems on behalf of a user, resulting in an analogue to a distributed digital library. In the University of Michigan Digital Library Project (Bermingham, 2009)\textsuperscript{45}, DLs were designed as collections of autonomous agents that use protocol-level negotiation to perform collaborative tasks. The Stanford InfoBus project (Roscheisen, 1998)\textsuperscript{46}, Stanford University, adopts an approach for interconnecting systems using distinct protocols for each purpose, with CORBA as the transport layer.
One of the main issues however in digital library is of interoperability. The Open Archives Initiative (OAI) addressed this problem by developing the Protocol for Metadata Harvesting (PMH) (Lagoze & Van de, 2001)\textsuperscript{47}, a standard mechanism for digital libraries to exchange metadata on a periodic basis. This protocol is widely supported by current digital library systems.

The Open Digital Library (ODL) (Suleman & Edward, 2009)\textsuperscript{48} is a framework that attempts to unify architecture with interoperability in order to support the construction of componentized digital libraries. ODL builds on the work of the OAI by requiring that every component support an extended version of the PMH. This standardizes the basic communications mechanism by building on the well understood semantics of the OAI-PMH. Since the secondary storage costs are more and more affordable keeping mirrors and copies is another possibility considered for preservation of the data. Preservation of data is being addressed in the Lots of Copies Keeps Stuff Safe (LOCKSS) (Reich and David, 2001)\textsuperscript{59} project, which uses transparent mirroring of popular content to localize access and enhance confidence in the availability of the resources.

1.7 Need for the Study

As already discussed above, the recent proliferation of research in digital library woks has given rise to creation of number of working digital libraries around the World. These digital libraries have been defined, designed and developed differently. Therefore the experiences that one might have gained from one particular digital library might not be the same with other digital libraries. Number of studies on these areas can be seen in the literature. In India awareness and importance of digital library and electronic information services is gradually increasing which can
evidenced by a number of conferences and seminars held yearly and also the number of digital library consortia are working in this country. While a national policy on digital library is still pending, a number of individual digital library efforts have emerged. But there are norms and policy practices on the digital library programmes and projects. Most of them are taken on ad hoc and random basis. So as a first step there is need for preparation of a check list on what are the materials to be digitized and what constitutes the initiatives. The need for this study has implied to do an inventory of ongoing or completed digital library project and the future programmes and initiatives. In this context the study is very important and is the bases for the need of the study.

It can be stated that number of digital library projects are initiated in India since mid 1990s the research contribution on the subject has been on some conceptual basis. The Digital Library made its entry in Indian scenario with the first International Conference on Digital Libraries (St. Clair, 2003)\(^9\) and this triggered continuous interest among Indian Library and Information Professionals, Computer Science Experts, Archivists and Manscriptologists and the many learned institutions and commercial organizations evinced keen interest in the subjects. From providing some digital content products like the CDs of learned and popular periodicals to some giant projects like the Indian Institute of Science (IISc), Bangalore are growing Digital Library programmes and projects in India.

The overview of the literature on Digital Libraries in general, shows that only limited attempts have been made in India to study the digital library activities and these studies concentrates on design, development and establishment aspect. An initiative of digital library on case study method in Indian scenario has been observed
in the literature. Attempts on evaluating either the status or initiatives on digital library initiatives of research institutions and R & D Organizations have not been noticed in the literature.

1.8 Statement of the Problem

There are many digital library initiatives happening worldwide and also observed in India with DL projects undertaken especially by the R and D Organizations and Research Institutions. There are many ongoing projects and yet they are lacking some visibility due to reasons not being exposed to international information requirements and the volume of collections. Hence this gap implied on examining the digital library initiatives in India in general and research institutions and R & D organizations of Karnataka in particular is the main focus of the study. In this context the study proposes to undertake a survey of digital library initiatives in Karnataka and examine them on their status in research institutions and R & D organizations in different parts of the State, hence an analytical study on “Digital Library Initiatives in Research Institutions and R & D Organizations in Karnataka: An analytical Study” is presented here as important study and need of the current days.
1.9 Objectives

The present study digital library Initiatives is aimed to find out the digitization scenario of Research Institutions and R & D organizations in Karnataka.

The major objectives of the study are:

1. To study in detail the concept of digital libraries and the availability and use of resources which are utilized for the projects and programmes of Digital Library.

2. To know the availability of infrastructure facilities in selected Research Institutions R & D organizations to execute the digital library activities and services in Karnataka.

3. To know the categories of digital sources and services that can included in Digital Libraries under the study.

4. To investigate the Digital Library projects and programmes existing in selected Research Institutions and R&D organizations in Karnataka.

