8-2014

HOW CONTEXT MATTERS IN DIGITAL LIBRARY USE

Swati Bhattacharyya
Syracuse University

ABSTRACT

This research investigates how organizational context contributes to the use of digital libraries, an ICT-enabled information infrastructure. Traditionally digital-library use is measured with the help of statistical analysis of download and other related data, but statistics alone have limited power to explain how such an expensive information infrastructure is used to meet organizational goals. Such limitation was overcome in this study by relating digital-library use to the context of such use.

In the last decade many Indian research organizations have witnessed the abundance of such information infrastructures accessible directly by end-users. The convergence of several phenomena such as current business models for digital resources, improved ICT infrastructure within organizations and several government interventions to help organizations have made this possible. Because of this recent change, the study was conducted in two Indian research organizations to understand how their respective contexts shape digital library use.

This qualitative study used two theoretical constructs -- *social actor* (Lamb & Kling, 2003) and technology-in-practice (Orlikowski, 2000). The lens of *social actor* helped to look beyond the boundary of an organization in order to identify entities that reside in its environment and create information demands on the members of the organization. Information demands from those entities, making up organizational context, often pressure the members to use digital libraries.

Consequently digital-library uses acquire various meanings depending on the nature and power position of those entities with respect to the members. The premise of the other lens used – technology-in-practice (Orlikowski, 2000) – is often for a technology use, the centrality does not lie in its technical capabilities, rather various other factors outweigh such capabilities resulting into a specific pattern of its use. In this study, this lens helped to identify several environmental, technological, organizational and personal factors that contribute to very limited use patterns of digital libraries.

The study contributed to our understanding of digital library use beyond merely measuring downloaded data from database companies. It goes further to describe organizational context in terms of several components and how such components often create workplace demands resulting to digital library use. It also explains how some of the contextual aspects can outweigh the technical capabilities of digital libraries leading to certain use patterns.

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BY

SWATI BHATTACHARYYA

Masters of Philosophy in Information Science & Technology, Syracuse University, USA, 2008

Masters of Computer Applications, Indira Gandhi National Open University, India, 2000

Associateship in Documentation and Information Science, Indian Statistical Institute, India, 1981

DISSERTATION

Submitted to the Graduate School at Syracuse University, USA in partial fulfillment of the requirements for the degree of Doctor in Philosophy in Information Science and Technology

August, 2014

ACKNOWLEDGEMENTS

It is a joyous moment for a doctoral student to write this section of her dissertation and finally that time has come for me. At this moment, the name that first comes to my mind is Barbara Hanna Kwasnik. Barbara often used to say that doing research is a joint activity of the committee and the student. I realized what she meant when I was in the actual process of doing research. Sitting thousands of miles away from the school while carrying on the research in last few years, I never felt that distance. She was always there to discuss a problem, to read a piece written by me, to critique my views on my findings. Numerous emails and recordings of skype sessions between us form a treasured collection for me. While doing this research, I also learned from her how an advisor can also become a research colleague.

I am equally grateful to the other members of my committee – Steve Sawyer, Jian Qin and Anne Diekema for their unstinting support. Despite their very busy schedules, they always interacted whenever I requested and continued on my committee till the end.

Sarah Webb Inoue is another very important name here. We were colleagues in our doctoral class in Syracuse and later in the study group that we formed. She then offered to be the auditor of my dissertation process. Since I came back to India to collect data and finish my dissertation, every Tuesday evening was marked for our Skype session. This was in spite of the fact that she herself was pursuing the doctoral program. Those weekly skype sessions, devoted to discuss my dissertation, continued till a few days before her daughter arrived in 2013. And then she was again there at the Syracuse airport to receive me in a freezing afternoon of February 2014, in the dry run and in the final defense session.

It was possible for me to join the research program after taking a break from a job of many years as my school – iSchool@SU – supported my study with assistantships and summer jobs. Another very important and timely financial support from my school was a grant under the Students of

Promise fund. This grant helped to complete the final round of my dissertation work. I am extremely thankful to Dean Liddy and the Board of Advisors of the School for this grant.

Emerald India LIS research fund provided a grant that helped me travel within the country for data collection. I take this opportunity to record my gratitude to Emerald. I am also thankful to all my informants whose identity I cannot disclose.

I am thankful to my friends in India – Dr. Rukmini Mitra Dasgupta, Dr. Rakesh Kumar, Dr. Dipayan Sanyal and Dr. Sukomal Ghosh who provided me very valuable support in my data collection. I am also grateful to another small group of my acquaintances that surprisingly includes my dentist, who continuously reminded me that I was yet to complete this study.

Last but not the least, I am thankful to my loving sister Bulbuli and her husband Kalyan. Together, they relieved me of many family responsibilities that otherwise would have occupied my time. Bulbuli does not exactly know what her *Didi* (elder sister) did in all these years but that her *Didi* is now a Ph.D. gives her immense pleasure.

Swati Bhattacharyya, Ph.D.
Kolkata, India
August 2014

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CHAPTER 1: INTRODUCTION

1.1 Chapter introduction

The goal of the current research was to understand how the members of an organization are exploiting digital libraries (DL)[1], as an Information & Communication (ICT) tool, in order to meet their organizational responsibilities. The study intended to look into the situations when digital libraries become a meaningful tool at the hand of those members and how, in reality, it is used. The actions of the organizational members involving digital libraries, in relation to organizational responsibilities were of prime importance in this study.

Studies on the use of DLs/electronic resources have emerged, predominantly, into two streams of research. One stream devoted to understand the process of information seeking in terms of interaction between a user and an information system. It has resulted into a rich body of literature that guides on what should be the features of a usable system. Another stream focused on counts of interactions and used those counts to understand use patterns. Every click on a search feature of a system or on an icon to download full text of a citation is captured as a "count of use". These counts are then projected as the measure of "use" of digital libraries/electronic resources. This notion of "use" has been employed by libraries to justify the expenditure, to re-orient their collections and so on.

[1] Hence forth the terms digital library and its abbreviation DL have been used interchangeably throughout this document.

Notwithstanding the rich body of information that has been created, certain aspects of use are left outside the purview of both the streams. On the larger canvass, a technology can be said to be useful when it actually fits into the environment in which it was intended to be used. At a more micro-level, when an organization makes huge investment in developing an information infrastructure, a legitimate question – how this infrastructure is used to serve the ultimate purpose of the organization – arises. Organizations do not necessarily develop systems – rather they procure systems that are available in the market. Hence interaction-based studies cannot shade light on the use of digital libraries as aimed in this study. At the same time, a count of interactions ends the phenomenon there. There is no way to understand how such counts are transformed into a higher level of use that can serve the organization goal.

In order to overcome the limitations of prevalent studies with respect to this research, the context of DL use was considered for examination. The premise was that context is a major force that contributes to DL use. In order to understand how a digital library is used, the reason for its use (or non-use), one must consider the context of such use or non-use. Expanding on concepts from Information Science and borrowing from Organizational Science, this research aimed to explore how context contributes to DL use.

The following sections review the prevalent notion of digital-library use, the terminology adopted in the study, and the rationale behind some of the decisions made in this study. The research paradigm and theoretical constructs used to frame the study are highlighted. Finally, the chapter introduces the research objective and the research questions formulated through the lenses of the theoretical constructs used.

1.2 The notion of "use" as explored in this research

The last twenty-five years of the previous millennium revolutionized the information industry, first by online information services and then by packing those online information services onto a CD-ROM medium. Finally, the Internet brought several changes in rapid succession. As the Internet was adopted as a medium of publication, a new business model – referred to as the consortium model – came into the market. Libraries could band together to form consortia and get a substantial discount on electronic resources in lieu of assured procurement of multiple copies of a resource for all members.

Technology facilitated measuring the use of these resources. Use studies already have a long history in the literature of Library and Information Science. In the beginning of the electronic era, reading statistics were used to understand how researchers were moving from print to the online environment (Tenopir et al., 2003). In the Internet and electronic-publication era, COUNTER[2] – a standardized measure of use – was introduced. COUNTER-compliant usage data of an electronic resource, by an organization, can be captured mechanically from the IP-based[3] log-in data at publisher's server. Such IP-based usage data became very useful in several ways, namely, understanding information behavior (Davis and Solla, 2003), as a tool at the hand

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[2] Launched in March 2002, COUNTER (**C**ounting **O**nline **U**sage of **N**etworked **E**lectronic **R**esources) is an international initiative serving librarians, publishers and intermediaries by setting standards that facilitate the recording and reporting of online usage statistics in a consistent, credible and compatible way. The first COUNTER Code of Practice, covering online journals and databases, was published in 2003. COUNTER's coverage was extended further with the launch of the Code of Practice for online books and reference works in 2006. The body of COUNTER compliant usage statistics has steadily grown as more and more vendors have adopted the COUNTER Codes of Practice. This has contributed to the new discipline of usage bibliometrics and a great deal of work is underway to try to establish .value metrics. associated with usage, in which the COUNTER compliant statistics play an increasingly important role (retrieved on March 6, 2014 from http://www.projectcounter.org/about.html)

[3] IP address represents an organization's computer address on global computer network. When registered with a publisher's server, the organization is recognized and authenticated by publisher's server and users from that organization are allowed to access the resources on the publisher's server.

of a Collection Development librarian (Cox, 2007), a way to understand from where users are accessing the resources (Coombs, 2005), to mention a few.

Scholars, acknowledging earlier research, have stressed the need for developing some other dimensions of use. Usage statistics are limited to the number of times a resource is consulted and they do not help in understanding how people make use of the information received out of such consultations (Bishop, 1998). Borgman (2000) depicted digital libraries as our future libraries, and hence it becomes incumbent upon us to understand why and when people use (or do not use) digital libraries so we can then address the related issues. This understanding can be developed if the connotation of “use” is extended beyond the “number of consultations”. As the needs of the individuals who consult such resources arise from the situations in which they are embedded, those embedding situations or contexts should be taken into account in this regard. This research is an attempt to understand this context and how the context shapes the use of digital libraries. In that process, the research brings a new dimension to the notion of the “use of digital libraries”. This research is as much about “context” as it is about “digital-library use”.

1.3 Terminologies and their connotations as used in this research

The ambits of two major terms that are fundamental in this research are explained here. These are: *digital library* and *organizational and social context*.

Digital library

Since the term *digital library* was coined in 1990s, it has been variously referred to denote organizations, services and resources by different authors. Elsewhere the term is used to mean one or a combination of institutional repositories, special collections, packages of electronic journals and books and so on.

A *digital library* in this study is a service comprising various digital resources – developed locally, procured through licensing, or available free of cost on the Internet – that are packaged as a service and deployed within a specific organizational boundary, using various ICT infrastructure, specifically distributed networks. This connotation was adopted from the works of Elliott and Kling (1998), Covi (1996), and Covi and Kling (1999) and was open to include any other genre of the Internet based digital resource that the informants of this research considered as digital libraries.

A more detailed discussion on the connotations of digital libraries has been made in section 2.2.

<u>Context: Organizational and social context</u>

Context is another term that requires disambiguation. One basic assumption of this research was that digital-library use can exhibit different patterns in different contexts; hence the boundary of context must be predefined before observing the phenomenon of digital-library use. In this research, the term organizational and social context was used to mean academic and research organizations in India. There are two levels of context – one is the geographic level and another is the organizational level. The importance of and the reasons for specifying the context in this way are described below.

An organization is affected by the characteristics of its location. ICT use is a prerequisite for *digital-library use* and may vary across time and space. This variance is a result of combination of one or more factors such as the economic condition of a state, its geographical spread, technological developments of the state, and the extent to which a technology is integrated into the lives of the people in that state at any given point of time. Table-1, for example, provides a glimpse of the number of the Internet users per 100 people in different countries over three years[4].

Table 1: Number of Internet users per 100 people in selected countries

Country	2010	2011	2012
India	7.5	10.1	12.6
China	34.3	38.3	42.3
Singapore	71	71	74.2
UK	85	86.8	97
USA	74	77.9	81

In a networked society (Castells, 2004) electronically processed information networks become the center of key social structures and various activities. It is not only about electronic networks, but also about the social networks of individuals who process and manage information and use the micro-electronic based technologies. In that process, individuals and various forms of organizations, such as firms, schools, and government departments, are connected with each other. A networked society is not an absolute situation – almost every society strives to be even more networked. Thus, one of the key differences between a more networked society and a less networked society is that in the former a greater number of members are connected for a greater

[4] Source: http://data.un.org/

number of purposes than those in the latter. Table-1 presented above gives some indication of how differently networked are different states, resulting into variations in the spread of ICT usage and the use of other ICT-dependent technologies. This table provides some indirect justification of limiting the boundary of context in this study to a geographical level, which in the case of this study is India. Justification for this choice is explained in section 1.4.

Organizational and social context is the next level of context. ICT may be used by various segments within a geographical level. Such segments are users at home, researchers in a laboratory, and managers within an organization, to name a few. The availability of ICTs, the extent of their use and the purpose for use may vary for different segments. Thus, Internet uses for leisure at home, for research work within an academic organization and for transactions in financial sectors are not the same. This is the rationale for introducing the second level while describing context. Organizational and social context is a generic term here. It encompasses organizational aspect which arises from the organizational structure as well as the social aspect arising with respect to the organization. For example, peers in a specific field such as scientists, academicians, chemists belong to respective specific communities which become their social context.

1.4 Rationale for choosing India as the geographical study site

Indian libraries leapfrogged from the print era to the age of digital libraries in the post-Internet scenario. Because of high telecommunications as well as data costs, the majority of Indian libraries could not afford the developments brought by a rapidly growing online information industry services in the late 1980s and CDROM-based information products in the 1990s. The level of library automation in the country was fairly low, and thus, people had hardly any experience in using computerized information systems.

In the Internet era, the government made a very significant intervention in promoting access to digital libraries by various academic and research organizations within the country. As the country's telecommunications facilities experienced spectacular development, scientific research organizations embraced the new Internet technology and made it available for their scientists and other employees. This gave people ample opportunities to learn how to search in a computerized environment, especially using Google.

At the same time, publishers and aggregators started promoting the concept of consortium-based subscription to electronic resources in different forums within the country. The first informal library consortium arrangement was developed in 2000 by six Indian Institutes of Management in the country[5]. Shortly after this, the government supported the formation of a centrally funded consortium[6] that started procuring electronic resources for its members. Within a few years, more such government-sponsored consortia came into existence serving different segments of the scientific, technological as well as academic research organizations[7]. All these events together resulted in an abundance of electronic resources in academic and research organizations, particularly those pertaining to scientific and technological research. Thus, from the early years of this millennium, many Indian academic and research libraries became rich in electronic information.

[5] http://www.iimsworld.in/consort.htm retrieved on March 6, 2014
[6] http://paniit.iitd.ac.in/indest/ retrieved on March 6, 2014
[7] http://nkrc.niscair.res.in/ retrieved on March 6, 2014

The government's intervention expanded beyond procurement level. Most of the consortium members were using, until a few years back, the Internet of bandwidth 10 MBPS. Through another endeavor of the government – National Knowledge network (NKN)[8] – most of the academic and research organizations of the country are now allocated Internet facility of 100 MBPS bandwidth without any cost implication to them. Thus the government provided both the resources and infrastructure to access those resources.

Shortly after the formation of the consortia and with a commitment to investing enormous funds every year, the government started monitoring the performances of the beneficiary organizations. Since then usage statistics, captured through IP authentication of the organizations and provided by publishers/aggregators, have been considered as the only measure of the use of electronic resources. The administrative decisions regarding continuation for funding various resources for member organizations of the consortia have been greatly guided by such usage statistics.

The limitation of IP-based download data to explain actual use has already been mentioned. Some other limitations were also observed by this researcher. During the analysis of the usage data of a specific package across several organizations in India, these researchers found that large numbers of article downloads were from a few journals; and this was the pattern across several institutions. The reason for such skewed consultations can only be guessed at but cannot be explained definitively. One can of course argue that it is already established that only twenty-five percent of a collection is used seventy-five percent of the time. Such observations, however, were made in the all-print era. It is difficult to accept that in the current highly technology-

[8] http://www.nkn.in/ retrieved on March 6, 2014

enabled era, when it is very easy to discover relevant information, the same principles of the print era would hold as firmly.

Another anomaly regarding usage statistics was highlighted in a 2009 study[9]. This study showed that in the UK, per-user downloads were 47 out of total downloads of 102 million, while for one Indian organization, per-user downloads were 558 out of total downloads of 3.9 million. This study also showed that for several science-related disciplines, the average citation count per paper published by Stanford University faculty and students was 22.93, while the average citation count per paper published by one Indian university was 4.52. This data does not require any further explanation on the anomaly. These two examples may appear to be isolated cases, but in this age of quantification, when count matters, it seems improbable that such anomalies are not being noticed.

These anomalies created the diving board for this research. Such anomalies raise several questions, such as, what does digital-library use mean? How is it possible to understand the use (or non-use) of digital libraries? The researcher was convinced that more downloads do not mean more use. The use of digital libraries ought to be understood in terms of the meanings that users assign to these resources. This, in turn, may help in understanding how consultations of electronic resources (and generating number of uses) are getting translated into the action by the users. The meanings assigned to digital-library use are likely to vary depending on the situations under which such uses take place. This underscores the importance of situation or context.

[9] Sathyanarayana, N.V. (2009). Usage paradigms of e-contents: presentation (personal communication)

The question now arises is why India was chosen as the geographical context of this study. Indian organizations were chosen for both theoretical and practical considerations. The theoretical aspect is explained first. Without going into the details of economic and political aspects which are beyond the purview of this research, it can be said that the country started taking a different shape since the late 1980s. Organizations that were getting full economic protection from the government were asked to increase the degree of their self-reliance. This was particularly true for organizations pursuing research in science, technology and industry. The government, however, provided infrastructural support in order to enable those organizations to become competitive. The government's initiatives to provide support in terms of Internet facility and digital resources attest to this.

With all these facilities, an Indian research organization in all probability would appear the same as or isomorphic to a research organization in any other country, such as the US. But an earlier study revealed that the local and cultural contexts can differently shape the use of an ICT-based tool (Walsham & Sahay, 1999). In the current emerging economic situation, the Indian context is likely to hold both new and old features that may not be present in economically advanced countries, thus making it a good candidate for study.

The practical consideration had several layers. The obvious reason for the choice was that anomalies as mentioned above were noted for Indian organizations. This was further strengthened by the fact that the researcher, being a working librarian in India for many years, had an excellent understanding of the organizational culture in India, thus strengthening the probability of being able to describe and understand the context of digital-library use. Being a natural citizen, she would also have greater access to organizations in India. Thus if the study were to be done in a country of emerging economy, India was the best choice.

1.5 Research paradigm and theoretical underpinnings of the study

The research was framed within the paradigm of social *informatics* and supported by two theoretical constructs, namely the concepts of *social actor* and *technology-in-practice*. A discussion on each of these is presented here. The relevance of the research paradigm and the theoretical constructs are discussed along with research questions in the following section.

1.5.1 Rationale for the choice of research paradigm and constructs

This study adopted the research paradigm of social informatics and two theoretical constructs – *social actor* and *technology-in-practice*. Several other theories have been frequently used in research pertaining to the use of ICT or Information System in organizations. Two such important theories are Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM). It is appropriate here to explain why the current research did not adopt DOI or TAM. Brief descriptions of each of these two theories and a rationale for selecting alternate theoretical constructs follow.

Diffusion of innovation theory (Rogers, 1983) explains how new things, new ideas disseminate through social system over time. Innovation can be an idea or behavior that is new to an organization (Swanson, 1994). DOI focuses on the process of diffusion. Researchers have attempted to understand how this process is related to the characteristics and perceptions of potential adopters (Moore & Benbaasat, 1991; Kappelman, 1995), under which conditions the adoption or diffusion of an innovation would occur (Sanson-Fisher, 2004). Studies also looked into the stages through which diffusion/adoption passes as well as into the nature of the process. Those stages have been variously described by researchers as knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1983), compatibility, complexity, trialability, observability and relative advantage (Sanson-Fisher, 2004), orderly or chaotic process (Van der Ven, 1999), initiation, development, and implementation/termination and with a flow back and forth within complex networks and relationships (Gosling, Westbrook & Braithwaite, 2003). In relation to ICT, DOI was applied to study the diffusion process of knowledge management system, health care system (Gosling, Westbrook & Braithwaite, 2003; Sanson-Fisher, 2004), information systems (Kappelman, 1995; Mustonen-Ollila & Lyytinen, 2003).

TAM was originally proposed by Davis (1986) and is based on the Theory of Reasoned Action (Ajzen and Fishbein, 1980). The model has two variables, namely, “Perceived Usefulness (PU)” and “Perceived Ease of Use (PEOU)”. The core of this theory is the belief structure of an individual. The theory posits that individual’s acceptance of an information system is determined by two belief factors; one is that job performance will be enhanced by the use of information system and the other is that the use of information system will be free from effort (PEOU). Thus TAM is an expression of intent and is an outcome of the belief structure of an individual, to use a specific technology.

TAM has been tested on a variety of ICT tools – communication systems (email, cell phone), general purpose systems (personal computer, workstations), office systems (word processors, spreadsheets), and specialized business systems (case tools, telemedicine). Between 1986 and 2003, research using TAM yielded 26 external variables that influence PU and PEOU (Lee, Kozar, & Larsen, 2003). TAM based research aimed to understand how intention to use a specific ICT can be related to various factors.

The current research, did not intend to look into the process through which digital libraries has become accepted as an ICT tool within an organization. In fact, by the time this research started, *digital library* was no more a new phenomenon within organizations. Similarly, the study also did not focus on the intention of individuals to use digital libraries. All intentions may not get translated into actions. As found in an earlier research on public hygiene, 95% of the interviewees expressed intention to follow a specific hygiene related activity while observation confirmed that in real life only 67% people practiced it (Legris, Ingham & Collerette, 2003).

The study aimed to understand how *digital libraries* are being used by organizational members in order to meet their organizational responsibilities, the meaning associated with such use, the pattern of use and to reveal how these understandings are connected to the organizational context. It is not only the use but also the situation under which actual use takes place is important. The study required some model of action which could help observe the situated action. Hence the study could neither fit within the framework of DOI (model of process) nor within TAM (model of belief). The aim of the study also did not align with any framework which can predict the economic benefit or performance improvement as a result of using digital libraries (technology imperative).

On the other hand, *social informatics* as research paradigm and *social actors* and *technology-in-practice* as constructs provided the required frame for capturing the actual use of technology as aimed in this research. Brief discussions on these follow.

1.5.2 Social informatics – the research paradigm

The field of social informatics addresses how organizational and social contexts shape the use of ICT. The studies under this paradigm are interdisciplinary in nature and examine the design, implementation, use, and consequence of information technologies that take into account their interactions with institutional and cultural contexts (Kling, 1999). Sawyer and Eschenfelder (2002) asserted that social informatics is the field of study which explores, explains and theorizes the design, implementation and use of ICTs in a wide range of social and organization settings. In order to describe what the field is about, the authors enumerated that this paradigm excludes studies on information activities without technological reference, studies that address individual, cognitive, or psychological processes involved in using technology, economic aspects of technology and the technological imperatives that seek to understand the effects caused by introducing technology in an organization. Consequently, this guideline was used by the researcher to remain sensitized about the questions to be asked and issued to be examined in the field.

1.5.3 Social actor – the institutional view of user

Social actor is one of the theoretical constructs used in this study. The concept of *social actor* was proposed for industrial and business setups with respect to ICT use in those organizations. An organization is surrounded by an institutional environment that shapes its interactions with the environment and subsequent actions. Technologies are integral part of such interactions. A social actor, as proposed by Lamb and Kling (2003), is an organizational member and is pressured to perform legitimate actions and interactions within this institutional environment. Such interactions are facilitated by the exchange of resources and information between members of firms and institutions. As individuals, organizational members have little choice over the technologies acquired by the organization. They are rewarded or sanctioned for the work they do. ICT use in such work can be instrumental in being rewarded or being sanctioned.

Scientists as organizational members, conceptualized as social actors, are surrounded by an institutional environment as context. The lens of *social actor* has been used to identify such institutions and reveal how such institutional environments pressure scientists to use digital libraries and to develop an analytical description of the context.

1.5.4 Technology-in-practice – structure of technology use

Technology-in-practice, proposed by Orlikowski (2000), is the other theoretical construct used in this study. This construct is based on structuration theory proposed by Anthony Giddens (Giddens, 1984). Structuration is a social process involving reciprocal interaction between human and structural features of an organization. Within a social system, structure is manifested through structural properties that consist of rules and resources mediating human action and is re-affirmed by the actors. The core of the theory is the reflexivity of the human beings to routinely observe, understand and continuously monitor the context.

This notion of structure was extended to the use of technology. Technology is an artifact with material and cultural properties. Such properties transcend the experiences of individuals as well as of particular settings. Such artifacts, however, do not appear the same to all people. Rules and resources are built into a technology. When the rules and resources of a technology are mobilized into use, a specific recurrent social practice of using the technology emerges. In that process, a technology structures human action and it is possible to see that structure through those recurring actions.

It is important to acknowledge what the use of a technology means. Orlikowski (2000, p425) describes the use of a gun in a way that can help us understand use of technology:

> *. . . if our knowledge of a gun comes primarily from its use, then we cannot assume that a gun "is a gun" without knowing how that object is being used. While guns are designed and built for a particular purpose, and their possession has important implications for social policy, gun possession is not sufficient grounds for presuming that a gun will be used in a particular way. People can and do choose not to pull the trigger, and that makes all the difference.*

Thus technology-in-practice can help to reveal the structure of the use of a technology and the associated reasons. This was the importance of the construct in this study.

1.6 The research questions

Conceptualizing digital libraries as network based, ICT-enabled information infrastructure, the study was brought under the paradigm of social informatics and the overarching research question was:

> **How is the practice of digital-library use by people in Indian academic and research institutes being shaped by organizational and social contexts?**

As mentioned earlier, bringing the study under the paradigm of social informatics helped to frame further specific research questions and to remain sensitive on what to observe and what phenomena to take cognizance of during data collection.

As mentioned earlier, context and more specifically organizational and social context is important. An analytical view of context is generally missing in the literature and is very important to reveal how context contributes to any phenomenon (Courtright, 2007). The first research question was developed keeping this issue in the mind. However, there was an additional dimension in the research question targeting the understanding of context. A brief description of this dimension is discussed here and details will be found in Chapter-3 on methodology.

Technology, specifically ICT, forms the backbone of a digital library. Thus any reference to digital libraries also refers to the use of technology. As this research required close interactions[10]

[10] Detail discussion is provided in Chapter-3

with study participants for dialog, there was a threat to the truthfulness of the data collected. Such threats are there when qualitative studies are designed on technology use (Barry, 1995). Frequent reference to a technology-driven facility, during ongoing dialog at the time of data collection, could have pushed some participants to a stage where they would try to develop an image of themselves, as frequent user of technology when in reality they were not. Moreover such questioning about technology use might lead quite often to a description of what they do with the technology, searching, downloading, for example, and not what led them to use it.

On the other hand, digital-library use is intricately related to information-gathering practices of users. Hence it was felt prudent to develop an instrument which would focus on information-gathering practices initially. Such an instrument would thus minimize the risks mentioned in the preceding paragraph. In the process of interviewing, the instrument would be further augmented to indirectly unearth the concurrent use of digital libraries in those information gathering activities. Thus foregrounding the issue of information-gathering practice in the research question was found to be a better alternative than only asking about digital-library use per se.

The first research question was thus framed using the context and information-gathering practice of organizational members. At this stage, the lens of *social actor* was helpful to develop two specific questions. The notion of *social actor* is grounded upon the presence of institutions in the environment of the organization to which a member belongs and the institutional pressure on the members to act in a certain way or in a certain use of the technology. With the help of the lens of social actor, it was possible to reveal which are the institutions present in the organizational environment and how information-gathering practices meet such institutional pressure. This approach was adopted to develop an analytical picture of the organizational and social context and how information-gathering practice meets the needs arising from those institutions. Accordingly, the following more specific research questions were framed:

RQ1# How do the social worlds of an organizational member influence and shape her/his information-gathering practice?

RQ1(a)# What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes, engage in meeting the demands of their social world?

RQ1(b)# How do information-gathering practices help those social actors meet the institutional forces of those interactions?

In order to find answers to these two questions, this researcher examined different individuals and organizations with which the study participants have to interact in the process of discharging their organizational responsibilities. The institutional nature of such individuals/organizations and nature of information demand created by them upon the study participants were to be elicited. Subsequently, the researcher also examined how the study participants view their information-gathering practices with respect to the interactions with such individuals and/or organizations.

That organizational members are pressured to perform information gathering does not imply that they will automatically use the entire DL, even if it is available. One can preferentially use one or a few resources over others. Depending on situations, they may not use the DL at all. The use or non-use, is not necessarily limited to the content or technological capability of the resource. The lens of *technology-in-practice* helps to see that many such uses (and non-uses) can be attributed to different organizational forces.

Two different forces can play a role here. One is the structural force that originates within an organization. How structural forces outweigh the power of technology is described here. In Orlikowski's (2000) study, the system *Notes* was deployed equally for all groups of organization members, but the consultants were not willing to learn it or use it for business reasons. Using *Notes*, according to their view, would lead to non-chargeable hours or giving up some of their personal time, which they were not willing to do. On the contrary, the group that was not restricted by billable hours strived to learn and use it. In a study by Adams, Blandford, and Lunt (2005), a group of organizational members could not use a DL because the deployment of the DL reflected the organizational structure: people in upper hierarchy within an organization were given more facilities to access those DLs. Thus, people who would draw such DLs into use were either made dependent on people who were hierarchically above them or they were excluded, in an indirect way, from availing themselves of the facility.

The other force originates outside the boundary of an organization and still shapes the use of technology within an organization. Disciplinary norms, norms of the technical and/or institutional environments within which an organization is situated belong to this category (Kling & McKim, 2000; Walsham & Sahay, 1999; Covi & Kling, 1996; Lamb, King, & Kling, 2003). In sum, how a DL is reckoned with as an organizational resource which can be recurrently used in the information-gathering activities by the members of the organization is contingent upon several intra- and extra-organizational forces. Thus another set of questions was framed using technology-in-practice as a lens. Those are:

RQ#2: What are the various extra- and intra-organizational factors mediating the practice of DL use (including non-use) by organizational members?

RQ#2(a): What are the various emergent practices of the use of digital libraries, both at the digital library level as a whole and at the feature level?

RQ#2(b): How are such practices accounted for by different extra- and intra-organizational factors?

Answer to these questions necessitated the examination of the types and features of electronic resources repeatedly used by organizational members. The exact resource was of no importance here but the nature of resources and the pattern of use across the study participants were important. Further, the research also probed into the factors which could be associated with such pattern of use.

Finally, the findings from research questions RQ#1 and RQ#2 were integrated to draw a picture of digital libraries use as shaped within the academic and research organizations in India.

Table-2 collates the main and sub research questions developed for this study.

Table 2: The total set of research questions

<table>
<tr><td colspan="4">Overarching research question: How is the practice of digital-library use by people in Indian academic and research institutes being shaped by organizational and social contexts?</td></tr>
<tr><td colspan="2">RQ#1: How do the social worlds of an organizational member influence and shape her/his information-gathering practice?</td><td colspan="2">RQ#2: What are the various extra- and intra-organizational factors mediating the practice of DL use (including non-use) in information-gathering activities of organizational members?</td></tr>
<tr><td>RQ#1(a)</td><td>What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes, engage in meeting the demands of their social world?</td><td>RQ#2(a)</td><td>What are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level?</td></tr>
<tr><td>RQ#1(b)</td><td>How do information-gathering practices help those social actors meet the institutional forces of those interactions?</td><td>RQ#2(b)</td><td>How are such practices accounted for by different extra- and intra-organizational factors?</td></tr>
<tr><td colspan="4">Conclusion: How do the organizational contexts in Indian academic and research institutes shape DL use by organizational members?</td></tr>
</table>

1.7 Chapter summary

This chapter briefly describes the background of this research. This research was designed to develop a description of context, in terms of its components, of a selected group of people, namely scientists working in different organizations. To this end, the research examined the followings:

(i) various components of organizational environment with whom the study participants had to interact in order to discharge their organizational responsibilities,

(ii) the institutional nature of such components,

(iii) information demand made by such components upon the study participants, and

(iv) what information-gathering practice means on the face of such information demand.

Further, the research looked into the pattern of digital-library use in regards to information-gathering practice by those participants and the associated factors, both within and outside the organization. In this process, the research attempted to understand what properties of digital libraries are often visible to the scientists so that they use such properties more frequently and what causes the visibility of such properties over others. Finally, the research concluded on whether different organizational contexts can lead to different meanings for digital-library use and use pattern.

Though the research was conducted within Indian academic and research organizations, the study was not about any specific country or specific organization. In that sense, the study explored digital-library use as a model for ICT enabled technology use. The study was about the institutional environment and organizational environment surrounding the members of any organization leading to their use of ICT-enabled tools. The fundamental assumption of the study was that the use of a technology by people is shaped by the demands of institutional contexts and structure within which they are embedded. So, the richer the institutional context, the more is the use of the technology – a digital library in this case. The study also attempts to show how the concepts of *social actor* and *technology-in-practice,* which were developed within the context of industries in the USA, are perhaps more universal, and can be used to explore ICT-enabled technologies within different organizational and social cultures anywhere.

CHAPTER 2: LITERATURE REVIEW

2.1 Chapter introduction

The present study seeks to understand how digital library (DL) use by people in Indian academic and research institutes is being shaped by organizational and social contexts. Questions include: who the external entities are with whom members of such organizations interact, the institutional nature of those entities, what kind of information demand is made by those institutional entities, how information gathering by those members helps to meet those information demands, what are the patterns of using digital libraries to meet those information demands, and organizational aspects that contribute to such patterns of use.

This chapter discusses the background literature, the ambits and definitions of major concepts used, and the theoretical constructs used in this study. The study stands at the intersection of two strands of research – context-based information behavior studies and organizational sociology based studies of Information and Communication Technologies (ICT). Relevant literatures from both the strands are discussed with a view to explaining how the research questions of the study were framed.

2.2 Digital library – its boundary in the present study

As mentioned in Section 1.3, the term *digital library* (DL) has been variously used since 1990s, though attempt has been made by scholars to broadly categorize what the term implies from different perspective. One of the earliest descriptions that stressed on the organizational aspect came from the Digital Library Federation[11] is:

> *Digital libraries are organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities*.

Borgman (1999) categorized the discourse on digital libraries from research and practice perspectives. Research-wise, digital libraries are of interest to primarily two disciplines, namely computer science (CS) and library & information science (LIS). CS researchers consider DLs as extensions and enhancements of information storage and retrieval systems manipulating digital data that exist in distributed networks. Their concern is improving the technological efficiency of DL. LIS researchers focus on content, organization, searching behavior, and publishing. DLs are constructed, by and for a community; DLs are extensions, enhancements and integration of a variety of information institutions as physical space; the information institutions include among others – libraries, archives and other settings such as classrooms, offices, laboratories, homes and public spaces.

The practice oriented definitions aim at current and anticipated practical challenges; for example, how the changing nature of universities and the advent of digital collections are affecting the evolution of libraries as institutions. Most librarians view DLs as part of the library institution and as a natural transformation of that existing institution to address the new information environment.

[11] http://old.diglib.org/about/dldefinition.htm retrieved on March 6, 2014

Many digital collections of resources such as NSDL[12] or GEM[13] are considered digital libraries. Those are distributed collections of digital resources, not owned by any organization exclusively, and are composed of resources that are available on the Internet. Digital institutional repositories are also discussed within the discourses related to digital libraries. Some authors used this term to imply a set of electronic or digital resources (erstwhile bibliographic databases and sets of full text journals) that are acquired by an organization, mostly libraries, and are packaged as a service using the Information and Communication Technology[14] infrastructure of the organization. The China Academic Digital Library (CADL) project includes such resources along with digitized versions of books (Shen, et al., 2008). Electronic journal services are also considered DLs (Monopoli et al., 2002).

Content, service, organizations and, most important, specific user communities are referred to in different definitions of digital libraries (Levy & Marshall, 1995; Lucier, 1995; Zhao & Ramsden, 1995; Marshall,et. al. 1994). A somewhat broader definition includes a sense of an organized collection, content being either in electronic or in a mix of electronic and physical media, contents in different formats including some full-text materials, and a specific community for whom the specific DL is built (Bishop & Star, 1996). Elsewhere, DLs are considered as hybrid libraries containing digital documents and pointers to non-digital documents – the pointers may be metadata embedded in the catalog of any library. Given the fact that a large part of the world's collections are still beyond digitization, and we do not know whether it will ever be possible to bring such vast resources under complete digitization, a digital library will be more

[12] National Science Digital Library
[13] Gateway to Educational Materials
[14] Referred to as ICT henceforth interchangeably

meaningful if it provides digital contents and digital records of non-digital contents (Borgman, 2000, p 76).

The above trend of referring to various collections, services as digital libraries still continue. Following are some examples from very recent literature. Digital library was considered as an integration of research resources which include online databases, electronic bulletin boards, local databases (Chang, et.al, 2009), a digitized native collection of rare books, ancient books manuscripts, pictures, photographs, audio-visual materials with a view to providing specialized services (Yao & Zhao, 2009), a web portal that provides consolidated digital access to materials from individual libraries (Dalbello, 2008) or a National Digital Library program that provides free access to several full text databases, many peer reviewed online journals and e-books to public and private sector universities and non-profitable research and development organizations (Warraich & Ameen, 2010). Data repositories, institutional repositories have also been referred to by this term. Conferences like JCDL admit papers in which collections of data sets are meant as digital libraries.

There is another view of digital libraries which can be labeled as users' view. Kling and Lamb (1996) suggested that the terms *digital library* and *electronic library* conjure up, in the users' mind, the images of the networked collections of resources in electronic formats and it is difficult to distinguish between them. Covi (1999, p293) noted that:

> *The term `digital libraries' refers to a variety of electronic resources and services including the world-wide web, shared databases and bibliographic systems. However, it is difficult to examine the use of any one electronic collection for knowledge work because `digital library' materials are linked in ways that often blur the boundaries between different*

> *collections. It is impossible to determine simply from access logs how a subset of users in a particular discipline uses them.*

Various authors have adopted this view of digital libraries – an information system made up of a combination of a variety of sources such as OPACs, electronic journals (Elliott & Kling,1998; Covi, 1996; Covi, 1999); and electronic databases, procured from commercial vendors and deployed within an organization boundary (Adams & Blandford, 2004).

The scope of the term *digital library* in the current study has been aligned with this last strand of definition. A digital library, in this research encompasses a set of digital resources: resources created locally, such as an OPAC, institutional repositories; resources procured commercially; or resources that are collected from the Web. All these resources are packaged as a service within an organization using several other ICTs.

2.3 Organizational context in information behavior research

Context has been an important construct in the area of information seeking and human information behavior. Contrary to earlier studies in this area, which gave importance to individual users and ignored factors external to information seekers, there have been calls for understanding the context (Courtright, 2007; Dervin, 1997, Johnson, 2003). There has been a growing realization that the context has a complex relationship with information-related activities. The context should include actual work settings as well as the institution that acquires and deploys technologies, and in which people for whom such technologies are acquired have little say. The need for methodological change, preferring field studies over experimental or quasi-experimental methods was also stressed (Borgman, 2000; p 1-15).

This study focused on organizational context of the members of an organization who use digital libraries. Context, in this study, was not limited to a selected number of factors labeled *a-priori* by the researcher in order to observe the influences of those factors on digital-library use. Context was what people experience while interacting with their social world. They may not be able to label that experience as *context* but they can certainly experience the forces at play in all of their interactions with the social world and try to reciprocate those forces by some taken-for-granted actions. This research looked into those taken-for-granted actions that is consulting digital libraries, by people in academic and research organizations and followed the trail to find the link between the digital-library use and the environment of those people. Then, context was depicted analytically by the researcher employing inductive analysis of the experiences as narrated by the informants.

Reference to organization can be found in the literature predominantly when information practices of groups have been discussed. Another type of reference of organization is found when information use environment within an organization has been examined. However, in both cases, earlier researchers focused within the organization. This section shows how context, in information behavior research, was treated in terms of groups and information use environments, both within the boundary of an organization and limitations of such treatment.

Subsequently, the discussion builds on the notion of open natural view of organizations and the usefulness of this view in treating interactions with various institutional entities residing outside the boundary of an organization, as context. It is then highlighted how this view of organization leads to the construct *social actor*. The section ends with framing research questions through the lens of *social actor*.

The rest of this section is devoted to:

- how organizational context is treated with reference to groups and their information practices;
- information use environments with reference to organizations;
- formation of an open natural view of organization;
- how interactions in an open natural view of organization act as context of information practices;
- how information practices of users as social actors are shaped by interactions in an open natural view of organization;

2.3.1 Organizational context in terms of groups in information behavior studies

Organization has been referred to quite often in the studies of information practices of groups. Out of four different categories of information users, namely professionals, entrepreneurs, special interest groups and special socioeconomic groups, as identified by Taylor (1991), professionals were mostly identified within an organization. Those professionals were engineers, lawyers, scientists, teachers, managers, physicians. Nearly all empirical studies collected data for groups which were located within an organization.

Information practices of professional groups (engineers, lawyers, and journalists), disciplinary groups (physicists, chemists), and functional groups (managers, administrators) were studied within the boundary of some organizations which were workplaces of those respective groups. Studies based on such groupings are quite extensive in the LIS literature. These studies enumerate the types of information required by different groups, and their preferences for different information resources.

Though organizations were referred to as the sites for the data collection, data regarding information practices were collected with reference to the immediate tasks at hand, in the studies of various groups. In a newspaper house, for journalists (Attfield & Dowell, 2003), news and feature research writing were such tasks. Activity and constraint-based accounts of such tasks describe goals and activities associated with generating an information product. The product constraints as well as resource constraints in terms of affordance and limitations of available resources are also important to the tasks at hand. These constraints described the context for the work task and gave a clue to what that work is (Attfield &Dowell, 2003). In a large university, the information practices of professional and managerial staff were prompted by daily managerial/professional routines or crises (short term) and those that arose from longer-term planning situations or special projects (Wilkins & Leckie, 1997). In a museum, the tasks of art administrators are various decision-making processes (Zach, 2006).

Within an organization, engineers as a professional group have been studied extensively, in order to understand their information practices. Fidel and Green (2004) studied the perceptions of engineers about access to resources. There was, however, no explicit link between such perceptions and the tasks at the hands of those engineers. With respect to aerospace establishments, the relation between degree of task uncertainty as faced and choice of information carrier by research engineers and scientists were studied (Anderson et al. 2001).

A discipline was also considered as context in various studies. Notable among those studies were chemists (Davis, 2004), academics from various disciplines such as astronomy, chemistry, mathematics and physics (Brown, 1999), engineers and scientists in different disciplines (Ellis & Haugan, 1997), academics from computer science, business management and English studies (Gardiner, McMenemy & Chowdhury, 2006).

The studies mentioned above, mostly focused on the various types of information resources used. Some of those studies highlighted the channels of information, namely oral, print, electronic and personal communication used. Within a specific group, an individual's relation with an ongoing project could also be related to the information-seeking intensities (Ellis & Haugan, 1997). These researchers found that intensive use of information sources take place in the beginning of a project, and on a smaller scale at the end of the project. There were associations between task levels, role, and the types of information that are required by special groups such as engineers (Kwasitsu, 2003).

In the study of nurses' information practice, it was highlighted how profession and workplace as contexts can create some tension in the information practices of nurses (Sundin, 2002). While professional leaders, researchers of the profession put stress on abstract knowledge, the workplace identity of a nurse forces her to experience a different information practice.

Despite their merits, these studies have several limitations as below:

(i) context was referred to in those studies from a very micro-perspective, in terms of situations or tasks such as the project initiation stage for research engineers or the decision making process by administrators;

(ii) the analytical presentation of context is almost nil; context, particularly the organization was used more as a background only; and

(iii) these studies assumed naturalization of member of such groups implying the stable characteristics of groups (Van House, 2004).

In sum, various groups and their settings within an organizational setup have been treated as contexts of information activities, in the literature. Mostly those contexts, though, do not have enough analytical features to help establish the dimensions or characteristics of these contexts that may be associated with information-gathering activities of people within them.

2.3.2 Information use environment as organizational context

The importance of the organizational context is also acknowledged in the Information Use Environment or IUE as proposed by Taylor (1991). IUE bounds organizational context in terms of predictable work settings in which professional groups such as physicians and engineers function. Four dimensions of the IUE that affect the flow and use of information messages and determine the criteria for judging the value of information messages are:

- a set of people in terms of their social identities, demographic and non-demographic characteristics;
- conceptualization of the problems that spark information practices;

- organizational and infrastructural attributes which facilitate or limit the action of information practice; and
- the nature of problem solutions that are sought or accepted.

The limitation of this model is in its level of analysis. If the context is to be considered as shaping the information behavior of a group of people within an organizational boundary, context should be considered separately from and external to people, and treated as an independent variable. Thus organizational settings and the nature of problems, the people within that setting, and the problem resolutions that are accepted by those people are three different levels of analysis. As well, the nature of problem resolution can be considered a specific situation within a context and is an outcome variable. Instead of treating those three levels separately, those are merged in IUE.

Rosenbaum (1993) elaborates upon the IUE and asserts that: “contexts” are settings within which the mundane information practices of people occur. Context is the social world and social interaction is thus an important underlying concept of the IUE. Rosenbaum also gave prominence to the setting. Setting, according to him, is an organization which establishes goals, style, rewards and penalties, and access channels for information use and validation. Rosenbaum thus identified a contradiction in the IUE. The contradiction lies in acknowledging users as an intelligent actor and at the same time assigning supremacy to the IUE. Rosenbaum proposed to reconcile the contradiction with the help of Gidden’s structuration theory. He suggested that the IUE is part of the organizational structure and not the one which contains the user as one of the dimensions. He further posited that the IUE has virtual rules and resources which are instantiated in action by the users (Rosenbaum, 1993), and the rules and resources of different types within an organizational structure (Rosenbaum, 1996).

It is important to note that literature discussed in sections 2.3.1 and 2.3.2 considered only internal view of an organizations. Studies in section 2.3.1, had a reference to organization; yet there was hardly any operationalization of the relation between the information practices of various groups and the organization. However, Rosenbaum (1993), while advancing the concept of context in terms of Information Use Environment, stressed some important factors of organization, namely interactions, goal, reward, penalties. But any elaboration on a direct link between these aspects and information behavior of organizational members was absent.

2.3.3 System views of organizations and organizational context

The point of departure in studies discussed in the previous sections was the individuals, and further, those studies directed to contexts surrounding those individuals but only within the physical boundary of an organization. However, there are different views of organizations and depending on the view adopted; the picture of organizational context emerges differently. Additionally, certain practice settles within an organization through the process of institutionalization. This section discusses various views of organization and the role of institutionalization in order to facilitate the understanding of the relation between various organizational views and information practices.

Notion of organization was expanded and mapped along of the two dimensions as below (Scott, 1992):

- Rational/natural view of organization
- Closed/open view of organization

According to rational system, organizational behavior is purposeful and organizations move towards defined goals with formalized processes. Elements such as costs, coordination efficiency, performance measures that constrain actions of an organization are often focus of this system model. The natural system model views organizations as organisms that struggle to survive. Organizational participants in the natural system model develop informal arrangements with their other elements to shape goals that contribute to their values and their existence. An organization can be viewed as a combination of a rational/natural and a closed/open system.

In a closed system, all key influences on organizational behavior can be located within an organization. In an open system, some key influences on organizational behavior are located outside the organization. Those influences are the result of relationships with clients, suppliers, other institutions, such as schools, regulatory bodies, and professional associations.

The characteristics of these four views of organizational behavior are summarized in Table-3. The open natural system perspective underscores the interchange with the environment, thus making this interchange a factor affecting the viability of the system.

Table 3: Four views of organizations

	Rational	Natural
Closed	Focusses on the influencing factors contained by the focal system of action.	Focuses exclusively on human activity within the circumscribed organization and help understanding the internal mechanisms of perpetuating group values.
Open	Focuses on other formal influences outside the focal system of action	Helps to understand the role of external conditions in shaping action and response by the model's elements.

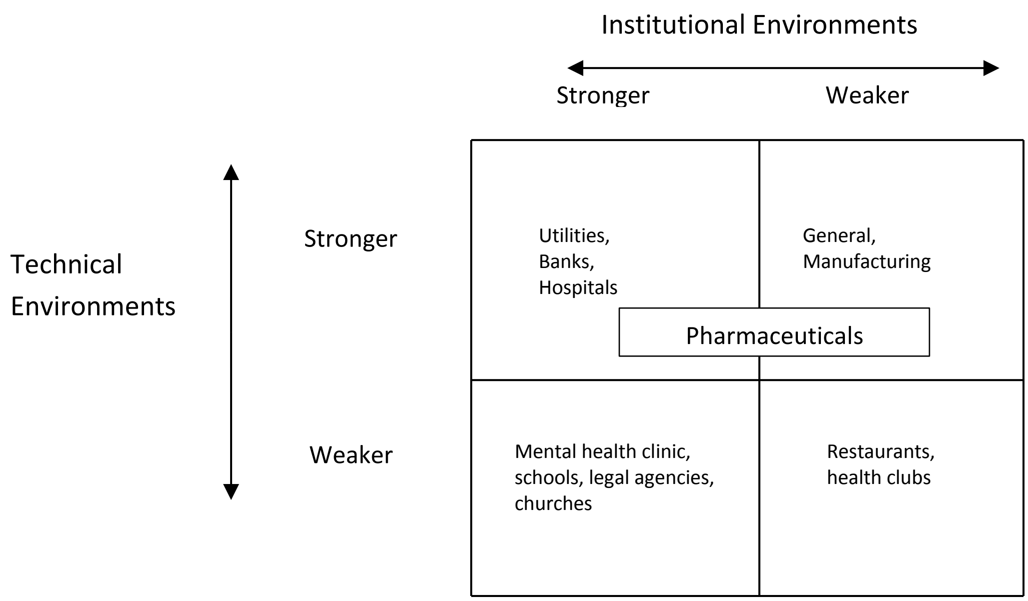
Institutionalization is the process by which an organization develops a distinctive character structure - a set of norms and routines, a way of doing things. Such practice may develop within one particular organization, or it may become standardized throughout an industry (Scott, 1992, p33). New Institutionalism is a cognitive approach to organizational behavior. It posits that many choices of organizational actors are governed by highly routinized habits, scripts, rote actions, and imitation of elites; these routinized actions are conditioned and reinforced by centralized institutions (DiMaggio & Powell, 1991). Institutions form an important social force that shapes behavior and also gives legitimacy to that behavior. This new institutionalism view was found to have more explanatory power of organizational actions when the notion of environment is extended beyond the boundaries of organizations. Such extended organizational environment focus at the 'functional organizational field level'[15] (DiMaggio and Powell, 1991a; Powell and Brantley, 1992; Powell et al, 1996.).

According to Scott (1987), organizations are embedded into a technical environment that can be described succinctly as shown in Figure-1. Within a technical environment, organizations are rewarded for effective and efficient control of their production systems. On the other hand, in order to maintain legitimacy and receive support, those organizations are to conform to a set of rules and requirements of the institutional environment within which they are situated. Regulatory agencies, professional or trade associations, and general belief systems contribute to those institutional requirements. To a varying degree, all organizations are subjected to both these two environments, namely technical and institutional environments (Lamb, King, & Kling, 2003).

[15] An organizational field is defined as: "those organizations that, in the aggregate, constitute a recognized area *of* institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products." (DiMaggio and Powell. 1983.) Functional organizational fields are industries, broadly construed— i.e., organizational systems that are isolated for analysis based on functional rather than geographic criteria. (Scott. 1987: p124.)

Figure 1:

Technical and Institutional Environments of Organizations (from Scott 1987, p133)



In sum, there is a direct relation between human activities within an organization, and the environment surrounding the organization.

2.3.4 Interaction - an open natural view of organizational context

The concepts of open natural systems and institutionalized organizations have formed the basis of several studies on organizational context. The characteristics of those studies are:

(i) the environment of an organization in those studies extends beyond its boundary;

(ii) interactions by the organizational members with various institutional forces in such an environment are considered; and

(iii) such interactions were legitimized through the exchange of information;

Some of those studies, relevant to the current research are discussed here.

From the open system perspective, context becomes more holistic as the focus moves from within the organization to outside the organization. Within the organization, at the individual level, context can focus on the task or technology at hand. At the next level, the context may be the task structure and coordination of the task, but is still within the boundary of the organization. This has been labeled as socially thin interaction. At the third level which is labeled as socially rich interaction, the focus of the studies moves away from the group and looks at the multivalent and complex relationships in the organizational settings (Lamb & Kling, 2002). Table-4 presents a summary of these interactions.

Table 4: Various Dimensions of Context (adopted from Lamb & Kling, 2002)

Focus of the study	Individualistic	Socially thin interaction	Socially rich interaction
Technology focus	Computer	Computers, networks	Technologies of interaction
Study participants	Individual	People performing formal task systems	Human activity systems
Contextual scope	Task/technology	Task structure and their execution and coordination	Complex and multivalent social relationships in organizational settings that can extend outside a focal group

To differentiate between *socially thin interaction* and *socially rich interaction*, the authors associated the first with inside-the-firm interactions and the second with inter-firm interaction. In a socially rich interaction, ICT or ICT information products are used by the members of an organization who remain aware of inter-organizational contexts. The members also remain aware that the role and power relationships in such contexts differ and this difference leads to the difference of the perception about the appropriate use of technology (Lamb & Kling, 2002). This socially rich interaction is built on an open system model of organization as proposed by Scot (1987).

From the perspective of open natural systems, the technical and institutional environments of an organization form the social world of the members of an organization. The activities of the organizational members may be viewed as interactions with such social world. As social interactions take place within a social world, and social worlds have their own norms, such interactions of organizational members are bound to be influenced by various institutions of that social world. Those institutional influences are taken for granted because they are so ingrained in practice that it is difficult to see them separately. By making those institutional influences explicit, it is possible to take into account the contextual factors which can explain an organizational information behavior and thus operationalize organizational context.

That extra-organizational social pressures or social norms can directly contribute to the types of resources used, and the way specific resources are used, has been recognized by Audunson (1999). Audunson (1999), using the case of the judiciary, discussed how various issues such as reducing uncertainty, preference to certain sources, preference to a channel for communication can all be shaped by different norms of different areas of jurisprudence.

In the domain of information and communication technologies, earlier studies examined how social aspects of computerization transcend the technological particulars of specific technologies by focusing on human activities (Kling, 1980; Markus & Keil, 1994; Walsham, 1993). This was further advanced in studies related to digital-library use. It was argued that effective digital-library use takes place when its users can readily integrate DLs into socially legitimate ways of working and that this way of working takes shape out of various norms in the environment (Covi, 1999; Covi & Kling, 1996). These studies showed that with an open natural view of organization, it is possible to provide a more holistic account of organizational information behavior surrounding digital libraries, particularly the followings:

- to give an account of differential use of digital libraries across different communities;
- to show how complex activities such as work habits, patterns of legitimation in a social group, and organizational politics shape DL use;
- to provide more enduring explanations of DL use than those based on changing technology.

Some of the findings of the studies mentioned above, which are pertinent to current research are highlighted here:

How work habits, legitimization process and organizational politics shape DL use: Discipline-specific work culture of molecular biologists strongly influences their DL use. The culture of this discipline values for new ideas. There is strong competition for getting credit for findings and verifying that the findings are original. Peer review through the invisible college[16] (Price, 1963; Crane, 1972) provides a key mechanism for authors to receive suggestions from the invisible college about new materials or standards for judgment. This helps in getting new ideas published. In this discipline, faculty researchers' raises, tenure, and promotions are usually dependent upon publication. There are also high stakes in terms of obtaining competitive funding. All these cultural aspects create a sense of urgency in terms of creating, finding information in a timely manner and hence utilizing DLs.

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[16] An invisible college is defined as a geographically distributed set of colleagues in a particular research specialty who are the peers that judge and legitimate research contribution.