5. To examine the Information and Communication Technology (ICT) skills possessed by the library and information professionals working in chosen libraries and information centers.

6. To identify the constraints among LIS professionals and institutions to develop the Digital Library Initiatives in Research Institutions and R & D organizations under the study.
7. To study the impact of the digital library projects on the information access and use, and also project futuristic view of Digital Library Initiatives in Karnataka.

8. To put forward some suggestions towards the improvement of digital library initiatives in Research Institutions and R & D Organizations in Karnataka.

1.10 Hypotheses

1. There is no significant difference in the Library Print Collections between Research Institutes and Research and Development Organizations.

2. There is no significant difference in the Library Non-book Materials Collections between Research Institutes and Research and Development Organizations.

3. There is no significant difference in the Library Electronic/Online Resources between Research Institutes and Research and Development Organizations.

4. There is no significant difference in the Library Services between Research Institutes and Research and Development Organizations.

5. There is a significant difference in the Library Information Services between Research Institutes and Research and Development Organizations.

6. There is a significant difference in the Library Electronic/Online Services between Research Institutes and Research and Development Organizations.

7. There is a significant difference in the Skill Development Training Programs for Library Staffs between Research Institutes and Research and Development Organizations.
8. There is no significant difference in the level of professional staff expertise in train the users in ICT applications between Research Institutes and Research and Development Organizations.

9. There is a significant difference in the Hardware facilities between Research Institutes and Research and Development Organizations.

10. There is a significant difference in the Software Facilities in the libraries between Research Institutes and Research and Development Organizations.

11. There is a significant difference in the Library Automation Services in the Libraries between Research Institutes and Research and Development Organizations.

12. There is a significant difference in the Digital Library Initiatives between Research Institutes and Research and Development Organizations.

13. There is a significant difference in the Digitization and Digital Preservation between Research Institutes and Research and Development Organizations.

14. There is no significant difference in the Challenges and Constraints faced by the librarians between Research Institutes and Research and Development Organizations.
1.11 Method and Techniques of Research

In a broad sense methodology refers to the processes, principles and the procedures by which one approaches a problem to seek solutions. A researcher adopts certain techniques and procedures for studying a research problem, which are enumerated in the methodology. For this study data was collected through various methods on different aspects of the subject including (a) historical analysis (b) literature survey, and (c) questionnaire survey followed by observation. The first two methods used to collect textual data from published and unpublished documents; the literature survey is made to know the digital library initiatives at international and national level. A highly planned survey of research institutes and research organizations libraries of Karnataka has been planned as a primary method of data collection on digital library initiatives in these Institutes and organizations. For this purpose the questionnaire method is employed to solicit information from librarians, project investigators of research institutions and R & D organizations of Karnataka State on the digital library initiatives undertaken by them. Thus the data collected includes both primary and secondary data. The secondary data from literature study will be positioned with the primary data to understand the gaps at national level and at the study area level so that an assessment can be made on the adequacy and inadequacy of digital library projects and programmes and the methods and modes of reaching to a level of satisfaction in this context.

At the first instance, a profile of types of Digital Library projects and programmes undertaken in India was built to understand what types of initiatives are underway. Then a survey of DL project and programmes with similar scope and content was undertaken for research institutions and R & D organizations in Karnataka. For this purpose, a well-designed Questionnaire with sections on
1. Conceptual Framework, 2. Infrastructure facilities, 3. Availability of Human Resources, 4. Services of Digital Libraries etc. have been adopted to collect the necessary data. The profile in fact will bring the clarity of the study on digital library initiatives and types of projects and programmes on Digital Libraries.

Therefore this study have discovered the amount of digital library initiation, digital library projects, availability of information communication technology and usage, library automation, online services and skills possessed by the staff, ICT expertise, other related things that they had done and the problems that they faced in progressing to a greater height and also to explore and solicit the perceived conditions for future growth of digital library.

1.12 Scope and Limitations of the Study

Historically, the first original preliminary effort of digital library initiatives in Karnataka was spearheaded by the Indian Institute of Science (IISc), Carnegie Mellon University (CMU), the International Institute of Information Technology (IIT), Hyderabad, IIT, Delhi and many other academic, religious, and government organizations in India, a total of more than twenty "Content Creation Centers", have become partners in the Digital Library of India (DLI). The present study is confined to particularly research institutes and R & D organizations located in Karnataka state. For the present study, 40 Research Institutions and R & D organizations was selected based on the Digital Library Initiatives, ICT infrastructure, skilled manpower etc. and the libraries have been chosen randomly from all over Karnataka State. Among the 40 Research institutions and R & D organizations selected for the study, Nine are Research and Development Organizations and remaining 31 are Research Institutions. The subject-wise distribution shows, nine, the maximum are from Biological and
Medical Sciences and seven are, Agricultural Sciences. Six each are in Science and Engineering and Humanities and Social Sciences. Two each are in Food Science, Electronics and Computer Science.