Differential use of digital libraries across different communities: The differences in culture and characteristics create differences in the use of DL – the type of resources that are used and the mode of communication – across disciplines. Molecular biologists depend on gene sequencing information and photographs. Hence they give as much importance to gene databases and photos as on published literature. Those scientists predominantly use the database MEDLINE. As mentioned, there is a strong culture of competition for getting credit in the discipline. This culture reinforces the use of electronic communication system and also to make a balance between competition and collaboration. Computer scientists depend more on established scholarly communication outlets and those outlets which publish materials relevant to current research that they are involved with. Scientists in this domain also keep track of specific authors for possible collaboration and try to develop a link while meeting in conferences. At the time of contributing to the discipline, they value timeliness over the possible risk of duplication. Sociologists are required to know more about unfamiliar area or a previously known area and they collect information from respective disciplinary literature. Researchers in the area of literary theory give importance to keeping up with current discourse, rather than new ideas. Scholars in literary theory, attempt to develop their own working collection which they consult. At the time of contributing to the discipline, scholars in literary theory value thorough and crafted arguments, accommodating difference in textual forms, over timeliness. Literary theorists prefer book publication and value the slower communication speeds of print to allow more time to produce acceptable work. There is a concern that what constitutes good work would change if everyone circulates her/his work via E-mail (Covi & Kling, 1996).

There are examples of how regulatory agencies in the institutional environment directly play a role in the information practices in industries. For example, a biotech company in the U.S. before selling its products must obtain approval from the U.S. Food and Drug Administration. This is an example of a relation as well as interaction between an organization and a regulatory agency. In the process of interaction in that relation, which is securing the approval, the new drug application must include, among other information, citations to what has been published about the drug, its compounds, and its medical application (Lamb, King, & Kling, 2003). This relational requirement leads to extensive information gathering and a link is thus made explicit between the institutional influences in the environment of an organization and the related information-gathering practices within the organization.

The information-richness and interaction-richness nature of the environment coupled with the availability of technologies such as mobile technology was used to understand information activities for a particular population such as the police, for instance. Both extra-organizational and intra-organizational forces were found to shape the information activities. As well, in order to gain recognition, people in those environments engage in more information activities (Allen & Shoard, 2005).

The use of electronic media for scientific communication is another area which was found to take shape differently for different disciplines, due to different institutional norms. The organization of work and the access to resources to conduct research are influenced by the conventions about legitimate forms of scholarly communication. Communication conventions, in this "institutional view" are embedded in ways of organizing work that differ between fields and that may change slowly (Kling & Iacono, 1989). The notion of “legitimacy,” borrowed from

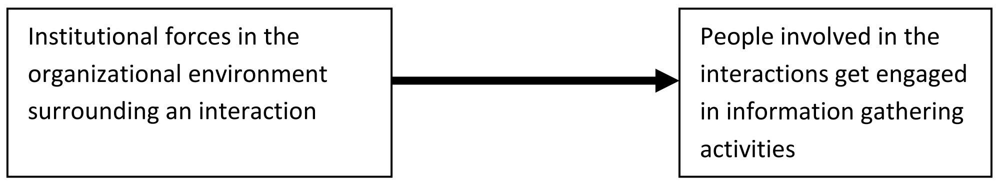
New Institutionalism, was used in the study of the development of electronic media to support scholarly communication system which was embedded in work organizations. Authors further used the concept of *social shaping of technology*, which focuses on the ongoing dynamics that takes place between a technology and a community as the technology is developed, used, shaped, reconfigured, and reconstituted within the community. Kling and McKim (2000) also noted the influences of disciplinary differences in terms of extra-organizational institutional norms resulting into differential use of electronic media for scientific communication. Among the factors that contribute to such extra-organizational disciplinary differences, the culture of competition for credit for work performed has already been mentioned. Some other factors are: selection of target audience for research, access to resources including data, speed of work and result sharing, and allocation of professional status.

Studies of the genre as discussed above are clearly different from those mentioned earlier. For example, Gardiner, McMenemy and Chowdhury (2006) reported differential use of print and electronic resources, and a different perception about access and use of digital resources across three disciplines. But such studies were limited to the observation of such differences and did not have enough power to make any analytical description of the discipline as the context leading to such differences.

The core point that emerges from above discussions is when organizational members are viewed as part of an open natural system a holistic picture of context of the behaviors of those members develops. This is because of interactions with external entities located in the organizational environment more clearly articulate the context than group. By contrast the group-as-context approach puts people in a passive role, thus making the dimensions of the context less visible.

The conventional notion of group becomes fuzzy in real work settings: for example, a physics faculty member is both a physicist and an academic. In addition, the interdisciplinary nature of many fields also adds to that fuzziness. For example, in an organization, where members are pursuing research on building technology, the members come from various disciplines such as construction science, physics, chemistry, and so on. Though they contribute to their own area of specialization, they primarily work under the mandate of the organization. Moreover, they often cross the boundary of their own discipline and enter other areas if demanded by the job. The strict definition of boundary does not hold in such cases. Interaction as context emphasizes an active role of people who want to meet the demands of various social worlds in which they participate. Interactions that take place between an organizational member and any other entity are more clearly bounded. As those interactions are always situated in real-life experiences, it is possible to understand, from such interactions, who are the others participating in an interaction, their relations with the organizational member, and thus the institutional force that can play in that interaction. Interactions make the information gathering a part of an open system and depending on whom an organizational member is interacting; the institutional forces surrounding the interaction can be located within or outside the organization. This can be visualized in Figure-2.

Figure 2: Institutional Forces in Interaction Shape the Information-gathering Activities



2.3.5 *Social actor* – a lens to view organizational context

Social actor (Lamb & Kling, 2003) was one of the two theoretical constructs that are used to frame this research. This construct is based on the open-natural system view, institutionalized organization, and socially rich interaction, as discussed in earlier sections. A *social actor* is an organizational member, whose individual autonomy, agency, and behaviors are shaped by social norms, institutional forces, and the social and physical structures that surround her/him. This view gives primacy to the interactions between organizational members and individuals/institutions outside their workplace. In those interactions the use of ICT to gather and package information becomes an essential component because either those external individual/institution request for information or organizational members are required to persuade them with information. Social actors are also connected to the global network society, describing a rich environment within which we can view social interactions (Castells, 1996). Lamb and Kling (2003) underscored the importance of the perception about the role of external organizations/individuals (*variously constituted others)* by organizational members to form the basis of social institutions and identities (Goffman, 1959) and the importance of ICT to shape identity and institutions. ICT related changes are not agent-directed; agency is channeled through a complex, multi-level system of networks and organizational affiliations that constitute local and global environments. Also, these social actors decline to be identified as users of a specific technology. They gain recognition for the work they do and not for using a technology (Lamb & Kling, 2002).

Exchange of information is the important function for *social actors*. Information exchange as part of organizational behavior in inter-organizational relationships was highlighted by several authors (Blau, 1964; Hall et al., 1976; Alexander. 1995). The earlier example of information exchange between biotech companies in the U.S. and the regulatory agency in order to secure approval also illustrates this (Lamb, King, & Kling, 2003). This relational requirement accounts for why in some cases, information gathering does not scale up to the expectation. The smaller the institutional pressures in an interaction, the smaller may be the intensity of information-gathering practice (Lamb & Kling, 2003). One important point to note here is that in the literature, only formal exchange of information through reports was stressed. In the current research, as we will find later, information exchange that takes place informally is also taken into account.

Lamb & Kling (2003) conceptualized social actor in four dimensions. Those dimensions are affiliations, environments, interactions, and identities. Organizational members as social actors develop affiliations through organizational and professional relationships. Environments can be construed as stabilized, regulated, and/or institutionalized practices that circumscribe the organizational actions. Interaction is the process of mobilizing information, resources, and exchanges that takes place when the actors engage with the affiliated individuals/organizations.

Identities are the avowed presentations of the self and the collective entities. Social actors at the individual level routinely use ICTs, information products in their inter-organizational and interpersonal interactions. These technologies shape who they are as organizational representatives and what they can do in terms of exchange. These are important aspects of their interactions with other actors (speed, complexity) and influence the perceptions of other actors, the nature of reciprocal engagements, and the social actors' perceptions about themselves.

From the above discussion using the literature, following points emerged:

- Institutional environments of an organization place an organizational member within a network of relationships;
- Information exchanges by those organizational members take place in response to the demand of various entities in such institutional environment.
- Those information exchanges can be viewed as one or more of (i) compliance to regulatory agencies (ii) attempt to survive the competitive world (iii) display of competency (iv) adjustment to an already established process of sharing information load.

Hence, looking at the organizational members through the lens of *social actor*, it is possible to unearth the institutional environment of those members and understand what digital-library use means to them.

2.3.6 Organizational context shaped through social actor in current research

This study is framed using the open natural view of organizations and conceptualizing organizational members as *social actors* who engage in information-gathering practices using digital libraries. The construct of *social actor*, which was first conceptualized in industrial setting, has been extended to academic and research organizations selected as cases for the present study. As the notion of *social actor* was developed by Lamb and Kling (2003) within industry/business environment, a question arises as to the suitability of that concept in academic and research organizations. Heavily laden with the language of organization science such as *inside-the-firm interaction*, *inter-firm interaction*, their discourse initially suggests that such a construct is suitable only when business transactions take place.

The organizations selected for this research are neither industries nor academic organizations such as universities. It is not clear what kind of technical and institutional environment surrounds academic and research organizations as there is no mention of this type of organization in the work of Scott (1987). But these organizations are certainly in the business of knowledge. Alavi, Yoo and Vogel (1997) stressed that universities are in the business of knowledge creation and sharing, they have an organization-like structure, and hence conceptualizing IT-enabled collaboration in the partnership of knowledge sharing business is applicable for the universities. This logic can also be extended to the organizations under study. Knowledge generation is a major task of both the organizations selected for this research.

Using the lens of *social actor*, the first specific research question (RQ#1) was framed to explore what constitutes organizational context in terms of institutional entities with whom members of organizations selected for the study are required to interact. It is recognized here that one organizational member can have multiple roles and each role may lead to different organizational environments. In this study, instead of imposing categories in a top-down approach, the social worlds of the organizational members are revealed inductively by allowing them to speak about themselves. Further, the study looked into the types of information demands made by such institutional entities on those members and how those members view their information-gathering practices in response to such information demands. The research questions were framed as:

RQ1# How do the social worlds of an organizational member influence and shape her/his information-gathering practice?

RQ1(a)# **What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes, engage in meeting the demands of their social world?**

RQ1(b)# **How do information-gathering practices help those social actors meet the institutional forces of those interactions?**

2.4 The organizational context of technology use

In previous sections, the emphasis was on organizational context in terms of interactions between organizational members and various institutions in the external environment. ICT as a technology adds a new dimension to organizational behavior. Digital libraries are conceptualized in this study as an ICT-enabled tool. Hence, it is necessary to examine how the use of a technology is shaped by contextual factors. This section provides an account of technology use and its context, discusses the theoretical construct used in this study and finally presents the research questions framed within this theoretical construct.

The study, framed within the paradigm of social informatics, aimed to explore what can possibly contribute to the way ICT-enabled tools, digital libraries in this case, are used within organizations. The study did not attempt to assess the technological or economic impact on digital-library use because such studies on impact analysis cannot possibly reveal the meaning attached to digital-library use by the participants, which is the objective of this research. Given this, social informatics was found to be the right paradigm for this research. According to Sawyer and Eschenfelder (2002, p430), research under this paradigm is:

> *…..set within the context of social milieu such as work groups, communities, cultural units, societies, and/or organizations, in which use of ICTs is increasingly important and pervasive. This orientation toward context helps to distinguish social informatics from other information science work that focuses on individual behaviors and/or draws on theories rooted in, for example, economics, computer science, or psychology*

Adopting this paradigm helped to steer the observation of this research in a way that it could keep issues such as technological imperative, economic impact, and so on out of scope. The following sections explain how this is so.

2.4.1 Social informatics – a paradigm support

In one of the earliest reviews published on the social informatics of digital libraries, Bishop and Star (1996) described this area as the study of social influences, processes, practices and effects related to how knowledge is structured and communicated in digital libraries. In this regard, various document genres and metadata for organization of knowledge within digital libraries were considered important. Communities share their ideas about various document genres for communication. The digital environment offers scope to change such shared notion of documents and increase the scope for the mutability and integrity of various types of documents while structuring knowledge in digital libraries. The creation of document surrogates in digital libraries, with the help of metadata, are affected by types of artifacts, as well as by institutions and the legal framework of knowledge production, conservation and consumption practices. One example is the online catalog, which, contrary to earlier days, now provides access to indexing and abstracting databases and online resources with full text contents. With regards to digital-library use, both infrastructure and content can contribute to the use of digital libraries. Some of the issues regarding usability factors are convenient access to technology, useful content, degree of systematic use of computers in daily work life, availability of training and support to the end users (Bishop & Star, 1996).

A more inclusive definition and description of social informatics came later. This new definition considered social informatics as the interdisciplinary study of the design, use and consequences of information technologies (ICT) that takes into account their interactions with institutional and cultural contexts in which these ICTs exist (Kling, 1999). The issues of research in this area are: the impacts of social and organizational settings on design, implementation, and the uses of ICT; the intended and unintended social and organizational consequences of ICT-enabled changes and change efforts.

As mentioned in the beginning of this section, the main thrust of social informatics is the context of ICT – work groups, communities, cultural units, societies, formal organizations in which the use of ICT is increasingly pervasive and not on economic or technological impact analysis. Vexing issues that people face when they work and live with ICT are studied within the framework of this paradigm. Such studies explicitly recognize the role of ICTs in the information world of the people. Studies of following perspectives are out of the scope of this paradigm:

- System development perspective – studies that employ the psychological process of using ICT tools or performance measure to ascertain the efficiency of a given system;
- Economic perspective – studies that aim to measure the economic impact of ICT adoption;

Social informatics also excludes the studies of the effects of pre-defined external variables on ICT use. Rather, it aims to explore and identify the contextual factors which contribute to the use or non-use of ICT (Sawyer & Eschenfelder, 2002).

The important feature of this paradigm is its critical orientation that advocates examination of possible failures or unintended consequences of ICTs. These include, for example, studies of the failure of an expert system to completely automate the task of coding documents because the rule-based expert system failed to capture the actual complex process of judgment (Suchman, 1996), the improper use of passwords (Adams & Sasse, 1999), or unexpected use of a listserv to evaluate other members where the initial objective was to share information among members (Eschenfelder, Heckman, Sawyer, 1998).

2.4.2 ICT use within the paradigm of social informatics

Studies under the paradigm of social informatics examine various factors both outside and within the organization surrounding the uses of various ICT based tools. Factors/entities outside the organization are system developers, vendors, and publishers whose ways of developing a system can shape the use of technology. Within an organization, in-house system staff, library leadership, and trainers can also influence and shape the use of the technology. Social informatics covers both creation and use of ICT-based tools. As the current study is concerned with the use of digital libraries, the scope of the discussion is limited to the use aspect.

Kling and Elliott (1994) underscored the cultural influence of different groups of stakeholders in designing digital libraries. Based on this, Davies (1997) identified several such stakeholders within and outside an organization. Project leaders in the area of digital libraries, the politics of the information environment within which such leaders perform, overall strategic management by those leaders, and how they make the system visible within the organization all contribute to the usability of digital libraries within the organization. Anything that makes it more difficult for the user to use the system, both within and outside the organization, is a usability factor. Developers contribute to how it becomes easy or difficult to use digital libraries in terms of navigating within a document, displaying a document, and downloading. At another level, the attitude of the library staff members who generate and provide services and their perception of their own roles in a digital environment also contribute to the usability factor. The training imparted to end-users, its timing, language used in-training materials also contribute to how end-users appropriate digital libraries (Davies, 1997).

Extra-organizational infrastructures in the organizational environment become the context of technology design and use. Being part of such an infrastructure can facilitate technology use within an organization. For example, libraries in some parts of the U.S. can draw on the comprehensive information infrastructure at the county level for Internet connectivity, while county libraries in some other areas have difficulty since they are not part of any such established network (Curry & Curtis, 2000). Similarly, the availability of electronic systems developed and maintained by real estate agencies also encourages their use by individual organizations (Lamb & Kling, 2003).

Issues internal to an organization can contribute both to the use or non-use of technology. Those issues may be administrative structure of an organization or the librarian's perception about the technology. For example, unstable technology, such as non-functioning computers, led to teachers' uncertainty about adopting that technology in their classes. The problem however, was rooted not in the technology *per se* but in the administrative structure of the school that paid less emphasis on administrative computing support (Soloway, 2000). Librarians may carry the old baggage of work practice with print materials to the digital environment and thus cause, inadvertently, users' poor DL awareness (Adams & Blandford , 2004). The mismatch between technology deployment and the work characteristics of communities of practice can lead to a feeling of social exclusion. Poorly designed systems can provide information that is available in principle, but not accessible in practice. For example, DL access was deployed favorably to more senior people in a given organization, thus making junior people dependent on the senior people for information. This differential structure caused a sense of exclusion. Thus, the administrative structure within an organization may favor undue hoarding of ICTs and information at some point and uneven use by people who want to use the technology (Adams, Blandford & Lunt, 2005).

Boudreau and Robey (1996) highlighted the paradox of information technology in business-process reengineering. While information technology enhanced the scope of organizational processes, including variety of time and place of work and speed of response, the system once hard-coded had little flexibility to accommodate new or emerging processes.

It has already been mentioned how extra-organizational institutionalized norms such as allocation of credit for work performed, selection of the target audience for research, access to resources including data, speed of work and result sharing, and allocation of professional status shape information-gathering practice. This, in turn, also shapes the use of ICTs particularly communication technologies which support such information practices. All these shape the differential use of electronic media for scientific communication (Kling & McKim, 2000). Similar disciplinary differences were also found to play a role on the pattern of use of DLs (Covi, 1999).

Cultural values inscribed in technology may make the technology dysfunctional. When a technology developed within one culture is taken to a different culture, the expected or desired usage of the technology may not take place. The organizational and cultural contexts of the place of use of the technology contribute to such unintended consequences. In their study of the use of a Geographical Information System (GIS) in a specific developing country, Walsham and Sahay (1999) described how in effect the system was not used by organizational members. The GIS in their study – was inscribed with the culture of the country where it was developed. Those inscriptions were: display and use of spatially related data, coordinated working when there are overlays, and the domination of the truth value of scientific data. The same GIS system was implemented in a different culture where all these characteristics were culturally absent. The usability of this GIS in a different culture was affected by several factors – lack of orientation towards spatial data, an altogether different philosophy towards work getting done, very restricted administrative structure leading to compartmentalization of work and overtaking scientific inferences by local political interests – to name a few. Thus the context of the study site and the inscriptions of the GIS mismatched and led to non-use of the system in the site of study, notwithstanding the accuracy of the technology and availability of hardware and software at the disposal of people in the study site.

On the other hand, an almost similar technology – Geospatial Information Technology (GIT) changed the structure of working relations of various coordinating groups following the World Trade Center crisis (Harrison et al., 2007). This work shows how a facilitating context can transform an ICT-based tool from inert reference material to a dynamic decision making tool. In the process that tool shaped the way of working of the organization members.

Two contrasting examples may be illuminating here. The quotes have been taken from each of the studies cited above:

> *None of the Indian scientists, or for that matter the Indian author of this paper, had considered the production or use of a map for this purpose and when this was jokingly queried by the non-Indian author of this paper, he was firmly told that "we don't use maps for this purpose in India". A GIS project leader in the National Informatics Center (NIC), one of the other institutions in India trying to introduce GIS, said: The most difficult part of GIS introduction is getting people to think spatially* (Walsham & Sahay, 1999, p49).

> (from a quote of informant). . *I still remember creating that LIDAR image on the 19th. I got the data; we printed it out and brought it to the firehouse and to Pier 92 and the firemen, you know. They stood around staring at it silently. . . there was about half a dozen of them. And then suddenly, they understood what it was, you know; even though they'd never seen this technology before, it started to hit home. And they could recognize the different mounds and the pits and where the guys were working in different parts of the image. And I think it became a really important tool for organizing their thinking and orchestrating the response to the whole crisis. . . (author's quote) once identified and used, images created from LIDAR data became a critical decision making tool. Daily images of ground zero allowed respondents to identify, investigate, and plan for shifts in the topography of the site* (Harrison, et. al, 2007, p2250)

These two examples of use show that the way a technology is used by an individual is shaped by the organization context.

2.4.3 Intra-organizational factors and differential use of ICT

A more interesting point of ICT use is that the same technology may be used differently by different groups within an organization or the same technology may be used differently by the same people at different times. This can be likened to a situation in which some properties of ICTs are only visible to users over other properties or some ICTs are not at all visible to users some of the time. When a limited number of features of word processing software are used by most of the people, it appears to the observer as if only those properties are visible to users, even though on each user's table the system is available with all its features. Jasperson, Carter, and Zmud (2005) also bring to our attention the point that people use a very limited range of features of a technology. Citing the example of tax return software, Orlikowski (2000) showed how one software was used differently by different people or differently at different times by the same people. That tax return software is used for printing a blank form, for learning the current tax code, or for learning the interface of such software is an example of how the same technology evokes different interest and hence different usage among different groups of people. Or, the same tax-return software is typically ignored for most of the year and only intensively used for a short period by the same group of users demonstrating how the same technology remains invisible depending on the time when it is needed. This specific pattern of use of the same technology by different groups of people, or at different times by the same group of people is termed as *technology-in-practice* (Orlikowski, 2000).

Orlikowski (2000) elaborated how different work groups' interests, organizational demands on them and different perceptions can contribute to different technologies-in-practice within the same organization. She used the example of "Notes" – software installed on the desktops of employees of a company. This software was very powerful in promoting and supporting cooperative work within the organization. It was found that two groups – "technical support" and "consultants" – were enacting different technologies-in-practice for the same software. "Technical support" members were free of a competitive culture, not subjected to "up-or-out" career tensions or "billable hours" pressure. Members of this group were found using many features of the software and thus promoted their collective technical work and cooperated with each other. They also modified the technology over time as they added data to the databases and created or customized them. Thus one kind of technology-in-practice emerged from this group. However, members of the "consultant" groups were found to use the technology in a minimal way. This group was subjected to strong competition ("up-or-out") and higher performance metrics ("billable hours"). The competitive culture strongly reinforced by the ''up-or-out'' career path was seen by many consultants as encouraging the development of individually distinctive competence. This increased their reluctance to use *Notes* to share expertise, and reinforced their firm's practice of rewarding individual effort and distinctive competence rather than cooperation and knowledge sharing. Similarly, this group was doubtful of the relationship between the technology and company performance. The training conducted for this technology was also very abstract and technical. Overall, *Notes* triggered their fear that use of its collaborative properties would threaten their status within the company and all these resulted in minimal technology-in-practice (Orlikowski, 2000).

The important point to note here is that such differential use happens within the same organizations and issues which contribute to such differential use are also internal to the organization. A theoretical underpinning was adopted to explain such differential use, which is described in the following section.

2.4.4 Structuration theory and technology-in-practice

As mentioned in the previous section, Orlikowski (2000) proposed *technology-in-practice* to describe what she observed about technology use in organizations. This construct is developed using structuration theory (Giddens, 1984), which describes and explains how structures are developed, maintained and changed within social systems. This theory has been used by many scholars to explain phenomena that have roots in social practices. The theory, its various explanations and critiques form a voluminous body of literature and it is beyond the scope of this work to present such a discussion in detail. A brief introduction to structuration theory is given here followed by the discussion on technology-in-practice – a structuration theory based lens – as proposed by Orlikowski (2000).

Structuration theory posits that structuration is a social process involving reciprocal interaction between human and structural properties of an organization. The structural properties consist of rules and resources which mediate human action, and at the same time, the structure is re-affirmed by the actors. The core of the theory is the reflexivity of the human beings to routinely observe, understand, and continuously monitor their context. That is how a social practice is developed and mediated through the facilities available to them (e.g., land, buildings, and technology), the norms that inform their ongoing practices, and their knowledge (both tacit and explicit) of prior action and the situation at hand. A facility which is an external resource only becomes a resource when it is implicated in the recurrent practices by humans. For example, in a society, money is a resource only when people use the money in a meaningful way. Unless money is constantly used, it does not become a resource. Norms define how a resource should be used in a given structure. The use of a resource in a meaningful way depends on people – intelligent and reflexive individuals – their past experience as well as the knowledge gained through their interactions with others. The interpretive schema of the intelligent and reflexive self of the individual helps an individual to develop a way of acting in a certain situation or using a resource in a certain way in a situation. Recurrent practices of doing certain things in a new or different way that are capable of being made visible, may give rise to new norms. In this way, they apply such knowledge, facilities, and habits of the mind and body to ‘‘structure’’ their current action. In doing so, they recursively instantiate and thus reconstitute the rules and resources that structure their social action.

Based on this explanation of structuration theory, Orlikowski (2000) proposed technology-in-practice – the theory of the structure of technology use. Technology-in-practice is the enacted structure of the action of *technology use*. In technology-in-practice, people draw on the

resources – the technical materiality of the technological artifacts inscribed by the designers as well as added by people (specific data contents, customized features); **norms** – skills, power, knowledge, assumptions about the technology and its use; and the **interpretive schemas.**

Interpretive schemas require some detailed discussion. Technology-in-practice focuses on human agency. From an agency point of view, human interaction involves the constitution and communication of meaning. This is achieved *via* interpretive schema – that is, stocks of knowledge. Interpretive schemas represent organizational structure of signification, which represent organizational rules that inform and define interaction. As the organizational rules are reaffirmed or challenged through their use by human agents, interpretive schemas are also reinforced or changed. Thus in any interaction, shared knowledge is not merely part of the background, but is an integral part of the social encounter, in part organizing it and in part being shaped by the interactions themselves.

Interpretive schemas are developed through training, communication, and previous experiences, which include emotional and intellectual meaning and attachments that people associate with a specific technology and its use, shaped by their experiences with various technologies, and their participation in a range of social and political communities. Knowledge and experience also come from the institutional contexts within which people live and work, and the social and cultural conventions associated with participating in such contexts. Thus people's use of technology is structured by these experiences, knowledge, meanings, habits, power relations, norms, and the technological artifacts at hand. Such structuring enacts a specific set of rules and resources in practice that then serves to structure future use as people continue to interact with the technology in recurrent practices. Consequently, over time, people constitute and reconstitute a structure of technology use; they enact a distinctive technology-in-practice. Through ongoing enactment of technology-in-practice, it becomes regularized and routinized. Though the technology-in-practice is enacted in current use, such enactment is influenced by the past uses and experiences which serve essentially as a “behavioral and interpretive template”.

The interpretive schema can help better understand how and why people are likely to use their technologies and with what intended or unintended consequences in different conditions. The emphasis on interpretive schemas also assumes that people are purposive, knowledgeable, adaptive, and inventive agents who engage with technology in multiple ways to accomplish various and dynamic ends. When the technology does not help them achieve those ends, they abandon it or work around it. Structures are not static and get changed through agency, so does technology-in-practice. No technology-in-practice is static forever. As intelligent people interact with various worlds and get sensitized to the various ways of using a technology and the usefulness of using this technology in different ways, technology-in-practice gets molded.

Different groups can demonstrate different technology-in-practice with respect to the same technology. Technology is an artifact because its material and cultural properties transcend the experiences of individuals and particular settings. Such artifacts, however, do not appear the same to all people. By implicating rules and resources of technology as specific recurrent social practice, as mentioned above, the technology structures human action and it is possible to see that structure through those recurring actions. Even for a specific technology, different people can see and use different sets of features and implicate those features accordingly and thus give shape to the technological artifacts and/or some of the properties of a technological artifact. A parallel has been drawn between technology use structure and supermarket use (Lave, 1988, pp.150–151). The supermarket for individual shoppers is a repeatedly experienced, personally ordered and edited version of a setting of activity. Some aisles in the supermarket do not exist for a given shopper as part of her/his setting, while other aisles are rich in detailed possibilities. Similarly, the use of a technology involves a repeatedly experienced, personally ordered and edited version of some technology. This explains why people, at best, routinely use 25 percent of the functionalities of office software packages such as word processing, spreadsheets or the differential use of tax return software by different group and by same people at different times (Orlikowski, 2000). Technology-in-practice can vary among users as rules, resources and conditions for a technology use can be experienced differently by different individuals and differently by the same individuals depending on the time or circumstance.

Technology-in-practice is emergent and is not embodied within the technology. What a technology embodies are particular symbols and material properties. Repeated interactions with some properties facilitate implicating those properties in the ongoing process of structuration, and thus instantiate the properties in practice. Technologies-in-practice can change as users experience changes in awareness, knowledge, power, motivations, time, circumstances, and the technology. They are changed through the same process that all social structures are changed—through human action. Users may also choose to enact different technologies-in-practice when they become more knowledgeable about using their technology (through attending a training class or watching a colleague's use, for instance) or because they have changed jobs and now need to use technology differently in their new work community. At the same time, users' knowledge of what technological properties are available to them may be updated or made obsolete, may change the meanings, expectations, associations, and conventions they attach to the technology and its use. By focusing on this emergent structure, a view of technology use emerges which can describe what users do with technologies as enactment. It can then be further extended to understand whether such emergent structure is associated with any specific work groups or is a result of some organizational factors.

Using the lens of technology-in-practice for the studies already discussed above helps to understand how organizational context directly intervenes in shaping the use of ICTs by organizational members. In the case study of Geographical Information System (GIS), as mentioned in Section 2.4.2, cultural and educational aspects were associated to limited use technology-in-practice of GIS (Walsham & Sahay, 1999). One of the examples of the effective use, or "substantive use," as termed by the authors, of a GIS in this case would involve district forest officers using the GIS outputs on a regular basis to support decisions on what kinds of trees should be planted in particular wasteland areas in order to help restore these lands. This was found not to be happening, though. This is an example of limited use technology-in-practice and was the result of two factors: (i) the absence of a relatively stable set of key actors with aligned interests related to the GIS and (ii) creation and maintenance of such key actors demanded a long process of changing social attitudes and structures. The authors (Walsham & Sahay, 1999) noted that one key component in earlier education/training that would promote substantive use of this technology was map-orientation. This map-orientation was lacking in the people who were using the technology. Thus, in order to blend decision making process of administrators and output of GIS technology, change in educational components by brining advance technology like remote sensing for the users groups of GIS was felt necessary. The cultures of data sharing and cooperative work approach were also found essential for effective and substantive use of GIS technology and this culture was absent in the study site.

If the above cited case was an example of non-use or limited use of technology, the other study on GIT, as mentioned earlier, exemplifies how technology-in-practice can change. Inter-organizational social structure came into force and make the users take note of material capabilities[17] of a geospatial information technology (GIT) and enact those materials capabilities which were otherwise ignored (Harrison et.al., 2007). Sharing geospatial information across regions and integrating this information with other data sets are core to successful use of GIT. GIT's tremendous capability which can be exploited when geographical information across legal, organizational and economic jurisdictional boundaries are combined to make an interoperable system was restricted, until the WTC attack in 2001, by the notion of "owned" data and thus preventing data sharing. Until this time, there were similarities between this and earlier case of GIS use. However, in the acute emergency of the situation, such social structural impediments lost their usual force and norms for collaboration in crisis gained prominence. Consequently, material features of GIT facilities, enabling capabilities that have been feasible for a long time, were drawn upon by GIT professionals to produce improvised GIT products to respond to urgent needs. Actors/users of the technology brought a set of diverse technical facilities and resources, pre-existing and newly adapted norms, and organizationally idiosyncratic interpretations of reality. An interchange of knowledge, meaning systems, and technological artifacts took place among members of the different groups in the course of which they shared perspectives on social reality at that moment, learned from each other, and engaged in a fertile period of technological innovation. In drawing on these structural properties, users' experiences are shaped not only by material aspects of the technology ("*facilities,*" of a resource, according to structuration theory) but they are also shaped by *norms* (rules of using the resource) for appropriate behavior within

[17] According to structuration theory – the basis of the construct technology-in-practice – the material capabilities of a technology are its features that can be put to use as resource

an organization and with respect to a technology, and by *interpretive schemes* drawn from the institutional context through which structure is instantiated. Thus, an important part of analyzing a technology-in-practice is to understand how structural properties of the social system, through the modalities of facilities, norms, and interpretive schemes, shape users' tendencies to enact technology in particular ways, giving rise to the possibility of structural reconstitution.

In sum, technology-in-practice allows us to observe the structure of use of a technology and also factors leading to not only use or non-use by different organizations, but also differential use within an organization. Such factors can be external to an organization such as infrastructure, political and work culture of a society in general, as well as internal to an organization such as administrative structure, work practice, and previous experience of working with the technology.

2.4.5 Technology-in-practice, DL use and research question

This section addresses how the concept of technology-in-practice can be used as a framework to understand DL use. The departure points here are that organizational members' information-gathering practices are shaped by some institutional forces and they should turn to one or more systems and use some features of systems preferentially over others to support their information-gathering practices. The question at this stage is what kind of DL use structure can be observed and the factors that contribute to such use structure. This question can be addressed at two levels and both are important, to my mind, to understand DL use. At one level, an ICT can be said to be used substantively if the outcome of that ICT is used in the day-to-day work of people (day-to-day work refers to the institutionally shaped actions of social actors). At another level, an ICT is used substantively if many features of the ICT are used to produce the outcome of the ICT, which can then be put to use to meet the day-to-day work of people.

We can conceptualize the entire range of information channels mediated through ICT as a DL and the various electronic resources, including commercially available as well as locally developed resources, search engines on the Internet and other services such as *Google Scholar* as properties (resources) of the information-service provision technology. There are mechanisms deployed by organizations to make those resources accessible by people who are entitled to implicate or put to the use of those resources in their practices. This technology, the information service provision, has several rules and resources. People instantiate one or more such properties in differential ways, depending on how such properties are visible to them. This visibility of some of the properties may be the result of the users' earlier experiences of the use of the technology. Also, rhetoric of powerful actors such as organizational policy or vendors who continuously promote a technology can contribute to people developing some image of a technology and attaching some meaning to a technology. Repeated use of one or more of those facilities, predominantly by people under certain contexts, establishes a structure of information channel use.

Each component of a DL comes with certain rules and resources. Within the purview of DL use as technology-in-practice for information gathering, people can read some of the properties more clearly than others because of their interpretive schema, which is again developed because of their experience in the past and their environment. Depending on such readings, DL use may be structured for some people as a simple store of articles that can be downloaded once the reference is exactly known; for other people it may be a simple word-searching facility to locate items; and yet for others it may be an extensive information discovery tool. In the light of the above discussions, the second research question is once again presented here.

RQ#2: What are the various extra- and intra-organizational factors mediating the practice of DL use (including non-use) in information-gathering activities of organizational members?

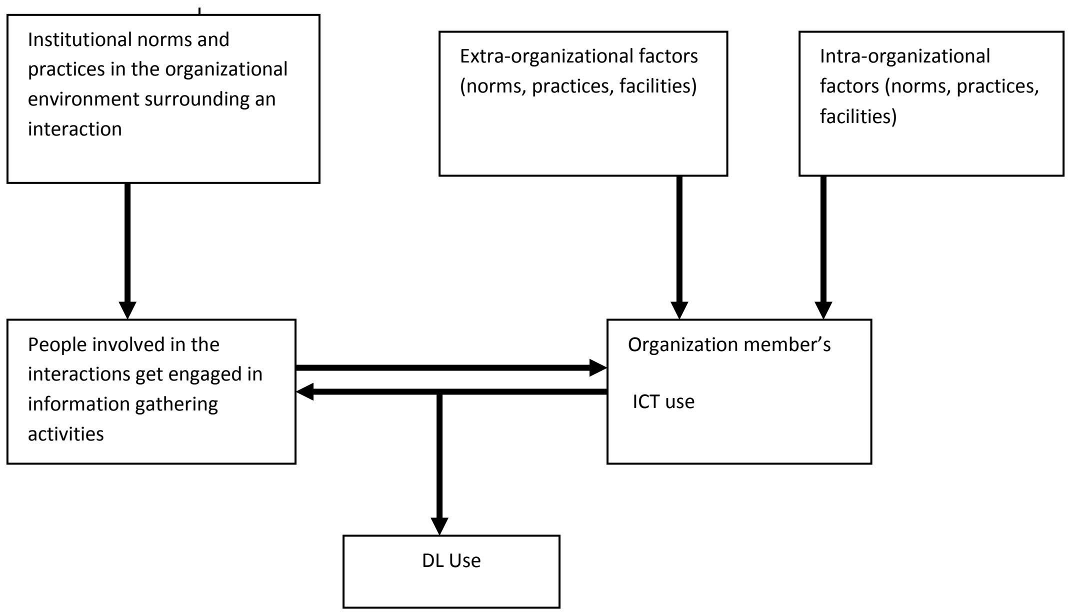
RQ#2(a): What are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level?

RQ#2(b): How are such practices accounted for by different extra- and intra-organizational factors?

A graphic presentation of the research question is presented in Figure-3 below.

Finally, the findings from research questions RQ#1 and RQ#2 will be reconciled to understand how digital libraries use are being shaped by the organizational context of academic and research organizations in India.

Figure 3: Intra- and Extra-organizational Factors Shaping the Practice of DL Use



2.5 Chapter summary

Organizational context can shape DL use in support of the information-gathering activities of the organizational members at two levels. At one level, there are various institutionalized organizations or representatives of such organizations with whom the organizational members have to interact in order to discharge their responsibilities. Information exchange is part of such interaction. Information gathering is viewed as routine activities to meet such institutional information demand. In that routine process, DL use also becomes routinized. Using the construct *social actor*, this study attempted to capture how the DL use and information gathering activities are routinized by organizational members of academic and research organizations in India.

Digital libraries are ICT-enabled tools. Because of this, at another level, organizational context of DL use can be mapped onto those issues that contribute to any ICT-enabled tool within an organization. Organizational context, from this perspective, covers a wide range of issues, namely, external information environment/infrastructure, administrative structure of the organization leading to ICT deployment within the organization, the nature of work demand on individuals, and the previous experience of organizational members of using the technology. All these not only contribute to varying degrees of use of ICTs but also contribute to differential use of ICTs by different groups in the same organization or by the same person at different points in time. Using the paradigm of *social informatics* and using the construct *technology-in-practice*, the research attempts to capture the elements in an organizational context that can shape the use of ICT-enabled tools, which in this study are DLs.

This chapter drew on the literature relevant to the core ideas of the proposed research and showed how the ideas from the literature had been adopted and modified. The chapter also provided a detailed discussion on the concept of digital library, various definitions as found in the literature and the definition adopted in the current study.

CHAPTER 3: THE RESEARCH METHOD

3.1 Chapter introduction

This chapter starts with a review of the research paradigm adopted in this study and a justification for this adoption. This is followed by a review of case study and field research as an approach and the appropriateness of these two methods in the current study. Next, a summary of case selection criteria, the sample selection process, the sources of evidences, data elicitation techniques, data reduction and data analysis are presented. The description of each is supported by various decisions taken to address concerns in each area. The chapter also highlights some changes that had to be accommodated and the evolving insights regarding research design that took place. A pilot study was conducted before the actual research study was initiated. A brief summary of the experience of the pilot study and how it was used to fine tune some of the steps in the research process is presented at the end of this chapter

The target of this research was to develop an account of the context of digital-library use within an academic and research organization in India. To this end, the questions to be pursued were:

(i) What are the components of the contexts of members of an academic and research organization?

(ii) What is the institutional nature of those components?

(iii) What kind of information demand is made on the organizational members by those components?

(iv) How do information-gathering practices help those organizational members in meeting such information demands?

(v) In the process of consulting digital libraries in order to support such information gathering activities, what are the properties that are visible to those organizational members and are used recurrently? and

(vi) What contributes to make some properties more visible than others?

The best way to develop such an account of organizational context was to look at it through the eyes of the organizational members who use digital libraries. Hence coming into close contact with organizational members was necessary. To this end, the research was conducted within the paradigm of qualitative and naturalistic studies. The following section provides a brief description of this research paradigm and its relevance to the current study.

3.2 The research paradigm for the current study

The current research adopts naturalistic and qualitative research paradigm. Naturalistic inquiries are based on five axioms. Those axioms are: realities are multiple, constructed and holistic and can be understood but cannot be predicted or controlled; the inquirer and the object of inquiry interact with each other; separating cause from effect is not possible as each influences the other; knowledge can be described ideographically as a working hypothesis that describes a case; and all inquiries are value-laden (Lincoln & Guba, 1985: pp 39-44). Terminology differs but these axioms are attributed to qualitative research in general (Cresswell, 1994). Here are some examples of different terms: *ontological* (the reality is multiple and subjective as seen by the participants), *epistemological* (the researcher is required to interact with that being researched), *axiological* (the research is value-laden or biased), *rhetorical* (the language of the research is informal, the decisions are evolving, a personal voice and qualitative words are accepted), and *methodological* (the research has to progress inductively). Other scholars emphasize the process of conducting qualitative research and define it as the process of exploring issues, understanding phenomena, and answering questions. Overall, the goal of all qualitative research is to better understand human behavior and experiences by grasping the process by which people construct meaning, and then to describe what those meanings are. Concrete incidents of human behavior are empirically observed in order to think clearly and deeply about the human condition (Bogdan & Biklen, 2007; pp 20-36).

Following this paradigm, the questions raised by this research could be answered best by those who use digital libraries, and in their own narratives. DL use is a convergence of information-gathering activities and the use of ICTs. Individuals acquire experience in information-gathering and using the associated technology and they subsequently assign meaning to these activities as an outcome of the experience. Thus each person's worldview of information-gathering and DLs is part of a reality and is constructed by them. Based on the individual's worldview, a more holistic picture emerges inductively and progressively. It must be noted here that a holistic picture of reality or total reality is a relative state because it always remains unknown how much is still unknown. The term total reality is used here to imply a discernible pattern in the worldviews of people who are available to the researcher. The process of developing the total view recognizes the importance of language and personal voice. Consequently, informal language becomes the most important vehicle for empirical data in this study. This process demands the researcher coming into close contact with those who serve as sources of evidence thus bringing the value of the researcher into the mix. For these reasons, the research was a perfect fit within the paradigm of qualitative and naturalistic research.

3.3 Case study and field research – the fit with current research

In the research design stage, some of the major concerns are the sources of the data and decisions about how that data will be collected. Adopting the case-study approach addresses the question of the source, while the decision to do field research addresses the issue on how the data should be collected. A summary of these two research approaches and the fit to the current research follows.

3.3.1 Case study – a description

Case study, as a research method, is adopted when the researcher intends to explore a program, an event, an activity or a process or individuals in depth. The cases are bounded by time and space and data is collected using a variety of procedures over a sustained period of time (Stake, 1995). Some scholars view case study as one of many strategies to conduct inquiry (Baily, 2007). Bogdan and Biklen (2007) describe case study as a detailed study of a setting. Yin (1994) unambiguously calls the case study a research strategy. It is neither a data-collection tactic nor merely a design feature alone (Stoecker, 1991). An extensive list of criteria that make a study a good fit for case study includes: (i) examining phenomena in a natural setting; (ii) collecting data through multiple means; (iii) examining very few entities; (iv) intense study of the complexity of the unit; (v) exploration, classification and hypothesis development; (vi) no involvement of an experimental control; (vii) no specification of independent and dependent variables; and (viii) results being dependent upon the integrative power of the researcher (Benbasat et al, 1987). Case studies are typically conducted to observe current phenomena, bounded by time and space, and hence observations are to be made after the data points are bounded by a context (Yin, 1994).

A case study can employ either single case or multiple cases. A single case is selected when such a case has potential to be a critical or revelatory. On the other hand, the evidence from multiple cases is often compelling resulting in a study that is regarded as robust. Replication logic works more for multiple case studies. In multiple case studies, each case either predicts the same results or produces contrasting results for predictable reasons (Yin, 1994: p45).

Subsequent to the selection of a case or cases, different data-collection strategies can be employed depending on the nature of questions raised. One can administer a questionnaire survey, adopt participant observation or other techniques for empirical observation within the case.

3.3.2 Field research – a description

Field research is the systematic study, primarily through long term, face-to-face interactions and observations of everyday life (Bailey, 2007). Studies in this category aim to understand daily life from the perspective of people who live that life in a setting. In field-research-based studies, researchers are required to come in close contact with study participants, in their natural setting, in order to observe the phenomenon under study. From this perspective, field work meets one of the epistemological axioms of naturalistic inquiry, which states that the researcher has to come in close contact with those being studied.

Field research is referred to as naturalistic inquiry as it does not move people from their daily lives. Field research also does not impose any parameters from the outside. Unlike researchers using surveys, who focus on a few pre-selected variables, field researchers learn from larger, complicated, multifaceted, social and historical contexts within which people live. The temporal order of events and the change over time are important to them. Field researchers often become part of the setting and personally experience and reflect on it afterwards (Bailey, 2007). The most important mode of data collection is observation, although interview is also another instrument for data collection. Field studies tend to capture the essence of human behavior, particularly when the people under observation are unaware that they are being observed, resulting in authentic behaviors being reflected without the influence of demand characteristics (reactivity) or social desirability answers (Persaud, 2010).

3.3.3 Similarity and differences between case study and field research

Case study and field research have similarities on three counts, namely, the notion and role of theories; the level of generalization that can be achieved through these strategies; and the nature of variables to be examined. The importance of the role of theories has been recognized for both the methods. Such a theory need not be a grand theory; it can be a proposition which can guide what to study or serve as a blueprint by stressing the questions, propositions, units of analysis. It can help by connecting data to the concepts and the criteria for interpreting the findings (Yin, p28). It can also provide orienting frameworks, conceptual lenses, sensitizing concepts, causal models, disciplinary perspectives, philosophical perspectives, or worldviews (Bailey, 2007).

Theory influences how we understand the world and the research, and helps wade through large amounts of data, avoiding merely dumping the data as research output.

Neither of these two research methods aims to achieve the generalization of the findings at the population level. When based on a single case, both field study and case research aim to understand the details of the selected case. On the other hand, when multiple cases are selected, analytical generalization can be made among situations.

Both these research methods recommend not restricting the study to a few selected variables. Rather, larger, complicated, multifaceted, social, and historical contexts within which people's lives unfold provide a rich understanding to the researcher. The case study research also relies on multiple sources of evidence, with data needing to converge in a triangulating fashion and benefits from prior developments of theoretical propositions to guide data collection and analysis (Yin, 1994; p 13).

One can adopt a case study approach and then opt for field work for data-collection purposes (Yin, 1994). On the other hand, cases are purposive samples in field work (Bailey, 2007). Thus, when flavors of both these research methods are present in a research, their relative importance in the research depends on the approach taken by the researcher.

3.3.4 Applicability of case study and field research in the current study

Even though the current research was conducted in a naturalistic setting it did not perfectly fit the criteria of field research along two dimensions: (i) the researcher's role and (ii) the data-collection mode. In field research, in order to have "the lived experience" the researcher becomes part of the setting and participates in the daily life of those being studied. Bailey (2007) gave an example of such lived experience from the work of Russell (1991):

> *For her data collection she volunteered for four months at a day shelter, where she could directly observe the women in their role as residents of the shelters, diners at soup kitchens, participants in social activities. She held babies, poured coffee, and chatted with sheltered women….she wanted to explore how they made sense of their lives and how they viewed themselves and other homeless women*

This role naturally indicates that observation is a significant part of the data-collection technique in this research method. The aim of the current research was to know what digital-library use means to the organizational members in academic and research settings, but to be a part of a highly technical world was not possible for the researcher. Hence, the full lived experience was not a requirement for this research. Additionally, observation was a minor part of data collection in this research as explained in a later section where data elicitation is discussed. Primarily, because of these two reasons, the current research could not be identified as a field research in which lived experience of the researcher is important.

The research method of the study aligned more with case study. There were several ingredients in the research that made it better align as a case study methodology: the phenomenon under investigation was current and it had to be studied within the clearly defined boundary of an organization, thus making the study bound by time and space, a quality of a case; cases had to be selected as purposive samples (more discussion on sampling to follow); a case study allows several methods of data collection and need not necessarily restrict to observation – the current study primarily depended on interviewing technique; the study targeted multiple sources of data for triangulation; and finally, the researcher could not control the phenomenon and did not reduce the context into any preselected variables. Hence it met the basic criteria for a research study to be identified as case study (Yin, 19994).

A multiple case study approach was adopted in the study. The researcher did not have any evidence that there is a single site that could be considered as critical or revelatory. On the other hand, selecting multiple cases enabled the researcher to make a cross-case analysis to understand the universality of the phenomenon.

3.4 Research design

Designing a study is the process of translation of elements of inquiry and research approaches into practices (Creswell, 1994). The elements of inquiry were summarized as questions at the beginning of this chapter, and a qualitative, naturalistic case study was adopted as the research approach. This section will provide details on the actual design.

3.4.1 Case selection

Cases in a multiple-case research are purposive samples. Two organizations – ORG1 and ORG2 – were selected as purposive samples for the study. Detailed descriptions of both the sites are given in following chapter 4.This section presents how these two organizations were determined to be fit for inclusion in the study.

There were several concerns in selecting cases for the current multiple-case study. These were: the possibility of finding adequate data for the research, differences in the organizational contexts of the cases to be studied, the possibility of getting access to the sites in a more or less hassle-free way, and the geographical locations of the cases.

It was obvious that in order for a site to qualify as a case, there must be possibility of getting adequate data. This was possible if the selected case, at the time of starting the data collection, was sufficiently familiar with electronic resources and their uses. Both ORG1 and ORG2 were sufficiently accustomed to electronic resources when data collection started in early 2009. In India, it was such government-supported/funded organizations that witnessed spectacular changes in terms of electronic resources. This happened because several measures were taken by the government to make Indian scientific and research organizations competitive under the assumption that knowledge is the greatest tool for coping with competition and that electronic resources can provide such up-to-date knowledge speedily. Organizations similar to ORG1 and ORG2 were part of some government-sponsored consortium and had access to a large number of resources that were otherwise inaccessible during the all-print era. This government policy made ORG1 and ORG2 quite rich in information resources and subsequently, these two organizations were qualified as representative organizations where there were possibilities of finding rich phenomena of digital-library use.

The organizations were to be selected in such a way that their contexts were sufficiently different. When two organizations are quite different, it is possible to observe if such differences in context contribute to a given phenomenon, digital-library use in this case. Selecting each organization using the principles of theory-driven purposive sampling was helpful because it gave the researcher the opportunity to select organizations with differences. Such differences between selected organizations were at two levels – field of specialization and structure.

A field of specialization is a recognized area of scholarly activities. Thus two organizations pertaining to two different fields of research are most likely to be different. As reported in the literature, field differences and their contributions contribute to different communication patterns corroborate this. To make the findings comparable, however, only applied fields, namely, metallurgy and materials science and biotechnology, were selected.

Metallurgy and materials science is a very conventional and old discipline. As quite a few informants described, this discipline now devotes itself mostly to developing processes leading to better quality of metals or to developing new materials that can be used by other industries. The first area supports operations of large existing industries, such as steel industries or power industries, where the quality of metal in the infrastructure/equipment, such as blast furnaces, can contribute to the operational cost. The second area is more challenging. According to the informants a big task is not only finding the applicability of new materials but also finding the areas where new materials will be applicable. Biotechnology, on the other hand, is comparatively a new but extremely thriving field. Its main goal is discovery of new items directly related to the benefit of society. New drugs and new genetically developed plant seeds are examples of such items. In addition, biotechnology, as a discipline, was selected in order to be able to compare the finding of this study with literature (Lamb & Kling, 2003). Choosing biotechnology as discipline of research in an academic and research organization provides an opportunity for comparing the findings from an academic and research organization with that from an industry.

Discipline-wise, ORG1 devotes its research to metallurgy, materials and mineral science. ORG2, on the other hand, devotes itself to many areas of research, including basic disciplines such as physics, chemistry, and so forth. However, there is a division that pursues research in the area of biotechnology. Hence, for ORG2, only that division was considered for this study.

Structurally, ORG1 and ORG2 are two different types of organizations. Details of these two organizations are given in chapter-4 and a very succinct version is presented here. ORG2 is committed to basic research and ORG1 is committed to industrial research with a specific objective to make the country self-sufficient in this industry. From the objectives of these two organizations, it is clear that these two organizations are structurally different. Thus selection of these two different organizations provided an opportunity for analytical generalization across cases.

The two other concerns, namely, getting entry into an organization and geographical proximity of cases, were mostly related to research management. Getting entry into an organization is extremely important but can be complicated sometimes. Two types of organizations were kept out of purview because of the impossibility in getting access. Those were organizations doing research in the defense sector, and in mission areas, such as nuclear science or space science. Organizations that are supposed to direct their research to the betterment of society, in terms of production, economic development, and self-sufficiency, were considered. Even then, getting entry into those organizations was a long process. Hence the researcher resorted to her personal connections in order to be introduced to the authority of respective organizations and to get permission to conduct the data collection.

Regarding geographical proximity, it was a concern that cases selected should be in the same geographic area so that time and resources could remain at a manageable level. Thus both the cases selected were from same region of the country. Though this selection was made for convenience, it did not undermine the merit of the cases as organizational goals and research agenda are not dependent on geographical locations within the country.

3.4.2 Sample selection

Individuals were the basic building blocks of the two cases. Selection of study participants within each organization was accomplished through purposive sampling and by using the snowballing technique. The first issue was how to select the individuals whose worldview would matter in the research. Depending on the experiences – and people can certainly have widely different experiences – the worldview may vary widely from person to person. So the question ensues; how to ensure that experiences are not randomly collected. If context matters, then individuals bounded by a given context will have comparable worldviews.

Spradley (1979) recommends selection of informants who are enculturated, have current involvement, are in a cultural scene that is unfamiliar to the researcher, have adequate time, and are non-analytic in nature. As enculturation takes some time, the informants were to be ideally selected from those who were serving the organization for a few years. In the Indian research scenario, it is not uncommon that sometimes researchers are moved to administrative positions. In the process of handling administrative works however, they become enculturated differently and therefore, could not be included as informants. To ensure current involvement the informants were to be selected from those who were working in research projects, preferably managing both internal tasks and the external relations, and were specifically in charge of report writing.

The site of research must be culturally unfamiliar to the researcher. Even though this researcher has experience of working in different academic and research organizations in India for nearly 25 years, the organizations she selected are of the type she left almost 15 years ago. It is a sufficiently long enough time to have made her unfamiliar with the situations in those organizations.

In order to get the informants who had sufficient time for an interview of about one hour, people in a very high rank within organizations were avoided. It was difficult to predict how the informants would be chosen based on the last criterion – informants of non-analytic nature. A certain degree of reflexive capacity of the informants is necessary for them to articulate how they look at events, phenomena, and objects. There is a trade-off, however, and some of these people may inadvertently try to translate their thoughts with the good intention of helping the researcher. During the data collection stage, one interview was rejected on this ground. A person who can provide a good description would be a good informant. It is the researcher's skill to encourage the informants and engage them to show their world in their native language. It was not possible beforehand to identify such good informants. In addition to the above issues, the researcher was keen to and could include two of the following kinds of informants: people who are almost nearing retirement – those who started working when libraries were completely conventional and continued to do so even a few years before that; and people who were educated in countries such as the U.S. and have gone back to India within the last few years and were currently working there.

Within ORG1 and ORG2, there are two types of science workers who are engaged in research. One group is referred to as scientist and the other group is referred to as technical. Though some of the technical people became highly knowledgeable and scientists of respective organizations may have great respect for their capability, it was the scientists in both the organizations who were in charge of the research projects. Hence to keep the findings comparable, both within and across organizations, study participants were drawn only from the pool of scientists.

ORG1 is a large organization. Entry to ORG1 was first made through an acquaintance who also participated in the study. The researcher approached six (6) scientists, in the first round of data collection, after examining documents such as annual reports and future vision document. Before the second round of data collection also, the ongoing project list was consulted and one of the acquaintances was requested to introduce the researcher to other scientists some of whom were doing different types of research. This former research participant circulated an email to selective scientists meeting the criteria, requesting them to participate in the study. Nine scientists agreed and actually participated in the study in this round. Overall, the informants were recruited using snowball technique with a touch of theoretical sampling.