1.13 Data Analysis and Interpretation

The data thus collected were arranged into simple tabular form. The activities, library collection, library and information services, planning and management, information communication technology infrastructural facilities such as hardware and software, library automation, communication and networking, digital library initiatives, digitization and digital preservation and library challenges and constraints faced by the librarians are considered as dependent variables. The independent variables selected for the study is major Research Institutes and R & D Organizations.

The data were analyzed by using simple statistical tools such as percentages, cross tables, chi-squares, mean, standard deviation, ‘t’ test and in addition to that multiple regression analysis has been used where appropriately using MS-Excel and SPSS.

A percentile measure is used the data analysis which indicate the percentage of observations in a group of observations fall. A percentile score tells us what percent of other scores is less than the data point we are investigating. In this section the researcher representing the sample distribution over personal information of institution libraries. The responded libraries have been classified on the basis of major research institute type as the results have been presented in the in frequency tables.

The data is presented in a progressive order, from personal information of the library professionals, then the data about the libraries and their details like collection, services and so on.
1.14 Organization of Chapters

The absolute characterisation of the thesis will be as follows

Chapter 1: Introduction

The first chapter gives an introduction to the problem of study, discusses the role of digital libraries in consolidating R & D and S & T research in India and also describes the digital library as a center of all the R & D activities of the concerned organizations but also works and distributes the information nationally as well as globally. The chapter provides the need and purpose of the study besides stating the problem, delineating the objectives of the study. Further this chapter highlights the hypotheses, scope and limitations, methods and techniques used for research.

Chapter 2: Review of Literature

An efforts have been made in this chapter to review briefly the relevant literature and studies on Digital libraries in general, digital library initiatives, digital library services, infrastructure facilities, DL software and hardware, digital library projects, conferences, digital library resources etc., using LISA, LISTA, Emerald, EBSCO, etc., databases including printed and online journals published from both India and abroad are used to reviewed the literature.

Chapter 3: Digital Library Initiatives: International Scenario

This chapter traces the historical development of digital libraries around the world and to profile how they have impacted on other countries to undertake DL projects and programmes. The technology that has triggered the digital library developments in large scale around the globe has been profiled.
Chapter 4: Digital Library Initiatives: Indian perspective with special reference to Karnataka

The Chapter-4 present the digital library initiatives in India with different categories such as digitization of art and culture, digitization initiatives at institutional level, DLI in Research & Development Organizations etc., Further the chapter outlined major DLI in Karnataka state, out of which some of them are national level. The present status and profile of Research Institutions and R & D Organizations DL projects and programmes under the study was also presented.

Chapter 5: Analysis and Interpretation

This chapter deals with the analysis and interpretation of the collected data through the questionnaires, which was distributed to the research institutions and R & D organizations under the study is reported. In addition to general aspects this chapter also gives an account of existing digital library infrastructure facilities and various services offered to the users in their respective libraries. This chapter also gives an account of application of IT & ICT tools i.e., hardware, software used for digital library creation, management and dissemination of digital library services to users.

Chapter 6: Major Findings, Suggestions and Conclusion

The major findings suggestions and conclusions are presented in this chapter, followed by future areas of research.

1.15 Summary

Digital library Initiatives and projects were establishing tremendously round the globe and touching different aspects of digital library activities such as library accessing, process, services, acquisition, processing, cataloging and information dissemination were charming on new viewpoint and lot of library services were
available in innovative ways with new technology driven. Digital materials and
digitization programs were concurrently being planned, produced and developed. The
importance and acceptance of digital libraries had resulted in many foreign literatures
reporting on digital library initiatives and projects at local, regional, national and
international levels, thus consolidating global resource sharing through online services
and universal access.

Conventional libraries basically from the concept of print oriented though they
are very good at user perspective slowly they were challenged by the scattered of
information resources. In research institutes and research and development
organizations library the progress could be seen through the initiation of either digital
library initiatives or projects or virtual libraries. The issue is to determine the amount
of research libraries in implementing electronic and digital operations and services as
their western counterparts, so that we would be able to know the extent of our
progress against world digital library development. More importantly, to examine
research institute and R & D organizations digital library related problems and to
solicit the perceived conditions for digital library future growth.
REFERENCES