In ORG2, the group devoted to the research in biotechnology was very small. Through acquaintances, contact was made with almost all in the group who were present in the city at that time. Four scientists initially agreed to participate in the research, out of which three scientists finally took part in the study.

Because the process of research was emergent in nature, data collection, analysis, and the adjustment of the instrument (i.e. the researcher) took place in a cyclical manner. Though sampling was the first step in any research process, after selecting one sample and completing the process as far as preliminary data analysis, the next sample was to be selected based on the questions that emerged in previous analysis. Similarly, based on the analysis, necessary adjustments were made to include more questions on a specific issue or questions on a different but relevant issue.

3.4.3 Sources of evidence

Initially, the target was to examine two types of sources for data collection -- documents and individuals. Documents can hold the footprint of how organizations as a source of "power" create the structure of DL. The intent was to include both print and electronic versions, if any, of annual reports, research reports, websites of the organizations and their libraries, assessment and promotion guides, job responsibilities at different levels, any materials prepared on DLs, minutes of meetings of library committees dealing with DLs, library brochures, handouts and so on, subject to availability. The research method using case study also recommends collecting data from multiple sources for the purpose of triangulation (Yin, 1994; p91-93). It was an expectation that these organizations might have some policy documents regarding adoption of ICTs as well as digital libraries. However, no such document was found in any of those organizations. Hence, librarians and system managers of both the organizations were interviewed to understand the evolution of the current state of ICTs as well as digital libraries in those organizations. Those interviews were used to develop the background information for each organization.

The second source of data was individual organizational members who were study participants. In-depth interviews were conducted with those participants following which those interviews were transcribed verbatim. The transcriptions were then used as a major source of data.

3.4.4 Interview as data elicitation technique

3.4.4.1 Research design issues using interview as data elicitation technique

The issues regarding adopting a data elicitation technique, at the research design stage, are: (i) the choice of technique appropriate for the type of data required for drawing inferences; and (ii) containing the risk of data corruption. How these two issues were handled, are described below.

Qualitative and naturalistic inquiry is often accomplished with the help of unobtrusive observation and/or interviews. This study used interviewing as the primary data-elicitation technique. This choice leads to an obvious question of why another standard data-collection technique, namely observation, was not employed. The reasons are: (i) unobtrusive observation on a purposive sample is not possible; and (ii) information related activities are very private in nature in the current electronic scenario (Barry, 1995). Had observation been used, there were two places within an organization where such observation would have been conducted: either the library or the participants' office spaces. The libraries of the two organizations were ruled out for two reasons: (i) the study participants comprised a purposive sample and were selected based on certain criteria. There was no guarantee that those participants would come to the Library to consult digital libraries; and (ii) both the organizations were found to have adequate local networking facilities and scientists, in general, of both the organizations were found to consult digital libraries from their office spaces. Moreover, the researcher spent some time, in the libraries of respective organizations watching users. It was found that computers marked for users were mostly used by other non-scientists for different purposes such as email checking. This was also corroborated during the interview as the participants admitted that they do not go to the library any more to consult electronic resources as those were available digitally on their computers.

Another alternate space for observation could have been their office spaces. However, computers or laptops used by those scientists in their office were located within a setup which can be best described as a personal space. They perform many tasks on their computers including searching digital libraries, but it could not be ascertained when they were consulting the digital library or performing some other activity. Spending time in the room of such scientists, beyond the time allotted for an interview, for the purpose of observing them would have been very uncomfortable and could not be defined as unobtrusive observation. Moreover, those scientists were also entrusted with other research administration jobs and would not have liked to be observed when they were engaged in such work.

But the most compelling reason for adopting interviews for data elicitation was the nature of expected data. This research aims to understand context as viewed by an informant and this was possible only if those participants guided the researcher into their worldview. This would reveal the way she/he sees digital-library use, and the language she/he uses to express that experience. Such views, based on the personal experience of the participants can only be captured when the participants speak. The words and their meanings attached to digital-library use by those scientists were important, and not the precise way in which they conducted their searches. Nonetheless, during the interviews, occasionally participants were requested to show how they do a specific job. Those activities were necessary for the researcher to understand the meaning of some of their actions. Such observations also led to some more questions. Some participants were comfortable and acceded to the request. Some scientists did not give much importance to such requests.

The second design issue was mitigating the chance of data corruption. Interviewing as a process can be prone to data corruption depending on the stand taken by the researcher. Close and informal interaction between the researcher and the participants may create some pressure on the interviewee. This may lead to form an image of "ideal self" or "good researcher" in the mind of participants. Out of such imageries, some interviewees may tend to give exaggerated data or idealized data (Barry, 1995). This can happen if the point of departure is the assumption, on the part of the researcher, that participants are using digital libraries when in reality they may not. Such an assumption on the part of the researcher could have resulted in questions directly on the use of digital libraries or referring to digital libraries. This could have been counter-productive.

In today's technology-laden world, any revelation of not using a common technology by a highly educated person may put her/him in an uncomfortable position. Any direct question on DL use may inadvertently create an image of an ideal person in the informant's mind. The informants might have then been tempted to exaggerate their DL use. They might have reported what ideally should be done and not what they do in reality. This would have resulted in corrupted data. In the research method that was adopted in this study, it was important that the informants of the study give their account uninhibitedly, without a feeling of being considered inferior if they did not use DLs in their information-gathering activities, for whatever reasons. Hence it was a conscious decision of the researcher, at the methodology level, not to make any utterance on digital libraries.

This methodological risk was tackled by framing the research question. The purpose of a digital library is to look for information. Thus the research question RQ#1 was framed in a way that information-gathering practice which may or may not lead to digital-library use was foregrounded. There were two assumptions behind framing questions in this manner. The first assumption was that if context does not drive one to information gathering, then DL use does not relate to the organizational responsibilities that make up the social context of an informant. The second assumption was that even if information gathering is practiced by informants, there may be competing resources, other than DLs. By handling this methodological risk through the research question the researcher was relieved of having to conduct the interview with the assumption that the informants did use DLs.

Further care was taken while asking the questions. The informants were gradually directed to the questions on digital-library use by making it a natural part of conversation. No question on whether they use DL was asked. Rather they were drawn into the discussions of their research programs, exploring what they are concerned about in various stages of the research. In the middle of such questions, a light probe was made on what kinds of information were useful during the specific stages of the project under discussion. Only after they started speaking about their information-gathering practices, the direction of the dialog was oriented towards the resources from which they obtain the required information (It was not only the questions that were crucial, but also the non-judgmental way those questions were placed that was important. The researcher did her best to control voice and gesture, not to express any surprise even when she heard something awkward, and asked the questions on information requirements in the most unobtrusive and un-evaluative way possible).

It was also important that they considered me as a researcher and not a librarian who would help them with resources. This prevented the interview from digressing into discussions towards the performances of the libraries in terms of electronic resources.

3.4.4.2 The framework of the interview technique adopted in this study

After deciding that interview would be the primary mechanism for data collection, additional precautions were taken to avoid data corruption. In section 1.5.1, it was mentioned that this research aimed to be based on model of action that had a methodological implication. The implication was that informants would be required to make visible their actions through descriptions. On the other hand, the risk of open interview is that participants may often speak of an ideal situation or rationalize/theorize their actions. In order to understand the meaning that participants attached to digital-library use, which takes place due to actual use, it was essential to capture their experience and not what they believed should have been done. Besides, it was important to encourage the participants to describe and not to provide just “yes/no” types of closed answers. Thus it was essential that participants would tell stories of their digital-library use and not make suggestions about it. To meet all these requirements, the interview was conducted by adopting certain techniques of phenomenological framing and an ethnographic style of interviewing.

Phenomenology, in qualitative inquiry, is a term pointing to interest in understanding a phenomenon from the actor’s own perspective and describing the world as experienced by those actors. The underlying assumption is that the reality is what people perceive it to be (Kvale & Brinkmann, 2009). Such an approach is termed as “phenomenological interview” (Thompson, et.al., 1989) and described as a stance of qualitative research (Cope, 2005). No assumption is made about what is not real; rather descriptions of phenomena begin with how one experiences things. The aim of phenomenological inquiry is to understand the subjective nature of "lived experience" from the perspective of those who experience it by exploring the meanings and explanations that individuals attribute to their experiences. As Cope (2005) described "*one of the defining features of phenomenological inquiry is that it is firmly located in the context of discovery rather than the context of justification*". An interview guided by a phenomenological frame situates the informants in their experience and thus helps to avoid any possible theorization by them. This can be attained by always raising the question in the form of "how did an incident help in a situation." By emphasizing "help" and not "why" facilitates avoiding any theorizing or producing any ideal response. The questions were always asked with reference to their ongoing projects – no question on ideal situations was raised. This was expected to help contain the chance of data corruption. Some of the guidance given for placing the questions in the interview (Thompson, 1989) are summarized in Table-5:

Table 5: Phrasing of questions in phenomenological interviewing

Forms of question that are not accepted	Accepted forms of question
What does this symbolize for you (theoretical and abstract? "why" question or "what caused you" question because it leads to rationalization	Can you tell me about a time when you (about a specific experience)? What was X like?How did you feel?. Can you describe a time when you were (a state as told by the respondent)? Can you tell me a time when you did this?

The experience of the participants is the main source of information in phenomenological interviewing. Such experience is, however, expressed through the language of the culture to which the participant belongs. Language is a means for communicating and also a tool for constructing reality. Ethnographic interviewing is a way to capture the language of people belonging to a certain culture. Culture here does not mean a specific race or nationality for instance. Each profession/trade has a certain culture.

The objective of an ethnographic interview is to facilitate the interviewee to link an incident to his own experience so that the researcher can infer what that incident means to the interviewee. To encourage interviewees to speak and not to answer in a closed fashion (for example, “yes/no”), ethnographic interviewing suggests that the purpose of the research must be explicitly revealed to the interviewee, questions should be repeated, researcher must express interest by repeating what informants say, express ignorance so that the participants are encouraged to show what do they think about an object, details must be asked and full form of any abbreviation must be asked. Questions should be of various types and depth and a shuffling of grand tour question, mini tour question, example question, experience questions, and native language questions, structural questions and contrast questions. Particularly, participants must not be asked the meaning of any incident/example and always asked for an example – thus reducing the chance of closed answer (“yes/no” type) (Spradley, 1979).

The interview process in this research was framed using these valuable guidelines from both phenomenological interview and ethnographic interview. For example, when an informant was drawn into a discussion of information-gathering practices using the digital library, she/he was asked for an example of such use. As the informant described her/his own situation of preparation before going to a review meeting, the researcher asked how that information gathering was helpful. This not only situated the informant with a real life experience but it was also possible to see her/his world. For example, it emerged that often information-gathering before a scheduled meeting with peers was not merely an action for collection of information, it was a way to establish herself, with her/his peers, as an equally knowledgeable person – information-gathering practices and digital-library use under those situations becomes a tool for establishing the scientist's identity.

The interviews within the phenomenological framework and using ethnographic technique were conducted in an unstructured fashion. The unstructured interview method helped informants to speak in an uninhibited way. Informants were drawn into a conversation by which they could express their concerns and their own way of looking at digital-library use or non-use. An unstructured interview was adopted to support building discussions on any new issues that emerged and that seemed relevant to the study.

As individuals are quite likely to differ from each other in terms of expression and speech acts, an instrument for such unstructured interviews is required that can adjust according to the situation. Thus, the researcher as the "human instrument" poses such questions in the identification stage as, "What is this?" "Who is that?" and "What is important here?" which lead to identifying or naming a phenomenon (Miller & Crabtree, 1999). Adjustment can be made by dropping a question if the answer was already offered or putting forward more probing questions if a lead to another direction is found. Only the human instrument can do this job.

There were three operational characteristics of the actual interview process. First, the initial plan of interview was changed partially. Second, the actual flow of interview process sometimes differed for a few informants. Third, there were several issues that emerged after the interviews of a few scientists were completed. These characteristics and necessary adjustments are discussed.

The original plan of open ended unstructured interview was changed to partially guided, semi-structured interview. Better time management was the reason for this change. Many of the informants in this study were at very senior levels and had extremely busy schedule. They agreed to speak for about an hour or so. While some of the informants started talking in an authoritative/assertive voice without giving the researcher much opportunity to place the cues for the questions, some scientists were often found to be easily engrossed in talking about their findings, achievements, even frustrations and thus consuming a lot of time. At the same time, information-gathering activities did not easily emerge from their discussion. Many of them did not see using a digital library or information-gathering activities as a separate process to recognize and mention. This unconsciousness of scientists about their information gathering activities made the interview process too time consuming to orient the direction of the interview. To overcome this problem of time management, guided and semi-structured interview technique was adopted. However, the process was maintained as open-ended as much as possible. The researcher, to start with, prepared a list of issues for discussion. After the initial ice-breaking session with the informants, those issues were placed before an interviewee one by on and discussion on each issue started.

The actual flow of the interview process was adjusted for some of the scientists. This means either the starting point of the interview was not same for all scientists or the same question was placed before some scientists differently. Change of sequence of placing questions was done in order to maintain an ambience of discussion in which the informant was given importance and to instill a faith that her every utterance is important. For example this researcher got a chance to be introduced to one of the informants much ahead of the scheduled interview. In that informal talking, the scientist commented how information has become important for his everyday work. During the actual interview session which took place a few days later, the researcher, instead of starting the session with regular formalities and with questions about the type of research done by him, opened the session by referring to the discussion on information that took place in the last informal meeting and discussion started. By giving importance to what he told in an informal meeting helped in (i) developing a trusting relationship with the researcher by giving a signal that the researcher was attentive to the comments made in the earlier informal meeting (ii) situating him immediately in the context based on which he made such comments. In this and similar other interviews, the informant was guided to the other issues at hand later. Thus, even though the sequence of brining issues was different for different informants, all issues were placed before each of them.

There were also occasions when the questions were placed before different scientists differently. For example, if the flow of discussion brought a listed issue spontaneously by the scientist, he was not asked the same question afresh – rather a verification question was placed by repeating some of her statements and she was asked whether the researcher understood her correctly. One example of such variation was the question related to different types of projects conducted by the organization and the informant’s involvement. After a few interviews were conducted, the types of projects that are conducted within the organization became clear. A list of all such project types and their characteristics, as understood by the researcher, were listed. Next scientist, instead of being asked on various project types of the organizations, was offered what the researcher prepared on various projects and was asked whether the understanding was correct, whether the researcher missed any other types of research that the current informant is involved with, whether the informant was participating in all those types of projects and so on. This is also an example of in-process member check that was administered to maintain trustworthiness of the study – an issue discussed later. This process helped in saving the time as well as either to confirm or expand any list of themes in iterative way.

Another characteristic of open ended interview is that an issue might have emerged at a later date in the process of data collection – at a time when several interviews were already conducted. An example will be helpful to elucidate this aspect. The theme that information gathering activities help to build identity of knowledgeable self while a scientist is facing an audience in a face-to-face meeting emerged after a few interviews were conducted.

All such newly emerged themes were always checked with the themes that already emerged. Interview transcripts were re-read to check if there was any indication of such themes in earlier transcripts. If the theme appeared to be new, it was noted. In the subsequent interviews the researcher remained alert and if that theme was not forthcoming, a light probe was made at the end of the interview. For example, on the issue of risk of accepting of unawareness about a piece of information in front of learned audience (Identity – knowledgeable self), in a face-to-face meeting, a question as below was placed before subsequent interviewees:

Me: *one scientist said that it is important for him to know relevant information as much as possible, before he speaks before an audience. He thinks it is very embarrassing if someone from* *the audience refers to some information that he never noticed and asks him to react on that. He said that regular information gathering saves him from such situation – how do you see this situation? Is it really so important to be ready with information by a scientist before she/he goes before an audience*?

This question had several features. By uttering "one scientist", the informant was assured that it was not the opinion of this researcher about what a scientist would do and did not hurt his ego. Second, by mentioning "one scientist" and not "many scientists" helped not to create any pressure on the interviewee to agree to what is being told by many. Third, by asking his opinion on that situation gave him superiority – the interviewee was free to say that it may be the problem of that individual scientist. Surprisingly all scientists came forward in support of that view and narrated more on this theme. One scientist even said that he cannot claim himself as peer if he does not know something what others in an audience already knows.

Themes forthcoming like the above, not only strongly supported the theme, but it also helped to build the larger picture which is one of the objectives of the inductive content analysis through constant comparison. At this point it did not matter that earlier participants did not talk on this theme. In fact, by the time the last scientist was interviewed, the themes were almost saturated. No new themes were forthcoming.

There were, however, a few instances, when a theme emerged from the interview of only one scientist. All such instances are discussed with educated guess in Chapter 8.

Thus it was possible to strike a balance between two aspects – to manage each interview within the scheduled time and also to situate the informants within an information environment so that the conversation could be anchored around themes that are relevant to the research questions. The "guided" nature of the interview helped the researcher to draw the conversation surrounding the themes that were likely to yield usable data, though the sequence in which those themes would be discussed varied from one informant to another depending on the point of entry into a conversation. At the same time, it was still an unstructured interview – the researcher placed open-ended questions prodding the informants to speak about their experiences, and their opinions about their use of digital libraries.

The language of the interview session was another concern. Native language is an important aspect of the ethnographic interview. India, where this study was conducted, has nearly 30 different languages. For the purpose of comparison, all the interviews were conducted in English.

As it will be demonstrated later, the findings vindicated the soundness of the interviewing technique. Informants revealed clearly when they prefer non-digital information sources over digital resources. The picture of digital libraries that emerged was a melting pot of various resources, Internet/Google search engines, specific journal websites, expensive resource such as Scopus, and free search engines such as *Pubmed*. Some could not even remember the name of the resource but the way they described the use left no doubt that they using digital resources. Overall, participants made direct statement about using digital libraries by describing how they use keywords while searching or their use of electronic content-alert services from various publishers. There were also frank admissions that some scientists either did not consult *Web of Science*, a very expensive resource, or were not aware of its features. The more interesting finding was that most of the scientists connected *Web of Science* to finding the impact factor of journals and never used some of its important features such as citation chaining for information gathering purposes. In sum, the elicited data stands as proof of success of the strategies adopted in data elicitation.

3.4.5 Data reduction and analysis

After the interview is over, the interviewee or participant of the study leaves the scenario. The onus is now on the researcher to interpret the meaning of the interviewee's experiences as captured through the interviews. The researcher serves as an instrument at the data-analysis level. Data reduction is the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in field notes or transcriptions. Though in formal research reports these steps are described separately, data reduction and analysis takes place throughout the life cycle of a qualitative study. In addition, data reduction forms a part of the data analysis. As an analytical process, data reduction sharpens sorts, focuses, discards and organizes data to facilitate drawing final conclusions (Miles & Huberman, 1994).

At this stage, the researcher poses such questions as "What is going on here?" "What is the nature of the phenomenon?" "What are the dimensions of the concept?" "What variations exist?" and "What meanings/practices occur in lived experiences?" In the explanation stage, the researcher establishes associations of phenomena by addressing questions such as "What is happening here?" "What pattern exists?" "How do phenomena differ and relate to each other?" and "How does it work?" (Miller & Crabtree, 1999).

There were three issues of concern at this stage. Those are: (i) The choice of a tool for data reduction and analysis – inductive content analysis; (ii) preparing the data for analysis; and (iii) coding. These issues are discussed in this section.

3.4.5.1 Inductive content analysis – a tool for data reduction and analysis

Data analysis is the process of reducing the data to meaningful accounts. Content analysis is the most frequently used tool for the data -reduction process for qualitative textual data. One of the various forms of content analysis, as found in the literature, is qualitative content analysis that emphasizes an integrated view of speech/texts and their specific contexts. Qualitative content analysis aims to examine meaning, themes and patterns that may manifest or be latent in a particular text. It thus helps the researcher to understand social reality in a subjective manner (Zhang & Wildemuth, 2009). This research used qualitative content analysis for data reduction and analysis.

Qualitative content analysis, which was developed in order to explore the meanings underlying physical messages, is mainly inductive, grounding the examination of topics and themes, as well as the inferences drawn from the data. This technique is also used to generate theories. Samples for qualitative content analysis usually consist of purposively selected texts which can inform the research questions being investigated. Descriptions or typologies, along with participants' views of the social world are the outcome of qualitative content analysis. Thus it is helpful to understand, by both researcher and the reader, the perspectives of the producers of the text (Berg, 2001).

A distinction has been made between two types of qualitative content analysis (Hsieh & Shannon, 2005). One is conventional qualitative content analysis in which coding categories are derived directly and inductively from the raw data with an aim to developing grounded theory.

The other is directed content analysis, in which the initial coding starts with a theory or relevant research findings. Themes emerge from the data and are used to validate or extend a conceptual framework or theory. The current research aligned more with directed content analysis as it used a theoretical lens to raise the research questions brought to the analysis. However, the process did not use any existing typologies. All themes were developed inductively from the text of the transcription.

Deciding on the unit of analysis is a prerequisite and fundamental job for any coding task (Weber, 1990). It is the basic unit of text that is to be assigned a category during the process of content analysis. Unit definition can affect coding decisions and the comparability of outcomes from similar other studies (De Wever, et.al. 2006). The emerging themes were of interest in this study and hence they were considered the units of analysis. A theme may be attached to a single word, a phrase, or any chunk of the text. When using themes as the coding unit it is the expression of an idea which becomes the focus (Minichiello et al., 1990). Accordingly, during the analysis process, a theme was attached to a chunk of text so long as it was sufficient to represent the theme.

Though the analysis started with inductive coding, after a few transcripts were coded and generated codes were reconciled in terms of definition, the existing codes became a starting point for analyzing new transcripts. At that point, analyses were done by both deductive and inductive mode. The iterative process of coding and selecting a new sample is summarized in Table-6.

Table 6: Data Analysis and Adjustment in Research Design

Findings from data analysis	Changes to be made	Effects take place
A new clue, a gap is discovered, or a bias is sensed	Guiding questions for interviewing will be adjusted	Data collection level
Specific relation between categories are found	A negative case to be searched to understand if and under what condition that relation can be falsified	Informant level - search for an informant (theoretical sampling) who may work as negative case
A specific organizational context and its effect on digital-library use	A different organizational context will be searched for to account the differences in organizational context	Organization level - search for an organization which is different from the earlier one (theoretical sampling of organization)

This approach to coding was complemented by the *constant comparison* technique. Constant comparison helped either to expand the properties of a code or to include a new code. Constant comparison was applied at several levels – between two informants from the same organization, and between two informants from different organizations.

3.4.5.2 Audio records to text – data preparation

For the most part, the entire audio records of all interviews were transcribed verbatim. There were, however, exceptions. Occasionally, during the process of the interview, scientists described the scientific theory of their work in too much depth. Sometimes, in the process of describing how important their job was, they gave a very detailed account of the experiments conducted by them. Verbatim transcriptions of such theoretical descriptions and laboratory experiments were omitted. In the transcription record, a note was made, in such cases, indicating that the audio in that part dealt with scientific theories and processes.

3.4.5.3 The coding process

As the researcher did not have access to any content analysis software, the coding task was accomplished manually with the help of spreadsheet software. Each block of text to be coded was tagged with an identifier, which was a combination of the code for the organization, a code for the interviewee, and the block number. On the transcription document, each such block was marked with the identifier and all codes that could be assigned to that block. Finally, each identifier and its associated codes were transferred to a spreadsheet and the necessary sorting and merging were done.

Demarcating each block of text for coding was a little problematic. Ideally, text could be broken based on turn-taking between the researcher and the interviewee. But, these interviews did not work in such a balanced way. This was because in the unstructured/semi-structured interview process, interviewees were encouraged to speak more and the researcher controlled her speaking to a bare minimum. The discussion, most of the time, did not follow a linear path. Participants, in the middle of discussing one issue, referred to another related issue and switched over to that issue. After some time, they were urged back to the original issue. Thus, the interview did not always have enough continuity to chunk the text following a turn-taking strategy.

Coding was done through several passes guided by the theoretical lenses adopted in the study. For example, the first pass was guided by the theoretical construct *social actor*. Every action of information activity mentioned by an interviewee was marked and followed to locate the external entity triggering that information activity. Those external entities were coded. In another pass, those informational interactions were further examined to understand the kind of information demand made by the external entities and how the interviewee was describing her/his experience of information activity in response to that information demand. The nature of information demands and the interviewees' view of their information activities were coded. In subsequent passes, which were guided by the concept of technologies-in-practice, the use of digital libraries in terms of resources and features, and the factors leading to such uses were coded.

Constant comparison, leading to the discovery of the whole picture from its parts, is an essential characteristic of inductive content analysis. Codes generated from two transcripts were reviewed and compared and the necessary level of abstraction was adjusted. After a code list was generated from the first two transcriptions, the text was again read to adjust in coding. Thus the entire process went through cyclically. After all transcriptions from one of the organizations were coded, the same was repeated for all transcriptions from the other organizations.

3.5 Lessons learned from the pilot study

As qualitative field research involves human beings at various levels, it may meet some unexpected problems while conducting the study. The problem areas may be one of getting entry into a site, getting access to documents and/or individuals, the mode of interview, the interactions with the informants and many other considerations. Hence it is always helpful to conduct a feasibility/pilot study before the study starts in full scale in order to check the problems and think, beforehand, how to minimize those problems. To this end, a pilot study was conducted with an objective to assess (i) the difficulties in getting access to an organization (ii) the difficulties that the researcher would face during the actual process of interview.

Gaining the trust of the participants is very important and having a common acquaintance in each organization was found to have worked successfully. Scientists are very busy organizational members as most of them, apart from their research; have to serve on several committees within and outside the organization. Thus the common acquaintance could help initially to get an appointment date.

In addition, the way this research was conducted was unfamiliar to the scientists. They expected a questionnaire to which they could respond with some thought. The initial discomfiture of the participants of the pilot study made the researcher aware of this issue. As a result, during the actual study, the introductory sessions were conducted carefully to convince the participants of the reasons why an interview in the form of mutual discussion and not a questionnaire was helpful. It was also important to make them understand the topic of the research in their own language and how their participations were important.

It is also during the pilot study the benefit of a guided interview, rather than a totally unstructured interview, was realized. Both during the pilot study and later too, it was found that scientists are excited to talk about their experiments, research, and so on. As the flow of talk went in that direction, the interviewee would neglect talking about the information-gathering related question. Because of this, it was decided to conduct interviews in a guided manner. As an aside, the interviewee in the pilot study and several others during main study confided to the researcher that they enjoyed talking and it was a new experience for them.

The most difficult part of the interview was to make the participants see their information gathering as a task of its own. Asking any question about when they engaged in information-gathering activities, the typical answer was “always.” Since information gathering as a process has been so internalized by them and nowadays is a private activity not requiring them to go to the library, it is very difficult for them to see those activities separately.

3.6 Some other related issues

Annual reports, newsletters, websites, and vision documents of the organizations were also examined by the researcher. The researcher also searched for any public documents in which policy regarding digital libraries or electronic resources was recorded. No such document, however, was found. None of the documents consulted gave any special attention to this resource. For example, annual reports routinely mentioned the expenditures of the library including electronic resources. However, from the websites of both organizations it was clear that resources are made visible to the users. Those documents were not conducive to any further analysis for the purpose of triangulation, but they were very helpful in understanding the sites. A discussion of this will be presented in the next chapter.

In fact, as the research focus was on the experience and meaning that participants attached to their use of digital libraries, and not on any process flow, documentary sources cannot serve the purpose of triangulation. Triangulation was partly achieved through constant comparison when either two themes were collapsed or a new theme emerged from two different transcripts.

Another strategy was employed during the process of interviewing that partly served the purpose of triangulation. After covering nearly half of the sample, some summary statements were constructed out of some of the key themes that had emerged up to that point. During the succeeding interviews, at the end of interviews, the participants were presented with such statements and were asked to give their opinions or views on those statements. Participants enthusiastically responded and gave their own examples in support of their agreement or disagreement. This process was further extended to conduct a Delphi-like study which is reported at the end of the document.

Though inductive content analysis was used for data analysis, the purpose of such analysis was to help in discovering categories and their relationships – characteristics of a research obeying the principle of emergent design. Hence inter-coder reliability, which is used to establish the strength of codes when a codebook is deductively applied to a body of text, was not used in this study. What was important was to validate whether the researcher identified an event correctly and arrived at the categories without any bias. One of the ways this could be achieved is to make another researcher present during the process of interviewing and subsequent coding. However, this being dissertation research, such a process of validation could not be adopted. The alternate way which was adopted here was to connect with another researcher. Regular weekly meetings were held with her. She examined and commented on various decisions regarding arriving at codes. This arrangement also met the criteria of peer *debriefing*. *Peer debriefing* is the process of exposing the thought process of the researcher to a disinterested peer. The process helps the researcher: to remain honest by allowing her biases being questioned; to test any emerging hypothesis; to develop and test subsequent steps; and to clear the emotions and feelings that may inhibit the judgment (Lincoln & Guba, 1985).

3.7 Chapter summary

This chapter presented the research paradigm, namely qualitative and naturalistic study, adopted in this study and the rationale supporting this decision. The relevance of two important methods – case study and field research – in the adopted research paradigm was discussed and it was argued why this research could be considered more as a case study than field research. The details of the research design included the process of case selection, sample selection, methodological details of data-elicitation techniques, and data reduction and analysis techniques. The transferability of findings of a naturalistic study to another setting is important and the chapter ends with an account of the attempt towards establishing the transferability of the findings of the current study.

CHAPTER 4: STUDY SITES

4.1 Chapter introduction

This research set its objective to examine how organizational and social contexts shape the use of digital libraries and whether differences in the practice of DL use can be attributed to the differences in those organizational and social contexts. To this end, the research questions were: (i) What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes engage in meeting the demands of their social world? (ii) How do information-gathering practices help those social actors meet the institutional forces of those interactions? (iii) What are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level? (iv) How do different extra- and intra-organizational factors contribute to such practices?

In order to find out answers to these questions, followings issues were looked at:

- What are the components of the contexts of the members of an academic and research organization?
- What are the institutional natures of those components?
- What kind of information demand is made by those components on organizational members?
- How does information-gathering practice help those organizational members in meeting such information demand?

- In the process of consulting digital libraries, in order to support such information-gathering activities, what are the properties that are visible to those organizational members and are used recurrently? and
- What contributes to make some properties more visible than others?

These research questions were framed with the intention of developing an account of the context of digital-library use. It was thus necessary to develop a boundary surrounding digital-library use. This boundary was to serve as the context of use. This process of observing phenomena within a boundary is referred to as case study (Yin, 1994). In this study, this boundary or the context was operationalized as an organization. The scope of the *organizational and social context* was restricted, in this study, to academic and research institutes in India. As discussed in one of the previous chapters, selections of organizations/cases were achieved through purposive sampling. This study required that selected cases must have access to digital/electronic collections adequately and must be well equipped with ICT infrastructure[18] to make those resources usable by the members of the organizations. As a multiple case study, two organizations were selected for this purpose.

In order to observe variations or similarities in digital-library use, the organizations were chosen to be sufficiently different from each other. ORG1 and ORG2 were selected as two cases that differ from each other with respect to the field of specialization as well as type of organization. A field of specialization is a recognized area of scholarly activities. The role of disciplinary differences or field of specialization in various information practices is already discussed in the

[18] ICT infrastructure includes primarily Internet connectivity, local area network within the organization, computers etc. which are required to access data residing on a server – within or outside the organization.

literature. The field of specialization of an organization makes it different from an organization of another specialty. However, in order to make the findings comparable, there should be some similarities between fields of specialization selected for the study. Hence, two applied fields, one in the area of heavy industries and the other in the area of biotechnology were chosen. In addition, the difference in context was also accentuated by selecting different types of organization.

ORG1's specialization pertains to heavy industries that handle minerals, metals and other non-organic materials. As quite a few informants described, some parts in this area of specialization have become very conventional and this discipline now devotes itself mostly either to developing processes that can lead to better quality of materials or to developing new materials that can be used by other industries. Better quality materials can support operations of large existing industries such as metal industries, power industries, construction industries where quality of material in the infrastructure/equipment can contribute to the operational cost. The second area is more challenging. Not only is the applicability of new materials but also finding the areas where new materials will be applicable is a big task for the researchers in this organization.

ORG2 was selected as it contributes to the area of Biotechnology. Biotechnology is a comparatively new discipline with tremendous potential for contributing to more pressing demands of society such as food, medicine, and so on. New drugs, new genetically developed plant seeds are examples of such items. Biotechnology as a discipline was also selected in order to be able to compare the findings with the literature (Lamb & Kling, 2003). Choosing Biotechnology as discipline of research in an academic and research organization enabled comparing the findings from an academic and research organization to those from an industry.

Structurally, ORG1 and ORG2 are quite different, though both can be labeled as government funded organizations. More details about the relation between government funding and these two organizations are given in the following sections. The precise structural difference between these two organizations is that ORG1 is mandated to work for industries and to produce income for self-sustenance while ORG2 has no such mandate and pursues research in developing basic understanding of the field. The mandate for ORG1 has an implication – it is supposed to do research that has value to industries within and/or across countries.

The eliciting of the context is the result of a combination of information gleaned from the public domain documents such as annual reports, newsletters as well as the information emerging from the interviews conducted with scientists, librarians and officials in charge of the ICT infrastructure of the respective organizations. It is worth mentioning here that official public documents provide dispassionate important facts about an organization. Though such facts are important to understand the organization, its members' views are equally important in this regard. Discourse of the members can reveal, as we will see, many interesting aspects of an organization.

The following two sections portray both the organizations selected for the study in terms of history, evolution, and administrative structure. Though the case study method focuses only on current phenomena, a historical perspective of any organization helps to understand how it has been evolving over the years. The following sections examine how the evolved organizational policy connects the scientists of these organizations to external interactions. Each of the following sections has been structured as: brief history of formation and evolution, current governance structure, and how the scientists view their organizational activities. These descriptions help understand the activities of an organizations. Further the ICT infrastructure, library and digital library facilities of each organization are described.

4.2 Organizational view of ORG1

4.2.1 Brief History of ORG1

ORG1 is devoted to the research pertaining to the development of non-organic materials, including minerals and metals. Its research areas align with those of heavy industry. It was set up with a view to make the country self-sufficient with technologies that require the use of these materials.

4.2.2 Governing structure of ORG1

ORG1 is governed and controlled by the Government through an appointed agency. The policy, staff structure, salary structure of staff and almost all organizational rules are controlled by the government. All organizational level policies originate from the government and are implemented at ORG1. While implementing some policies, ORG1 adds its own perspective.

ORG1, locally, is governed by one research council and one management Council. The research council comprises external experts from industry and academic institutions as well as the head of ORG1 and some of its scientists. The management council is comprises the head of ORG1 and its scientists. While the research council guides ORG1 in intellectual activities, management council looks after the administrative aspect of the organization.

4.2.3 Evolution of ORG1 over years

ORG1 has evolved and changed greatly, in terms of research policy, over the years and was still found to be changing while the interviews were being conducted. While documents such as the annual report provided a factual account of the growth of the organization, the evolution over this period, as viewed by the organizational members, could be captured from informants' accounts. The interviews in ORG1 were conducted first in 2009 and again in 2012. As a government service holder in India normally retires at the age of sixty, there was no one found in 2009 who joined ORG1 in the late sixties or seventies and could talk about the organizational policies of earlier days. There was, however, one informant who joined the organization in the early eighties and could describe, from his memory, how the organization used to be prior to the mid-eighties. In addition, several informants referred to changes they had witnessed. From these interviews it could be inferred that ORG1 continued, since its inception, under one philosophy until almost the mid-eighties when the winds of change started blowing. In fact the impetus of such changes was so great that issue returned time and again in the interviews of almost all informants.

Before the mid-eighties, ORG1 was a typical government organization in the sense that the government used to bear all its expenditures. It also paid for the research done in the organization.

> *" earlier in 80s we were not much bothered about sponsorship project – not much of such projects – <govt> itself was giving almost all the funding – and at that point of time, I think even if you go – prior to 80s – <govt> used to fund 100% for development of*

> *technology – from bench scale to the large scale even pilot plant scale – all funding from <govt> – hardly any funding other sources” – ORG1-SCT3-01.*

Those research projects were based on, most probably, issues decided by individual scientists. There are frank admissions that in those days there was not much accountability on the part of ORG1 scientists. If the research was brought to the organization, it was carried out, but scientists themselves never took any initiative to bring in projects.

> “*one thing that has happened over the years. . if you think of last fifteen years and it has intensified thru the last 6-8 years . . there has been lot of pressure to take of lot of projects with the purpose of earning money and also delivering good scientific output . . if I compare with the situation when I joined 18 years ago, ... , there was not much pressure on senior people to deliver projects within time to earn money . . . the feeling was that the jobs will come. . . . jobs will be obtained by the Director or the government or people who are interested in getting the jobs. . . it will automatically <**come**> to me. . if it comes, I will do. . if it does not come I do not have to look for it*” – ORG1-SCT7-01

Major changes, in terms of policies, started taking place in the mid-eighties when government funds started dwindling. The current policies of ORG1 are mostly within the frame that started in the mid-eighties when government began cutting funds. After paying the salary of the employees, the remainder was hardly enough to conduct research or install facilities for conducting research. At that time, government initiated a policy which had two major aspects, namely, revenue generation and career advancement. Emphasis was placed on generating revenue by ORG1. The idea was that ORG1 and similar organizations must earn a third of their annual revenues from external sources. It was not that ORG1 was not earning anything at that time, but setting the target at one-third of annual revenue was quite a high standard to achieve in the mid-eighties. This implied that ORG1, in order to sustain its research activities, must find resources on its own.

The other aspect of the new policy was linking career advancement to various activities, including publications. From the mid-eighties, importance was placed on the productivity of scientists in terms of number of publications. This productivity was reflected during the annual assessments. Emphasis was placed not only on the number of publications but also on the quality of the journals. The notion of “impact factor” of journals, as a measure of quality of journals was introduced. Table-7 shows a decade-wise journal publication pattern by ORG1 scientists.

Table 7: Publication Pattern of Four Decades – an ORG1 picture

Time period	No of publications by ORG1 scientists			
	House journal	Indian journal	International journal	Total
1970-79	154	14	34	202
1980-89	69	51	61	181
1990-99	142	53	358	553
2000-09	218	61	864	1143

In addition, Table-8 provides an idea on the volume of publication on every 10th year, starting from1976.

Table 8: Distribution of publication of ORG1 scientists on every 10th year

Publication year	**No of publications by ORG1 scientists**			
	House journal	Indian journal	International journal	Total
1976	16	0	2	18
1986	7	2	7	16

Publication year	No of publications by ORG1 scientists			
1996	17	5	39	61
2006	13	6	112	131

It is evident from the Table-7 and Table-8 that the number of publications in international journals started rising from the late-eighties. Considering several factors such as (i) publication in journals is always time consuming since there are long wait-lists and such time was far greater in non-Internet days; and (ii) ORG1 could not afford to buy many international journals because of the lack of funding in the late eighties to nineties, it can be inferred that the new policy certainly had a correlation with the spate of publication in international journals. During this period, stress was also placed on patent filing, which was linked to career advancement.

When external environments change, someone is required within the organization to implement those changes. Along with the external changes occurring outside ORG1 in the mid-eighties, internal changes happened through a newly appointed young director who brought many new ideas and attempted to implement those ideas not only in research but also in the regular administration of the organization. He started recruiting young scientists (at the time the average age of scientists was quite high) and attempted to bring funds from other organizations for research. Those scientists who were appointed during his tenure still fondly remember the way he brought new ideas to ORG1.

"…in the mid-80s and beyond – that was exactly the time when <name of the Director> joined – and so after he joined, slowly the perspective changed – and by that time we already had certain technology . .. but then putting up a plant and developing technology are two different ball games – but then <the Director> was able to push thru development and there were takers . . we

transferred this technology to a party. ... and that was the time when the change in policy of <govt> – the interaction with entrepreneurs, industry and even gov't funded agency started – when you were supposed to get the funding .. .. but then slowly this approach was propagated by people- there were takers – in fact – since then we started getting a lot of funding from gov't sector as well as private and if you just look at the present – perhaps 30-40% funding which we are getting today thru from primary source" – ORG1-SCT3-03/05

Looking through the eyes of the ORG1 scientists in 2009, the evolution can be summarized as:

- Until the mid-80s, ORG1 was not asked to generate revenue;
- Even after the new change was introduced, the culture of passivity to bring funds remained for a long period. Now, scientists at all levels except entry level, are engaged in bringing funds through research projects;
- The majority of external sources came from other government agencies beyond CSIR.

Over time, the dependence on government funding has been reduced, though even in the beginning of the change, bringing projects and funds were the Director's responsibility. This culture, of course, started changing within the organization. New scientists joining ORG1 were given some support initially but were also told to bring their own funds without which it would be difficult for them to sustain their research activities.

> "*in today's scenario – if a scientist does not have his project of his own, perhaps <ORG1> may not be able to support his travel all the time – we have understanding – we are funding each to go once for a seminar – if anyone wants to go more, we say sorry you have to have your own finding – that is the kind of pressure.. pressure to the people…..– limit to govt funding – if we have to go and flourish then you have to have your own purse and use the money from that purse and go ahead*" – ORG1-SCT3-11

Over a period of time, the internal culture of ORG1 changed to such an extent that currently all scientists, except those who join at junior-most level, compete externally for bringing project and funds.

> "*I think in last 8 years it has come to a state when all scientists, even at junior level. . <mentions the ranks of junior scientists> may not have that pressure in terms of obtaining or interfacing with the outer world… but surely ..<mentions the rank of senior scientists> onwards are expected that they will interface with the outside world and obtain funds*" – ORG1-SCT7-04

This certainly had another effect. Contrary to earlier times, when only the Director or senior-level scientists were getting recognition, recognition started percolating down to lower level scientists too.

> "*last ten years we are much better recognized. . individual scientists are better recognized. .. thru awards, recognition than they were in nineties. in eighties or nineties, only directors were recognized nationally . . now there are quite a few people who are now nationally and even internationally ..*" ORG1-SCT4-05

Government funding still remains a major source of revenue of ORG1. However, that source is no longer guaranteed. ORG1 scientists now go to various government agencies that fund projects. Mostly those projects are of three-year duration and with moderate financial support. Some apex body of the Government of India also fund projects but those projects are mostly very large and require networking or the participation of more than one organization. Such projects result in building up research facilities in terms of equipment, laboratory, and so on, in ORG1. In industrial research, an organization can certainly carry on research, provided it has its own facilities. Several informants confidently declared that the infrastructural facility in the organization now is one of the best in the world, and when such facilities exist, research offers are bound to come to any organization.

> *"..and that is a very major. . . .probably most important difference. .nineties we did not have funds. . because there is lot of funding there are lots of facilities. . we have best characterization facility in the world. . forget about India. .if there are facilities, researches should come "..* ORG1-SCT4-09

Simultaneously, throughout this period, ORG1 served industries in a very specific way. One of the ways is to conduct various tests on behalf of other industries using various organizational facilities. The other way is to solve specific problems submitted by individual industries. These two types of projects generated a good amount of funds. At the same time, scientists also interacted with industries in a different way. Scientists were participating in research projects for which problems were identified jointly by industries and ORG1, though funding was provided by government. Subsequently the projects were monitored by industries too.

However, in 2012 when this researcher visited ORG1 for a second set of data collection, another change could be sensed. A new director had joined and "earning revenue" had taken a different direction. Instead of getting government funding and carrying on research of a basic nature, the priority has changed to research and service for industries and taking less government-funded basic research. The emphasis is now more on a pro-active role towards industries. The objective is to market the knowledge developed to industries. This new policy, taken at the ORG1 level, is making ORG1 scientists look for avenues for making them visible and acceptable to industries though ORG1 scientists are confident that they are the best in the country in several areas. Several informants were of the opinion that there is hardly any competition within the country as the field is very specialized and ORG1 has developed substantial knowledge in the area, along with a state-of-the-art facility.

4.2.4 ORG1 scientists' view of their activities

Overall, ORG1 scientists feel that they are mandated to bring research projects that will show their contribution to the "earning capacity" of the laboratory. It is a general feeling that the organization has changed substantially in the last 8 to 10 years. Reward is something that is no longer limited to top people; even juniors are now recognized for their contributions.

Scientists view those research projects that are funded by government grants and that are also directed to develop basic knowledge as an opportunity for development of infrastructure and a diving board for getting their papers published in good journals. Infrastructure is always a requirement, and publications in good journals make up the prerequisites for an upward career path. According to several scientists, it is difficult to get papers published in good journals out of research done for industries. Some informants also view those government-funded projects as a relaxed way of doing research because it was not as critical that the outcomes of those projects were really transferrable to industry. Submitting a report at the end of the project was all what was required. It appears that outcomes of those research projects did not matter but outputs in terms of papers and patents helped scientists to get rewarded in their careers.

4.2.5 The ICT infrastructure in ORG1

A digital library is an ICT-enabled tool. Hence any discussion on digital-library use within an organization is not possible without an understanding of the ICT infrastructure in the organization. ICT infrastructure in an organization means the arrangement that facilitates a user's working in a computerized environment. It includes access to computers, printers, network connectivity, Internet bandwidth, and so on.

Scientists recollect the past when the ICT infrastructure was not so good. Each division had a central computing facility where computers, and hence Internet accessibility, used to be shared by more than one scientist. Currently, ORG1 has a satisfactory ICT facility. All scientists are given computers in their workplaces. Besides, many scientists include provision of a computer in their project costs – thus upgrading the configuration of their current computers. Some scientists have more than one computer. The entire laboratory building is connected on a computer network. The Internet bandwidth availed by the laboratory is 100 MBPS. This connectivity is also provided by the government under the National Knowledge Network (NKN)[19] scheme. Prior to this facility, the Internet bandwidth available to the laboratory was 10 MBPS. At the time when this researcher visited the laboratory, computers were found at each scientist's work desk, placed in a way that is most convenient for the scientists to work without leaving the work table.

In addition, the library is also equipped with computing facility. There are several computers in the users' area of the library. Those terminals, however, were found to be used only by non-scientific workers. During the time spent in the library, the researcher did not see any scientist using the computers there.

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[19] The NKN is a state-of-the-art multi-gigabit pan-India network for providing a unified high speed network backbone for all knowledge related institutions in the country. The purpose of such a knowledge network goes to the very core of the country's quest for building quality institutions with requisite research facilities and creating a pool of highly trained professionals. The NKN will enable scientists, researchers and students from different backgrounds and diverse geographies to work closely for advancing human development in critical and emerging areas.

4.2.6 The library and the digital library in ORG1

In mid-nineties, library faced a resource crunch due to the shortage of fund. Retaining the subscription list over a period of years was a difficult task. Notwithstanding this financial difficulty, a computerized database service from M/s Dialog Inc was introduced in 1990. This introduction was to comply with one of the prerequisites of a large research project for which the World Bank gave a huge loan. Subsequently, in the following years, ORG1 started subscribing to such information storage and retrieval services, issued by Dialog Inc., on CDROM. Scientists did not have much experience in handling the search system on their own. The online service of Dialog Inc. used to be accessed through a telex service. For every request put to the search service, the search intermediary used to prepare a detailed search strategy in consultation with the user. Then, she used to access those services from the telex terminal. Finally, the search output was received by ORG1 through the postal service.

When the online service was switched over to a CD-ROM system, the same process flow continued. The only difference was that output was available immediately after the search. Occasionally scientists used to conduct their own search sessions. In those days, however, such information storage and retrieval services did not provide access to actual content beyond the citation information. Thus there was always a gap between the content demand of the scientists and the information that could be obtained through such information services. To some extent this gap was reduced by using the Document Delivery services from British Library Document Supply Center.

Current access to large numbers of electronic resources has been possible due to an intervention of the government in the form of a government-supported centrally funded consortium that was formed including ORG1 and similar other organizations. Thus, despite funding problems at the local level, which still remains (as revealed the current librarian), ORG1 scientists were able to access a large number of electronic resources.

All these resources are well organized on the website of the library. From time to time, users' training programs are conducted by the publishers' representatives. As one scientist stated, they had already learned much on their own but such sessions are helpful. Most of the time, searches are conducted by the scientists themselves, but occasionally they deliver the search job to the library as well.

4.2.7 Demographic information about the informants from ORG1

In order to understand the researcher population within the organization, annual reports of ORG1 were examined. According to the annual report, there are four divisions and two centers that pursue scientific research in ORG1. These divisions and centers contribute to research in seven areas. Besides, R&D services such as consultancy service are provided in six areas. Total number of scientists eligible for bringing funds for research projects, in those divisions and centers was 85. The authority was very kind to disclose a list of ongoing projects and the scientists involved in those research projects. This master project list showed that 64 scientists were active in various research projects. This helped to select informants who had live projects. Out of those 64 scientists, 15 participated in this research. There were three female scientists out of 15 informants. All those 15 scientists held highest academic degree, namely, Ph.D. in their respective areas and three of them received their degrees from universities in the USA and Europe. Most of the informants visited academic institutions abroad All informants had been working in the organizations, at least for ten years implying that all of them were completely encultured with the policies of ORG1.

4.2.8 Summary

Overall, ORG1 is a changed organization and such changes are felt by scientists in intervals of every 8 to 10 years. From the discussions with scientists, an urge to "earn" by the scientists was very evident. There was a sense of concern regarding industries' acceptance of the work and at the same time there was complacency regarding the capability of the laboratory. That scientists in ORG1 are mandated was evident from the discussions. At the same time, scientists also felt concerned about their future course of action in view of the recently introduced organizational policy. The organization is also fairly up-to-date in terms of the ICT infrastructure and has access to substantial numbers of electronic resources.

4.3 The Organizational view of ORG2

4.3.1 A brief history of ORG2

ORG2 was founded with the purpose of investigating the many and ever-opening problems of the nascent science that includes both life and non-life. The earlier organizational structure of the Institute could not be traced directly. From external sources like Wikipedia, some information in this regard was collected. Initially, the organization was funded through donations. For many years, it was a part of a university. Finally, in the mid-eighties, the ORG2 was brought under one of the agencies of Government of India, as a grant-in-aid autonomous body. The term grant-in-aid implies that its research function depends on various grants available from different government agencies.

4.3.2 The governing structure of ORG2

ORG2 has a Governing Body comprising several members from both inside and outside the Institute, and the Director of ORG2 is the Secretary of the body. The management of the Institute is vested with council comprising members from the Government of India, and nominees from the Governing Body with the Director of ORG2. There is a reference to the Research Advisory Council but details are not available. The first report of the formation of a Scientific Advisory Council was traced in the newsletter published in 1995. Apparently, the first review of scientific works done by the Institute was conducted in 1995. Another review committee's reference was found in the newsletter published in 1997. The review committee, according to the newsletter, was to review and suggest greater effectiveness of the organization and to suggest newer areas of research in next 10 years. This researcher could not find the outcomes of that review in any of the institutional documents.

ORG2 is also a government organization in terms of organizational rules, pay structure etc. Annual reports of several years mention receiving grants from the Government of India. In order to understand the types of funds received by ORG2, audited reports of few years were reviewed, revealing that "grants" and "services" are two major sources of earnings at ORG2. ORG2's newsletter regularly publishes the details of projects received, including funding. Without any exceptions, all such projects were found to be funded by some government agencies and a few of those projects were funded by some international agencies. Hence, it could be inferred that ORG2's main revenues are research funds from various government agencies. Compared to "grants," earning through "services" was very much less common.

4.3.3 The evolution of ORG2 as an organization

As mentioned, ORG2 was part of a university for many years. It still has a strong and distinct flavor of an academic organization. Though in annual reports/newsletters, science workers are referred to as scientists; the designations of those scientists within the Institute are Professor, Associate Professor or Assistant Professor. Most probably these were the designations followed when the Institute was a part of the local university, and the same trend has continued. The Institute houses doctoral students registered with various universities.

The Institute is engaged in doing research in multiple areas. It started initially with basic sciences, but later on added many new disciplines. The discussions with informants did not reveal any major shake-up within the organization in the last few years. Though the number of informants from this organization was very few, all of them have been attached to the Institute for many years.

Unlike ORG1, publications did not find any special mention in the discussions with ORG2. This does not mean that ORG2 is not engaged in publication activities – publications form a part of the scientific life of ORG2 scientists and there are associated awards for publications. Table-9 shows a decade-wise journal publication pattern by ORG2 scientists.

Table 9: Publication Pattern of Four Decades – an ORG2 picture

Time period	No of publications by ORG2 scientists (only related to Biotechnology area)			
	House journal	Indian journal	International journal	Total
1980-89	13	87	178	278
1990-99	7	35	193	235
2000-09		20	315	335

Table-10 provides an idea on the volume of publication on every 10th year, starting from1979.

Table 10: Distribution of publication of ORG2 scientists on every 10th year

Publication year	**No of publications by ORG2 scientists (Related to Biotechnology area)**			
	House journal	Indian journal	International journal	Total
1979	1	11	16	28
1989	3	5	25	33
1999		2	22	24
2009			34	34

Both the tables (9 & 10) indicate international journals always got higher importance than local journals for publishing. This is just the opposite to what was observed for ORG1. One possible reason for this stress in international journals may be the academic nature of the organization. It may be recollected here that ORG2 has many divisions other than Biotechnology related area.

The above table reflects the publication pattern for the areas engaged in Biotechnology and not for the entire organization.

For the purpose of this research, those who are working in the area of bio-technology were invited to participate. As such, there is no single institute in this part of India that devotes itself exclusively to bio-technology. Researchers in this area are part of research institutes that also carry research in related or other areas.

4.3.4 ORG2 scientists' views about their activities

Contrary to ORG1 scientists, ORG2 scientists say they do not feel mandated and have the freedom of pursuing any research that they find interesting. In fact, during the discussion, some participants directly made this comparison with ORG1 like organizations. There was no sense of urgency, during discussion, on "earning," though they confirmed that they have to bring in projects from outside. However, ORG2 scientists were more concerned about publications and the reputation of such publications.

ORG2 scientists do not see any big perceivable change in the Institute's policy within the last few years. A mention of reviewing the performance of scientists by the government, as found in the newsletter, was made by one scientist only. This scientist also mentioned how as preparatory work of that evaluation, impact factor of journals where they published, could be used as measure of their productivity.

4.3.5 The ICT infrastructure in ORG2

The ICT infrastructure in ORG2 is quite comparable with that of ORG1. During the time spent in ORG2, the researcher observed that scientists have their own computers in their offices. The Institute has a network covering the entire building and thus scientists can access the Internet from their rooms. The Institute, like ORG1 is also using NKN's Internet facility of 100MBPS bandwidth. Prior to this facility, the Internet bandwidth availed by the Institute was 10 MBPS.

Until a few years ago, ORG2 informants had a sharing system with respect to ICT infrastructure similar to the situation in ORG1. The Institute's Bioinformatics Center used to house all discipline-related information resources available in CD-ROM. Even for some time afterwards, the Internet used to be available from the Bioinformatics Center. Scientists could compare the current facility with the older facility in terms of comfort of access and privacy of using the ICT infrastructure.

The Library of ORG2 is also connected to the Internet and there are a few computers for users. However, all participants told this researcher that they use the facility from their offices. Going to the Library is required when they want to consult a print copy of books and other materials.

4.3.6 The library and the digital library in ORG2

The history of ORG2 library is not much different from that of ORG1 library. At one time there was a severe funding problem. The situation has improved during the electronic era, particularly after the formation of various government-supported e-resource procurement consortia.

ORG2 never had the experience of using online information services. However, the Institute started procuring information resources on CD-ROM as the technology came onto the market. There was, however, a gap between the content demand and information provided by CD-ROM services. The participants reported that it was a common practice at one time for them to get a copy of the paper by requesting it from the author or through some friends working in different universities worldwide.

The electronic resource section of the library is fairly organized through the website of the library. The digital collection includes subscription databases, e-journals as well as local collections of papers published by the scientists of the Institute, annual reports, newsletters, and so on.

4.3.7 Demographic information about informants from ORG2

This researcher could examine the annual reports for ORG2. ORG2 had seven departments and three centers. Those seven departments include physical sciences such as physics, chemistry, and along with more modern areas such as molecular medicine. A small group within ORG2 pursues research in the area of Biotechnology. Total number of scientists in this group was found to be seven. Because of this small number, attempt was made to interview all scientists. However, three scientists finally participated. There were two female scientists among the informants All three scientists held the highest Ph.D. degree from Indian universities. Two of them mentioned about their further studies in various North American and European universities. All of them had been working in ORG2 for more than fifteen years.

4.3.8 Summary

ORG2, from its scientists' perspective, has not undergone any major change over the years. It is still dedicated to basic research. The scientists of the institute feel they are not mandated enjoy great freedom to pursue any research in which they are interested. The organization has a satisfactory ICT infrastructure. It is a beneficiary of the government's initiative of providing Internet facility to the individual organization as well as through an e-resource procurement consortium. The digital collection of ORG2 is made up of databases, e-journals, e-books, and a locally developed digitized collection of reprints, annual reports and many other types of local resources.

4.4 Chapter summary

This chapter provided a brief description of ORG1 and ORG2, two organizations selected as cases, in terms of their activities, ICT infrastructure and digital libraries to which the members of each of the institutes have access. Though the ICT infrastructure and the characteristics of the digital libraries are comparable for these two organizations, the nature of activities differs. While ORG1 is dedicated to serving the industrial requirements of the country and as an organization its scientists are concerned with earning while doing research, ORG2 is dedicated to basic research and earning is not a concern for its scientists. Whether such differences in organizational activities are reflected in the digital-library use by the scientists of each of these organizations was examined in this study.

CHAPTER 5: INFORMATION GATHERING PRACTICES OF SCIENTISTS

5.1 Chapter introduction

The overarching question of this research is how is the practice of digital-library use by people in Indian academic and research institutes being shaped by organizational and social contexts? This question is divided in two parts. Since digital-library use is very much related to information-gathering practices, the first part focusses on the relation between context and information-gathering practices of scientists[20] (*RQ1# How does the social world of an organizational member influence and shape her/his information-gathering practice*?). Scientists are referred to here as organizational members and the social world implies their context. The second part identifies various issues that contribute to digital-library use in support of information-gathering practices by these scientists (*RQ2# what are the various extra- and intra-organizational factors mediating the practice of digital-library use in information gathering activities of organizational members*?).This chapter is devoted to the first part (RQ1).

In investigating information-gathering practices (RQ1), systematic studies were conducted in two different but related directions. Along one direction, were the components of context with which scientists have to interact and the ways in which each component triggers information-gathering practices (RQ1(a)# *What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes, engage in meeting the demands of their social world?*). The other direction of the investigation was how these scientists view their

[20] The methodological issues of foregrounding information gathering practices are discussed in more details in Chapter-3.

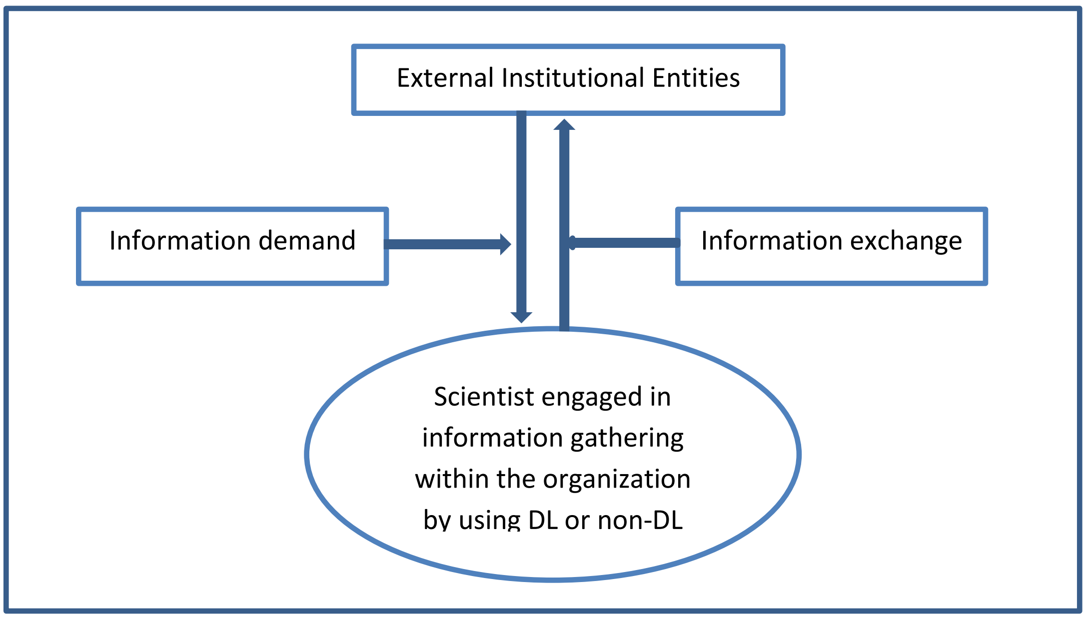
information-gathering practices with respect to their interactions with various components of their social world (RQ1(b)# *How do information-gathering practices help those social actors meet the institutional forces of those interactions?*).

Identifying the components of context on such a large canvass was an important task. This was accomplished in two steps. First, the scope of the context was limited to an organizational context since the policy and goals of an organization drive the work of their scientists. In the second step, this organizational context was viewed through the lens of a theoretical construct, namely *social actor*, and this helped in identifying the followings:

- The components of the organizational context, with which the scientists have to interact;
- The demand of information exchanges in such interactions leading to information-gathering practices by those scientists;
- The characteristics of information exchanges that take place between scientists and their organizational context; and
- How do such information exchanges (and information gathering in that process) help scientists.

A clarification on some terms used seems appropriate here. There are references to two actions, namely, “information gathering” that is used in the research question (RQ1#b) and “information exchange” used above. Another term “information demand” is also used frequently in the text. These are different but related terms. As a scientist interacts to an external entity, she understands that some of those interactions demand support of information. This is “information demand”. As a result, the scientist engages in “information gathering” (using Dl or non-DL resources). Subsequently, the scientist exchanges those information (information exchange) in order to make the interaction fruitful. Figure-4 depicts the relation between these actions:

Figure 4: Information Gathering and Information Exchange



To begin with, a brief discussion on some concepts and issues related to this research may be helpful. To this end, the rest of this introductory section

- Recapitulates some important concepts and issues of this research;
- Revisits the relevant literature and develops a structure to theoretically link the findings of this research;

- Highlights the relationship between the theoretical discussion and the research questions.

5.1.1 Important concepts and issues of the research

In this section, the important concepts and issues related to this research are briefly described. More detailed discussions on these issues can be found in Chapter-2. The main concepts addressed in this research are *digital libraries*, its *use* and *context*.

The term *digital library*, in this research, denotes a wide array of electronic resources of following characteristics:

- Contents of digital libraries may be either developed locally or developed/aggregated by commercial publishers/aggregators;
- Digital libraries may be hosted on a local network or may be Internet based;
- Digital libraries may cover specific websites or may be an organized collection of web-based contents.

The term "*digital-library use*" or simply *use* excludes the notion of download statistics or any other usage statistics, though the discussion sometimes may refer to such usage. Digital-library use is the incidence of consulting digital libraries for the purpose of information gathering. It also refers to connecting to specific electronic resources and exploiting one or more specific features of digital libraries. As the data for this research is collected from users' description, it was not possible to associate this aspect of use to actual download statistics. Download statistics is based on every time a specific IP of a computer performs an action in a publisher's site and cannot connect to the activities of a specific user. Thus it was not possible to quantify the use from the discussions with the informants.

Context is another concept in this research. Context is construed as the organizations whose members have access to and use digital libraries in order to perform organizational work.

Social actor is the theoretical construct which forms a conceptual pillar in this research. Social actors are members of an organization and their organizational behaviors are responses to their workplace demands. These workplace demands arise because scientists have to interact with various individuals and organizations external to their respective workplace. In this research, scientists are conceptualized as social actor and information gathering is conceptualized as their organizational behavior as a response to their workplace demand.

Chapter-3 covers in more details why *information-gathering* activity has been brought to focus in this research. Digital-library use is essentially related to information gathering activities. But using the term *digital library* or any other similar technology-laden term might have been counterproductive in eliciting the true picture if some of the informants were not comfortable with technology. They might have been tempted to provide what they perceive as the right answer and not the actual information-gathering practice using digital libraries. In order to take precaution for this possible situation, the notion of social actor is connected to information gathering and later it is examined (presented in Chapter-6) how such information gathering action is related to using digital libraries.

5.1.2 Theoretical background

A literature based overview of *social actor* and its deployment in operationalizing organizational context are relevant at this point. One major task of a context based study of information need, seeking and use is to disambiguate what constitutes context and how context is understood by the participants of studies (Courtright, 2007). The first disambiguation was done by considering the organization as the boundary of the context. The second disambiguation was required to identify what exactly are the components in an organization that play playing a role in the information-gathering practices of scientists. Theoretical support was brought into the picture in order to make a systematic approach to reveal the features of organization-as-context which can then be further studied. The construct *social actor* was used to this end.

Social actor was conceptualized based on the notion of an open natural system and an institutionalized organization. As already described, organizational members in natural system develop informal relation with others that shape their values and existence. Additionally, in open system, external relationship such as suppliers, clients and other institutions influence the organizational behavior (Scott, 1992). Institutions are made up of cognitive, normative and regulative structures and activities. Institutions are one important social force that shapes behavior and also gives legitimacy to that behavior. Institutions are transported by various carriers, namely culture, structures and routines. The cognitive structure is the important feature of new institutional view. It posits that many choices of organizational actors are governed by highly routinized habits, scripts, rote actions, and imitation of elites (DiMaggio & Powell, 1991).

Information use, as the literature suggests, can be richly described by examining the environment of an organization, along the lines of an open natural system. Complex activities such as work habits, patterns of legitimation in a social group, and organizational politics were found to provide more enduring explanations of digital-library use than those based on changing technology (Covi & Kling, 1996). Memberships of various communities outside the organizational boundary also contribute to various information activities. These communities can be formed based on specific jobs, such as police (Allen & Shoard, 2005), or on professions or academic disciplines. Discipline-specific skills of researchers that take shape from work characteristics could be used to explain digital-library use within universities (Covi, 1999). This study also highlights the role of the i*nvisible college*[21] in this regard. Invisible college is all about publications and peer review. Faculty members in that study were found to be highly concerned about others acknowledging the originality of their findings and giving credit. Such acknowledgement is important for their tenure, promotion and raise. This study found the digital-library use by university researchers strongly influenced by the social characteristics of scholarly research activities and effective digital-library use takes place when users can integrate these resources into socially legitimated and legitimate-able ways of working (Covi, 1999).

Social actor is a new institutional view of users and looks at their ICT use in their everyday interactions with various institutionalized systems residing outside their respective organizations (Lamb & Kling, 2003). This view highlights these actors' relationships with those who have requested information or whom they are trying to persuade with information gathered and packaged through the use of ICTs. Within the larger context of an organizational environment,

[21] An invisible college is defined as a geographically distributed set of colleagues in a particular research specialty who are the peers that judge and legitimize research contribution (Price, 1963; Crane, 1972).

information gathering can be conceptualized as a way to meet the demands of various social interactions developed out of various relations. The exchange of information can be a part of organizational behavior which can be influenced by inter-organizational relationships (Blau, 1964; Hall et al., 1976; Alexander. 1995). An industry level study can provide descriptions of how informational exchanges become integral to obtaining and sustaining legitimacy (Lamb, King & Kling, 2003). For example, a biotech company's obligation to obtain an approval from the U.S. Food and Drug Administration prior to selling a medicine reveals the relation between an organization and a regulatory agency. Interactions developed out of such relations result in an explicit information exchange, for example, producing a report based on collected information. The information exchange takes place through a report, prepared by the drug companies, that includes citations to what has been published about the drug, its compounds, and its medical application (Lamb, King, & Kling, 2003). All these exchanges are believed to be "legitimate ways" of interaction. Another important characteristic of such information exchanges is that all such exchanges take place through formal reporting. In the current research, as we will find later, information exchange also takes place informally.

Information gathering is an outcome of these relational requirements and a link becomes discernible between the institutional influences that play a role in the environment and the information-gathering practices. This relational requirement not only makes the context explicit, but it also accounts for why in some cases, information gathering does not scale up to the expectation. The smaller the institutional pressures in an interaction, the smaller may be the intensity of information-gathering practices (Lamb & Kling, 2003).

This construct of social actor has been extended to academic and research organizations selected as cases for the present study. The premise was that focusing on social actor, one should be able to trace various other institutionalized systems outside the boundary of the social actor's organization, interactions that take place between these institutionalized systems and the social actors. By making those institutional influences explicit, it is possible to take into account the contextual factors which can explain an organizational behavior and thus operationalize organizational context. In this current research such operationalization can help understanding why and how information gathering becomes a routine in the interactions that take place between an organization member and the organizational environment.

The construct *social actor*, however, was used for industries that are organizations involved in business. The organizations selected for this research are not industries. Hence the organizational fields surrounding these academic and research organizations are different from those of industries. But these selected organizations are in the business of knowledge generation. This can be likened to what Alavi, Yoo and Vogel (1997) stressed that universities have an organization-like structure and are in the business of knowledge creation and sharing. The authors made such reference to universities to draw the similarities between other types of organizations that engage in IT-enabled collaboration and universities. The same logic can be extended to the organizations under study. Knowledge generation is a major task of both the organizations selected for this research and in both capital flow takes place for the purpose of knowledge generation. Hence the construct of *social actor* should be applicable to scientists of academic and research organizations and it is possible to explore how their information-gathering practices can be linked to various institutional influences and how such institutional influences are generated.

5.1.3 Operationalizing organizational context in the current research

Following the information-gathering practices of scientists through the lens of social actor can lead to the identification of organizations, outside their workplaces, with which scientists interact and to institutional forces in such interactions that trigger information gathering by scientists. Our prevalent perception is that scientists search for information to have knowledge that can be transferred to new knowledge. We are accustomed to see the use of various information resources as outcomes of various technical features of such resources. While this study acknowledges that digital-library use is mainly for the purpose of knowledge generation, the findings of this research suggest that practices of information gathering settle, partly, in response to the demand of certain workplace forces and not just for acquiring knowledge for knowledge's sake. There are indications that more these scientists interact with entities beyond the boundary of their organizations, more information become helpful for their "survival in the market". In order to identify those interacting forces, the research question RQ1(*RQ1# How do the social world of an organizational member influence and shape her/his information-gathering practice*?) was split into two following sub-questions:

RQ#1(a): What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes, engage in meeting the demands of their social world?

RQ#1(b): How do information-gathering practices help those social actors meet the institutional forces of those interactions?

The sub-question RQ#1(a) addressed finer details such as:

(i) With respect to information-gathering practices of the scientists, who are the extra-organizational entities with whom they interact?

(ii) What kind of information demands are made in such interactions?

(iii) What kind of institutional forces exist in such information demand?

(iv) How similar or different are these extra-organizational information demands across the selected cases?

The sub-question RQ#1(b) elicits what meaning is attached by the scientists to those information exchange and information-gathering practices vis-à-vis meeting such institutional demands of information in those interactions.

5.2 Interactions with external entities and information-gathering practice

How information-gathering practices become an automatic response to the environmental demands of the scientists is the focus of this section. This section deals with research question RQ#1(a) and presents findings on the external entities[22] with whom the scientists of ORG1 and ORG2 interact, the type of information demands that are made in those interactions and how information-gathering practices help scientists to meet such information demands.

[22] The term "entity" is used as a generic term to denote an organization, an individual or a collective of individuals with whom scientists interact. Research funding agency, peer group, journal review system, or an individual scientist who is sitting in the audience all are referred to as "entity". As social actor, a scientist can have scope to interact with one or more of such entities.

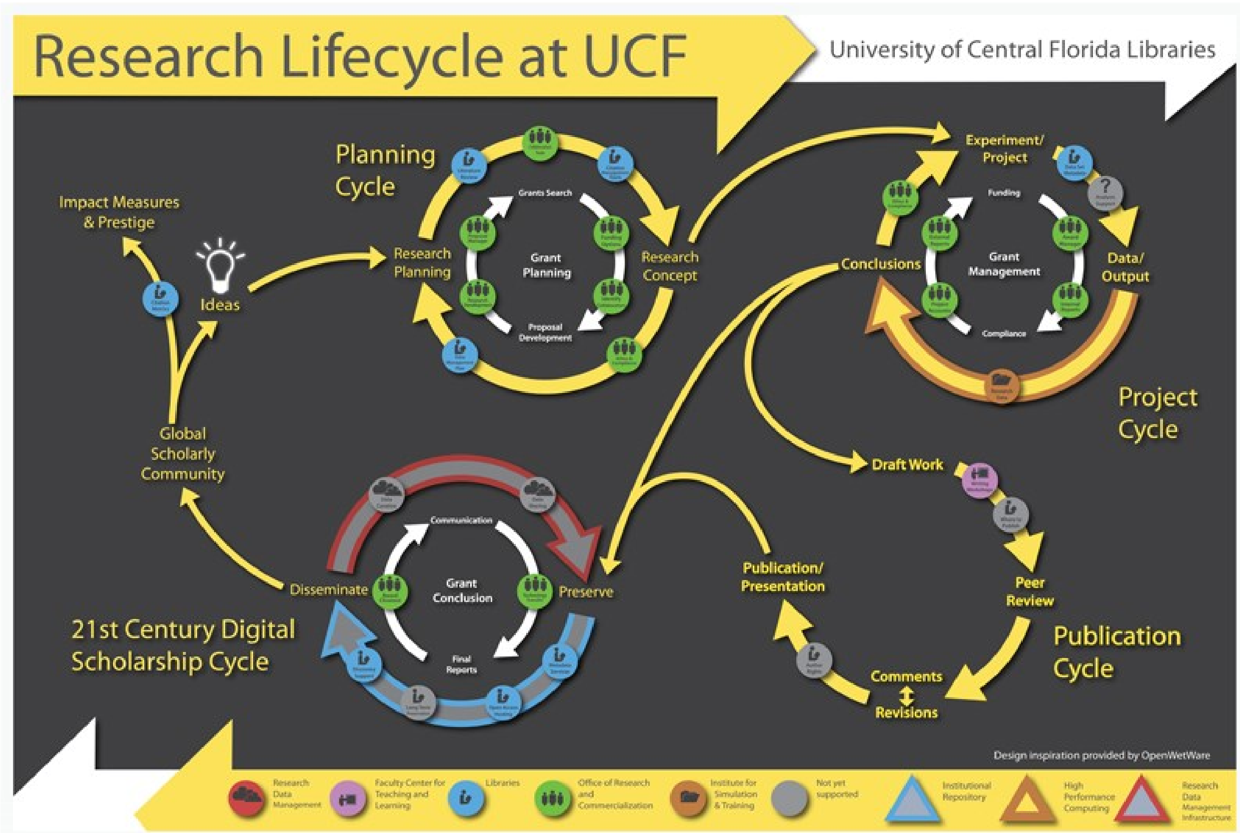
The most difficult part of the data collection was eliciting responses from the scientists on information searching. Information searching and screening are so much a part of the activities of scientists; they cannot separate one reason from another behind their information related activities. Any question on situations under which information searching becomes a necessity led to the cryptic answer “always”. Similarly any question on why information is required mostly resulted in the answer “need to know”. To work around this problem, following the principle of phenomenological interviewing technique, scientists were asked how information gathering was helpful in different situations and then it was followed up what the situations were. The descriptions as emerged from scientists were examined through the lens of social actor. Information-gathering practice was often found to be connected with various events that a scientist faces while discharging her/his organizational role and responsibilities. Within an organization, a scientist’s research activities mainly revolve around three broad events, namely, project initiation, project progression and completion, and scholarly communication. Before going into the details of the findings, some clarifications on these events are given here.

Project management life cycle, research life cycle and scholarly communication cycle are three terms that often appear in any discourse that involves “research” as study object. A research as a project has a finite starting and endpoint and passes through several stages. A research as a process for knowledge discovery also passes several stages but it has a fuzzy starting and ending point. A research is a never ending and spiraling process – when a research addressing a specific issue comes to an end, it automatically gives rise to related issues that are pursued successively. Scholarly communication too is a very extensive spiraling process associated with research. Association of Research Libraries defines scholarly communication as “*the system through* *which research and other scholarly writings are created, evaluated for quality, disseminated to the scholarly community, and preserved for future use. The system includes both formal means of communication, such as publication in peer-reviewed journals, and informal channels, such as electronic listservs*."[23] Elsewhere, scholarly communication has been defined as a cyclical process in the advancement of scholarship. In this cyclical process content is generated, reviewed, disseminated, acquired, preserved, discovered, accessed, and assimilated as new knowledge. The concerns in scholarly communications are state of publishing, impact of technology, economics, digital scholarship and so on [24] [25] [26]. Scholars have also agreed to the above definitions. As a field of study, scholarly communication focuses on how scholars use and disseminate information through formal and informal channels and studies in this area cover the growth of scholarly information, the information needs and use and relationship among formal and informal mode of communication (Borgman, 1990). These three processes are independent but connected as captured through the following Figure-5.

[23] http://www.arl.org/focus-areas/scholarly-communication#.U5IzcTf3vaB, retrieved on June 7, 2014
[24] http://library.manoa.hawaii.edu/about/scholcom/about.html retrieved on June 7, 2014
[25] http://www.lib.uwo.ca/scholarship/scholarlycommunication.html retrieved on June 7, 2014
[26] http://www.lib.uci.edu/about/projects/scamp/scholarly-communication.html retrieved on June 7, 2014

Figure 5: Research Lifecycle, Project Lifecycle and Scholarly Communication

(Adopted from http://library.ucf.edu/scholarlycommunication/ResearchLifecycleUCF.php, retrieved on June 14, 2014)



Doing research by the informants of this study is their organizational responsibilities. A scientist may be at any specific cycle or at more than one cycle in the above figure. For example, while in project cycle, a scientist can take part in the scholarly communication process.

The current study focused on a very specific aspect – it located an action of information gathering using digital library and then followed the trail to reach to the point which triggered that information gathering and to understand the institutional nature of that point of origin (the lens of *social actor*). Based on what emerged from the informants, such information gathering activities could be organized within more or less clear boundaries of project initiation, project progression and scholarly communication. Keeping this in view, this reportage mentioned project initiation, project monitoring and completion and scholarly communication as “events” in the workplace of researchers. The focus is not on the phase of the research but on the organizational responsibilities of the informants and different events that make them interact with different external entities.

Coming back to our original discussion, for each of these events, scientists come into contact with various entities that are located outside the boundary of their respective organizations. Event-wise entities that scientists interact with and information demands from such entities, as found in this research, are presented in the following sections and a summary is presented in Table-9.

Table 11: External environmental entities of ORG1 and ORG2 Scientists

Event	Entity	Observations
Project initiation	Entities supporting scientist-driven research (Knowledge generation - scientist oriented - institutional authority)	
	Entities supporting industry-guided research (Knowledge generation - industry participated - institutional authority)	For ORG1 only
	Entities procuring in-house research outcome (Industry - solution seeker)	For ORG1 only
	Entities as prospective research collaborators (Industry - knowledge application collaborator)	For ORG1 only
	Others (information product buyers)	For ORG1 only
Project progression and completion	Agencies monitoring research progress	
Scholarly communication	Institutionalized review system – formal and indirect communication (Knowledge Reviewer (Community) – Formal & Indirect Communication)	
	Knowledge reviewer (individual) – Formal & indirect communication (Knowledge reviewer (individual) – Formal & indirect communication)	
	Knowledgeable individual – informal and direct communication (Knowledgeable individual – informal &	

Event	Entity	Observations
	direct communication)	
	Community – competition and connection	
	Knowledge Dissemination Channel (Knowledge Dissemination Channel)	
	Regulatory agencies	
Administrative and others	NGOs, performance evaluation bodies, project monitoring bodies	

Types of information demanded and exchanged between scientists and the above mentioned entities and mode of such information exchange are synopsized in Table-12. In this regard, however, the findings are to some extent different from an earlier study (Lamb & Kling, 2003) in which informational exchange was found to take place through formal report. It was even found that for some industries, the reports must be made voluminous in order to establish that enough information is covered. In this research, it was found that information exchange takes place through both formal report and informal and verbal communications. Often, the scientists do not compile any formal report but keep the information ready at hand before interacting with the entities and present it when and if required.

Table 12: Information exchange during interaction

Entities with whom interactions happen	Type of information required to be exchanged	Mode of information exchange
Entities supporting scientist-driven research	Technical, research-based information.	Formal exchange through literature review, as part of project proposal
Entities supporting industry-guided research	Technical, research-based information.	Formal report as well as informal exchange in meetings
Entities procuring in-house research outcome	Mostly information exchange does not take place	No exchange
Entities as prospective research collaborators	Technical, research-based information as well as commercial information	Massive information exchange informally
Others (information product buyers)	Technical, commercial and production data	Formal report
Agencies monitoring research progress	Research information	Verbal but formal mode of exchange
Institutionalized review system – formal and indirect communication	Research information	Formal exchange through publication
Knowledge reviewer (individual) –	Research information	Formal exchange through

Entities with whom interactions happen	Type of information required to be exchanged	Mode of information exchange
Formal & indirect communication		publication
Knowledgeable individual – informal & direct communication	Research and technology information	Verbal but formal mode of exchange
Competitors (community)		
Community		
Knowledge Dissemination Channel	Research information	Formal review report
Regulatory agencies	Patent information	Formal report
NGOs, performance evaluation bodies, project monitoring bodies	Factual data, citation data, MIS data	Formal reporting

How such information exchanges, as presented above, are viewed helpful by the scientists are outlined in Table-13.

Table 13: Scientists' view on how informational exchange helps

Entity	How information exchange helps
Entities supporting scientist-driven research	Compliance, Confidence building, Identity, Load shifting, Scientific inquiry – continuity, Scientific inquiry – merit, Scientific inquiry – successful participation
Entities supporting industry-guided research	Compliance, Confidence building, Identity, Load shifting, Scientific inquiry – continuity, Scientific inquiry – merit, Scientific inquiry – successful participation
Entities as prospective research collaborators	Alliance formation, Confidence building
Others (information product buyers)	Product development
Knowledge Outcome Evaluator	Confidence building, Identity-credibility, Identity – knowledgeable self,
Knowledge Reviewer (Community) – Formal & Indirect Communication	Confidence building, Scientific inquiry – challenge, Compliance, Load shifting,
Knowledge reviewer (individual) – Formal & indirect communication	Identity – ego, Identity- knowledgeable self, compliance, Load shifting
Knowledgeable individual – informal & direct communication	Identity – knowledgeable self,
Competitors (community)	
Community	Community – acceptance, Community – connect, Confidence building, recognition
Knowledge Dissemination Channel	Scientific inquiry – merit, Identity - credibility
Regulatory agencies	Compliance
NGOs, performance evaluation bodies, project monitoring bodies	Performance evaluation, Load shifting

These tables suggest that information gathering is often practiced by the scientists of these organizations for more than "gaining new knowledge"; in order to discharge organizational responsibilities, that is doing research, scientists have to interact with many entities outside their respective organization. These interactions demand the exchange of information that is conveyed to the scientist by rules, norms and cultural practices. Findings on various entities and their information demand with respect to information-gathering practices of scientists are discussed in the following sections.

5.2.1 Scientists' interactions with external entities at project initiation phase

Various research funding agencies are entities with which scientists have to interact at this phase. Before a research project starts, scientists go through what can be termed as a project initiation phase. This phase starts when a scientist hits a research idea and ends with the confirmation that the necessary financial support will be available for a certain period of time to test that idea. The entities outside the workplace who matter most at this stage and with whom a scientist must interact at this phase are various sources of funding. Such funding sources, or entities, support different types of research with different aims. Consequently, the nature of the information demand and the information exchange that takes place in the interactions with such entities are different.

5.2.1.1 Entities supporting scientist-driven research

This group comprises various government agencies, inter-governmental agencies, international agencies that provide funds for research initiated by individual scientists. Through such funding, these agencies encourage knowledge generation out of fundamental research. Scientists in organizations like ORG1 and ORG2 need support to conduct research based on their own ideas in order to develop fundamental understanding of scientific phenomena in their respective specialties. To this end, agencies under this category provide financial support to research programs initiated at the individual scientist level. The idea, problem definition, entire planning for the program are the responsibilities of the scientist who would apply for such funding. Scientists have the liberty of choosing a problem, within the scope of the agency providing funding. A large number of research projects in ORG1 and all projects in ORG2 are initiated by individual scientists who look for various funding agencies under this category.

Information demand from this entity is both explicit and formal. These funding agencies have standard procedures for receiving applications from scientists requiring support. There are prescribed formats that must be filled out by an applicant. One specific component of the prescribed format is a review of the literature. This format becomes a rule-like structure and makes information exchange mandatory leading to extensive literature search by the scientists. Informants view the information gathering and subsequent exchange from four different but related perspectives. Those are:

(i) Meeting the mandatory requirement of producing a literature survey as directed by the prescribed format of application for funding.

(ii) Recognizing the need of strong argument for establishing the importance of the project and justification for funding (ORG2-SCT1-05, ORG2-SCT3-46).

(iii) Establishing uniqueness of the proposed research - informants were very concerned that in this age, access to information is much more than earlier days. In order to show that their work does not overlap with the work of others and that it fits in with the science being done in that area, the scientists keep abreast of the current literature in the area (ORG2-SCT2-17).

(iv) Remaining competitive in the market as receiving funding is competitive. Hence a scientist must be perceived as a capable individual by funding agencies. To prove their capability, a regular information gathering habit can be beneficial (ORG2-SCT1-17/18).

Though ORG1 and ORG2 are different types of organizations in terms of organizational policy and goals, scientists of both these organizations interact with this entity. ORG2 scientists opt for this kind of funding because of the structure of ORG2. As discussed earlier, ORG2 is a grant-in-aid organization and its scientists are to develop fundamental research and then publish. This drives ORG2 scientists towards interactions with this entity. ORG1, on the other hand, participates in scientist-driven fundamental research for four reasons: (i) to meet the mandate of "earning" (ii) to meet the mandate of publications as criteria for career advancement (iii) to develop, partly, infrastructure as funding provided under this category allows developing infrastructure on a small scale (iv) another reason for ORMET scientists to go for this type of funding is that they can work in a relaxed manner according to their pace and not be much concerned with the outcomes of the research as such (ORG1-SCT2-09, ORG1-SCT4-19).

However, at ORG1 there is a new trend due to a very recent change in the policy. In 2009 when the first set of interviews was conducted, there were some passing references to this change. But during the second set of interview in 2012, the policy was settling down and ORG1 was found to be slowly moving away from this type of government funding. Thus receiving funding from other government agencies has been planned to be stopped. But there is a strategic shift. As the emphasis on old values still remains and the scientists still need publications for career advancement, junior scientists are still continuing with government- funded projects. Seniors however, are gradually stepping into a different kind of projects:

> *"I took this responsibility because I do not need publications now ... but juniors need more publications" (ORG1-SCT2-17).*

Thus participation in scientist-driven government-funded research is a strategic decision within ORG1 but is mandatory for ORG2. Despite the differences between these two organizations, participation in scientist-driven research brings similar environmental influences on their scientists in terms of information scanning and searching practices. Interactions with this entity demand formal and mandatory exchange of technology information, in the form of a literature review and through the prescribed application format. Thus often the information-gathering practices of scientists are directed to meet these formal requirements.

5.2.1.2 Entities supporting industry-guided research

Government agencies in India also disburse funds from a different type of source. There are certain corpus funds which have been developed jointly by the industries and the government. The purpose of those corpus funds is to support research agenda that is beneficial for specific industries. One such fund has been developed jointly by metallurgical industries in the country and by government. Research supported by such corpus funds are collaborative activities of industry and the organizations where scientists work. Agenda of such research projects are developed based on industry-wide problems and scientists help industries to formulate such problems. Research is also carried out by the scientists with close collaboration with the industries. Apart from knowledge generation, these studies aim to develop some deliverables to industries. ORG1 scientists engage in this type of research.

Informants described that information demand from this entity is met with both informally and formally. Research projects under this category bring ORG1 scientists in touch with many other organizations – academic institutions and industries that contribute to the research together (ORG1-SCT3-07). Procedures for obtaining funds under this category do not follow the straightforward process of making application in a pre-defined format. Scientists have to interact with various stakeholders of such research projects from time to time, before the final papers regarding financial support are placed. Such interactions demand preparedness on the part of ORG1 scientists. At various interactions with those stakeholders, scientists have to display their knowledge on the current state of their research. Information gathering activities by scientists are often triggered by the urge to remain information-ready. It was very revealing that preparing various information reports by ORG1 scientists became a practice only after one participant industry demanded for information a few years back.

> *"<practicing the preparation of technology reports> I am here for more than 18 years.. of and on.. first it came from XXXX Steel... about 12 years back… first time someone asked for a state of the art " (ORG1-SCT4-46)*

While ORG1 has developed facilities for carrying on this kind of industry-supported research, ORG2 scientists do not make attempt at such projects. Though some ORG2 scientists work in collaboration with scientists of other organizations, they do not involve themselves in large-scale industry oriented problems. One ORG2 informant explained why it is not possible for them to join such projects – a big team is required which ORG2 scientists probably do not have:

> *"things have changed .... but these days government does not want to give grant in an isolated manner .. they discourage this kind of small research works.. that is good in one way but it is creating problem who wants to sit quietly on their table ..to do some research... you must have a big team to do something big .. that is the issue " (ORG2-SCT2-58).*

All informants of ORG2 confirmed that their research do not involve industry as they limit to fundamental research. Going for this type of research matches with the organizational mandate of ORG1 and its scientists engage in seeking fund from this entity.

Thus, even though the nature of the funding agency remains almost same (that is, government agencies) as described earlier, the aim of the research projects that are supported by the agencies and participation of many stakeholders in the research program might change the nature of information demand and the purpose of information gathering activities by scientists.

5.2.1.3 Entities procuring in-house research outcome

ORG1 scientists report another type of funding. More than funding, this can be considered a true *earning*. This funding comes directly from industries that pay for the outcome of research, that is technology developed or expertise generated within ORG1. This type of research can be identified more as firm-specific problem solving. Individual industrial firms approach ORG1 to commission a project in order to get a solution for their operational problems. ORG1 scientists offer this kind of service by using their already generated knowledge as capital. The core features of interaction with this entity are given in Table-14. The characteristic of interaction with this entity is that no information exchange is demanded in such interactions.

Table 14: Core Features of the entities procuring in-house research outcome

Criteria	Findings	Example
Who approaches first	Firms	*"… there are lots of private funds. .. they are the one who approach us.. they have specific problems. . ..mostly for problem oriented tasks…problem in their organizations.. production, manufacturing… just to solve the problem" (ORG1-SCT4-21)*
Who gives problem	Firms	*"for private funding. . they assigned a job and we have to do the work, but whatever we are doing we have to give our process, so we have to go and search for what all the processes are there and what we can do . . so then we can give this process to the party depending on his fund. . small or large scale" (ORG1-SCT1-08)*
Volume of job	Large	*"…one is research and one is testing type of activities .. industry wants some sorts of testing … we are now flooded with testing type of activities .. particularly our division" (ORG1-SCT2-06)*
Demand for information exchange	No demand	*"sometimes their projects are problem oriented...they have a failure.. they really do not know what is happening in the world…. Many of our sponsors are not interested in our state of the art…they are interested in their own problem" (ORG1-SCT4-43)* *"<sponsors> . . they are not interested to know (in vernacular) what has happened elsewhere. . they are bothered with the process that we will give to them and should be easily used by them" (ORG1-SCT1-09)*

In sum, when scientists transact a product or process developed by them and when the external entity that is industries approach the organization in order to have that product or process, interactions with those entities do not demand any information exchange. The reason for mentioning about this entity in details is to highlight that all external interactions do not necessarily lead to information demand and subsequent information exchange. ORG1 scientists reported that they still consult digital resources (information gathering activity) in support of research in this category but such consultation is required for their own knowledge. For ORG2, this entity does not exist in its organizational environment and its scientists do not have to interact individually with such entities.

5.2.1.4 Entities with prospective research collaboration

As mentioned earlier, ORG1 has recently undergone another change in direction in terms of organizational policy. According to this new direction, ORG1 is gradually discontinuing receiving government funding for scientist-driven research (ORG1-SCT2-01). Instead, industries are now looked to as the new source of revenue. But unlike the entities who would simply procure the outcome of in-house research as described in section 5.2.1.3, these new industry partners are viewed as collaborators in the knowledge-development process. It becomes incumbent upon the scientists of ORG1 to identify an industry partner and approach them.

Finding an industry partner that will agree to invest in the technology research offered by ORG1, demands that the research conducted at ORG1 is acceptable. ORG1's prime task is to convince the industry (ORG1-SCT2-10). Industries have to be convinced that investing in the technologies that would be developed by ORG1 will have a good return (ORG1-SCT5-08). Contrary to government-funded, scientist-driven research that gave all importance to outputs such as papers and patents, research outcome is the only criteria to draw industries towards this kind of funding. This process of convincing involves exchange of information. ORG1 has to show the industries that there will be value for their money. Sometime this process of convincing helps to educate industries on the benefit of the technology. The process of exchange of information takes place through presentations during face-to-face meetings (ORG1-SCT2-14), and the educating or convincing requires actual data. Industries may have some idea about the technology but unless they are convinced about the return, they will not invest:

> *"if you want to convince the people, you will give the data for example, for steel companies we give data for new steel .. show the demand and there is a shortfall" (ORG1-SCT5-20.)*

The interesting part is how the information is placed before industries. Earlier, for the entity supporting scientists-driven research, presentation of information in the proposal was mandatory through a structured format. Thus a technical report on the technology or the process was part of the proposal document. For this current entity under discussion, the information exchange, however, takes place prior to submitting the proposal through meetings and discussion sessions and the final proposal may not contain information in detail:

> *"but the proposal which will go to the industry .. will be 1 or 2 pages .. as small as possible .. because nobody will read it if you give 10 pages" (ORG1-SCT2-41).*

Thus, when entities expect a business return, the type of information demand and the nature of information exchange often become different from those interactions that are oriented to encouragement of knowledge generation.

5.2.1.5 Summary

A summary of various entities with which scientists of ORG1 and ORG2 interact, the nature of information demand and exchanges is provided in Table-15 and Table-16. The construct *social actor* illuminates the interactions that necessitated explicit information exchange between scientists and external entities. Though ORG1 interacts with entities which procure the outcomes of in-house research conducted at ORG1, those entities, according to the informants, are not interested in any information exchange. As a result, those external interactions lead to "no information exchange" or "nil information exchange". No formal or informal information exchange takes place in this interaction. It is obvious that all these information exchanges lead to information gathering activities by the scientists.

Table 15: Entities at Project Initiation – Across Space and time

Entities	Case - ORG1	Case - ORG2	Longitudinal observation
Entities supporting scientist-driven research	Yes	Yes	Nil
Entities supporting industry-guided research	Yes	No	Nil
Entities procuring in-house research outcome	Yes	No	Nil
Entities with prospective research collaboration	Yes	No	A new phenomenon in 2012

Table 16: Characteristics of Entities at Project Initiation Stage

Entities	Who initiates research ideas	Who executes	Information Demand	Information exchange
Entities supporting scientist-driven research	Scientists	Scientists	Strong	Formal
Entities supporting industry-guided research	Collaborative	Scientists	Strong	Formal or informal
Entities procuring in-house research outcome	Individual firms	Scientists	Internal	Nil
Entities with prospective research collaboration	Scientists	Collaborative	Strong	Informal

5.2.2 External entities responsible for project review/monitoring

A formal review of a project proposal before it is approved and periodic monitoring of the progress of the research are part of the life of a project. During this process, scientists have to come in direct contact with reviewers who are appointed by the funding agencies.

Scientists' information-gathering practices are often directed at this stage to display the comprehensiveness of information provided and their knowledge of the current state of technology. In order to understand how much stress they give on comprehensiveness of information, one scientist was requested to consider himself in the place of a reviewer and judge the proposal. The scientist was candid to admit that he would consider the applicant's knowledge of latest state an important factor (ORG1-SCT2-35). This can be extrapolated to the scientists who apply for funds and can be assumed that they also try to communicate to the reviewers about their knowledge of the current state of technology.

After the initiation of a project, the progress of research is monitored by the extended arm of the funding agency. This is applicable for both ORG1 and ORG2. This review process demands information awareness and appropriate information coverage. These information resources help scientists to be a more competitive candidate for a project (ORG1-SCT6-10 & 11).

As long as the project is continued, it is monitored from time to time by a monitoring committee. While the project proposal and its review demand adequate knowledge of the current status of the field, the monitoring demands a proof that "*enough has been done*" (ORG2-SCT3-48/49). In order to ensure that “enough-ness” scientists have to know the current literature so that they can establish the adequacy, if challenged.

One informant reported that during the direct interaction with the monitoring committee, he remains prepared on aspects beyond his project. In a direct interaction and conversation with experts, the discussion can turn to any direction and it is safe to remain updated about the current state of the technology in general (ORG1-SCT4-54). Such preparedness with information also shows him in good light before reviewers as a representative of ORG1.

As it stands, interactions with entities that scientists come across at this stage are direct and sometimes demand more broad information. Exchange of information is often necessary here to establish the completeness of the work. Such exchange of information takes place verbally in face-to-face meetings.

5.2.3 Interaction with entities during scholarly communication process

Scholarly communication is a process in which scientists take part, in addition to their assigned jobs within the organization. Information exchange is most obvious in this process. This communication process may take place in a formal or informal mode. Before presenting the findings in this regard, a brief introduction on how scientists of ORG1 and ORG2 become part of the scholarly communication process is described.

There are two reasons for scientists participating in the scholarly communication process. One is the organizational mandate that considers publication in good journals as credentials for career advancement. This career incentive drives the scientists to attempt to publish their works in journals and also in conferences. The other reason is that according to the culture of the scientific community, research findings are shared within the community in order to help science progress. Science has its own institutionalized system which facilitates verification of each knowledge claim. A scientist, who aspires to create new knowledge or claims to have created new knowledge, has to stand before this process of knowledge verification. Impartial and rational examination of any scientific claim is the culture of an epistemic community[27].

This section describes various entities and the nature of interactions and information exchanges during the process of scholarly communication, as perceived by the scientists.

5.2.3.1 Interaction with the institutionalized review system

The review system is an essential component of the journal publishing system. Because of their roles in such an institutionalized system, reviewers command respect from the prospective authors. Reviewers may seek clarifications, raise questions or suggest an alternate explanation of a result. In all those cases, it is incumbent upon the scientists to satisfy those clarifications or answer the questions.

The interactions between journal reviewers and the scientists are formal and indirect. It is formal because all communications are conveyed through written reports. Clarifications/questions are sent to authors formally and scientists also send their responses. It is indirect in the sense that for this purpose reviewers and scientists do not interact face-to-face.

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[27] Epistemic community is discussed in more detail in Chapter-8,

Interaction with the review system creates immense information demand on the scientists. Collecting extensive as well as most current information becomes essential as only information might help them achieve the following:

(i) To satisfy the questions raised by reviewers who are in more powerful position with respect to the scientists[28];

(ii) To establish the viewpoints and merits of the findings against the challenges posed by reviewers and thus assert themselves, notwithstanding their respect for the reviewers ;

(iii) To establish the merit of their work over others by comparing what other researchers have done, processes followed and results obtained;

(iv) To establish that their research is connected to that carried out in their field and their ideas are not "absurd"; by providing citations to other published works, this connection is established;

(v) To cover as much information as possible and display it in an attempt to avoid any adverse comments on the gap in information. This, scientists feel, is essential for two reasons. First, in the current age of Internet, no data can be suppressed. Second, in the current ICT supported reviewing process, many publishers allow reviewers to access

[28] While scientists generally admitted the supremacy of the reviewers to raise questions on the claims made in their papers, a different perspective emerged from some informants of ORG1. One scientist commented that by providing information, citations, reviewers are assisted in understanding the perspective of research. A similar view was echoed by , another scientists who conceded to this notion of "being helped". He admitted that accepting the reviewing job is rewarding because that gives the scope of updating the knowledge.

respective publisher's journals as part of the review process resulting into easy tracing of information/citation by the reviewers;

Overall, scientists of both organizations take active part in communicating their research findings through journals. Journals are the most institutionalized mode of such communications and reviewers form a part of such institutionalized communication. Thus responding to the reviewers becomes a rule-like activity. Even when scientists want to establish that they are correct and not the reviewers, they need to provide enough evidence from the literature to support their view. This leads to extensive searches for information.

The process of knowledge claim review also directs the discussion towards the notion of "epistemic community" and "invisible college". A separate discussion follows in Chapter-8 on whether or how these scientists form a part of epistemic community and invisible college and how those entities might shape the information-gathering practices by the scientists of these organizations.

5.2.3.2 Interaction with knowledgeable individuals

Scientists also participate in another form of scholarly communication when they present the findings of research in conferences, professional meetings, project monitoring meetings that are attended by peers or "knowledgeable individuals". These face-to-face interactions with peers generate information demand of a dynamics that is different from the interactions that are described in previous sub-sections. These interactions are direct in the form of question answering sessions and the mode of information exchange is verbal and informal. Unlike the reviewing system in which scientists get a reasonable amount of time to find information and frame an answer, information demand in such face-to-face interactions must be met instantaneously. As the interaction takes place through discussions, such interactions sometimes may lead to information demand on a more general or related areas. Thus an information readiness is considered a safe strategy by the scientists.

Additionally, the interaction taking place in the presence of an audience creates a different dynamic. Scientists acknowledged that it is a highly embarrassing situation if contemporaries or junior peers in such an audience point out that the author's control over the published information is questionable. They also admitted that they can only claim to be peers when they are on par in terms of knowledge with others.

In such interactions, it becomes very challenging for the scientists to display themselves at on par with those knowledgeable individuals in a large gathering. This leads the scientists to engage in information scanning and updating not only in their own area of research, but also in more general but related areas.

5.2.3.3 Interaction with the scientist community – competition and connection

Information gathering is also directed at keeping track of competitors and collaborators in a specific area of research. Scholarly communication opens a platform where scientists meet their prospective collaborators and competitors. Science progresses through both collaboration and competition.

Information gathering, with respect to competition, can be helpful for scientists in various ways. Information sensitizes them regarding new open issues for research and helps in strategizing to move ahead of others so that their work is recognized by other community members. Scientists feel a sense of supremacy when they can publish ahead of others so that others must have to cite their works. Regular information gathering/scanning helps them to monitor the publishing trend so that they can plan the timing of their own publications. One scientist at ORG2 was confident of her authority and stated that no one in her area can avoid citing her work.

Getting to know the publications also helps scientists to strategize on how to show the novelty of their work compared to what has already been published. Unless this novelty is established, publishers do not accept a paper for publication. Besides, knowing the literature was also felt important by the scientist to survive in the "market". Knowing publications and their quality also help scientists to identify a space within the community where their work will be appreciated and where they can build an intellectual space of their own (ORG2-SCT2-18, ORG2-SCT2-63). One ORG1 scientist reported the benefit of being "on top of the information" (ORG1-SCT5-57*)* in making his voice heard over competitors at the negotiation table. Table-17 shows examples of various prevalent dimensions of competition within the community.

At the same time, connections with members of a community are equally important for collaboration without which modern science cannot progress. Through publications, scientists working in the same area at different geographical locations come to know each other and develop collaboration. Scientists' habit of regular information scanning helps them in this regard too.

Staying connected to a community is also important for yet other reasons. There are gains of being informed and risks otherwise. Unless informed, scientists may put forward proposals that might not get an interested audience and will thus be disconnected from the community. Redundant research will earn them disapproval of other community members. On the other hand, community members remain up to date and can recognize novel work and appreciate good work as well as its authors. Table-18 shows examples of how scientists' information-based actions are reciprocated by the community.

Table 17: Competition within Community

Criteria	Example - ORG2	Example - ORG1
Supremacy through citation	*"– it also gives me an idea on how the scientific community is pursuing my work ... whatever I have done is helping somebody to go ahead ... I will take precaution that the competition may become very severe" (ORG2-SCT2-46)* *"in the area that I am working .. there are many researchers, .. and another advantage that my group has .. the fundamental problem (technical term), I am the pioneer in that field and nobody claimed that .. because if somebody publishes, she or he has to refer to my work " (ORG2-SCT3-42)*	*we know that <refers to some product> .. so I know who are the people working ..if I publish they would cite my paper or if they publish I have to cite their paper .. so that is a pressure .. but another way it is good also .. we know who are the competitors" (ORG1-SCT5-73)* *" recognition .. moment I am publishing in that area, people have to cite, but if I am not the first, then I have to cite the other's paper" (ORG1-SCT5-74)*
Establishing novelty over others	*"– find out what my competitors are doing … because a journal will accept your work only when it is novel .. . .. now when you have to say something novel .. you have to come out with entire literature review .. and place it such a way to convince the editor that yes I have something new " (ORG2-SCT2-38)*	*"first you do not want to duplicate what already has been done.. you want to make sure that whatever you are publishing is not duplicated….and apart from that you of course want to know what has already happened…. How you are adding… you have to show novelty in your research… that novelty has to be vis-à-vis other researchers' works" (ORG1-SCT4-75).*
Market	*"to be in this profession, I have to be aware what is going on – I should have up to date in that way" (ORG2-SCT1-34)*	*"you cannot describe how important it is … without that <information> you cannot do – you have to be up-to-date – one cannot stand in the market – that is – information is very critical nowadays" (ORG1-SCT3-16)*

Table 18: Community and information based actions

Action	Example	Community Reaction
Uninformed research	*"it is a major risk ... you are totally* ***out of business*** *... only thing you will have your job and salary .. and you will be totally out of business .. because it is a government job, I will not loose it ... otherwise that is the end" -(ORG2-SCT2-33)*	Out of Community
Redundant work	*"because you cannot do anything redundant now a days ...... now everybody knows what is happening in the world ... either you do something novel or you do not do anything at all..if you do something redundant, people get upset with you" (ORG2-SCT2-62)*	Disapproval
Making place through publications	*"<how electronic resources help in social world> people know each other – people know me by name ,,more number of people are referring . when they say that I have read your paper.. shows standard of my work– it helps me in introduction" (ORG1-SCT1-24)*	Acceptance
Making place through publications	*"my publications are archived in electronic resources… look at my publications… read them…know about the areas that I am researching…it is both ways… I know about other people and they also know about me…. So recognition wise it is very important" (ORG1-SCT4-80)*	Recognition
Making place through publications	*"Any one refers that paper – higher citation that paper – here is a group in India. . they know ORG1 is a place where somebody called xxx who are working in this field – through publication only you are known to the people so that is one . . likewise citation is very critical. . once a person cites your paper that paper has some meaning – other wise if none is citing" (ORG1-SCT3-23)*	Acceptance
Avoiding duplication	*"first you do not want to duplicate what already has been done.. you want to make sure that whatever you are publishing is not duplicated…." (ORG1-SCT4-75)*	Approval
Informing	*"and in fact we thought that there is no review in this field ….and we found that this is the area that we were supposed to bring our one review for the benefit of international community of researchers " (ORG1-SCT3P-19*	Benefit
Following a culture	*" wherever we go we have to give some information. . what I am doing, how I am doing this work, idea, how did I get the ideas, advantages/disadvantages. .academic or practical application all ideas . . we then go for extensive literature search" (ORG1-SCT1-16)*	Acceptance

5.2.3.4 Interaction with the knowledge dissemination channel

Journals as a knowledge dissemination channel become another entity which scientists come across as they receive invitations for editorship or writing reviews. These assignments are in recognition of the reputation of the scientists. With respect to this professional recognition, scientists view information gathering from two different perspectives:

(i) At one level it is important to keep themselves knowledgeable by extensive reading which will be transmitted in their judgment while reviewing. This will lead the editorial board to have trust in the knowledge base of the scientists as reviewers (ORG2-SCT3-25).

(ii) At another level, it is important to search for literature in order to understand the literature and the merit of the paper received for review (ORG2-SCT3-53).

Besides, intense search for information is required when they enter into writing a review on a specific topic for a journal or prepare a review in the discipline.

5.2.4 Interaction with administrative entities

Scientists of both ORG1 and ORG2 reported interacting with administrative authorities. Various information resources meet the demands of such interactions. ORG1 is subjected to queries from higher administrative bodies regarding project status, expenditure status, and so on. A management information system developed internally is used by ORG1 scientists to meet such information demands.

A different type of information gathering is done by scientists in this regard. Information on their own publications is required to be produced in their applications for awards, grants and so on. Scientists regularly collect such information. ORG2 scientists also collect such information in order to establish the organizational performance when subjected to government review. Such reviews are conducted once every few years. During the time of review, individual scientist's performances are considered. One of such indicator of performance are various citation measures such as h-index and the impact factors of journals where her/his papers have been published.

5.3 Characteristics of information demand from various entities

The characteristics of information demand during interactions with various entities as discussed above can be summarized from three angles. Those are (i) whether interactions with the entities make a demand for information exchange; (ii) what is the nature of such information exchange; and (iii) the type of information to be exchanged.

Demand on information exchange: the previous sections suggest that whenever knowledge development is the business for scientists, information exchange is often mandatory during interactions with various entities that matter in such knowledge development processes. On the other hand, when the business is on the knowledge-based processes such as the cases of industrial firms seeking solutions for their operational problems from ORG1, there is no information demand and/or exchanges during the interactions. As explained by scientists, such industrial clients do not care for the supporting information, interactions with this entity does not demand any information exchange.

Nature of information exchange: while most formal and rule-like demands for information exchange take place through formal reports, such as literature reviews and responses to reviews, in many instances – as reported by the informants – information exchange takes place informally and verbally. Formal and explicit information demands are made when (i) scientists apply to different agencies for funding; (ii) scientists apply for awards; and (iii) interact with a reviewing system. Applications for funding or for grants are to be made through specific formats where those formats make explicit demands for literature review/citation data of publications. Informal and verbal exchange of information takes place mostly during face-to-face meetings.

Type of information exchanged: For these scientists it is technical and scientific information available in journals and similar channels that is predominantly exchanged. Wherever literature review is required, the review report is based on such information. As ORG1 is now taking a new direction, the scientists of ORG1 are also looking for market and business information to interact with industries. While applying for awards or in response to some high level administrative authorities, information on citation-related data are required. Some of the information-specific tasks require specific object-level data that are not available through any formal channel. Such information is collected by means of a personal drive.

5.4 How information gathering helps in interactions with external entities

This chapter started with conceptualizing scientists as social actors with respect to their information-gathering practices. This led to identifying various other organizations and individuals, referred to as external entities, whom the scientists come across while meeting the goals of their respective organizations. It also helped to identify various information demands raised during the interactions between scientists and those organizations and individuals. In order to meet those information demands, scientists regularly engage in information gathering activities.

The enquiry surrounding social actor was further extended to understand, how those scientists view such information-gathering practices or what meanings they attach to their information gathering activities when triggered by such information demands. This understanding was guided by another sub-question (RQ#1(b): How *do information-gathering practices help those social actors meet the institutional forces of those interactions*?).

This section addresses this sub-question. To this end, the interview transcripts were subjected to thematic analysis that elicited several concepts. Scientists perceive that information-gathering practices and responding to information demands helps them, in: (i) Alliance formation (ii) Confidence building (iii) Identity (iv) Recognition (v) Scientific inquiry (vi) Load shifting (vii) Performance evaluation and (viii) Community relations. These themes are discussed below.

5.4.1 Alliance formation – a strategy through information-gathering practices

Information-gathering practices and subsequent information exchanges are important in the formation of alliances between research organizations and industries. ORG1 is now pressured to find those industries that will agree to be research partners. The scientists are targeting industries to adopt the processes/products developed by them and produce the materials in large scale. In this new relation the partner industry has to understand the theoretical basis of the technology and ORG1 scientists have to understand the marketability of the technology so that the partnership becomes beneficial for the industries. Scientists recognize that on the one hand they need to educate industries about the prospect of futuristic materials they have developed in the laboratory, and on the other hand they have to convince and assure the industries about the business prospects. Thus while interacting with industries, they are often required to produce convincing data about the futuristic materials and project themselves as credible partners. This is possible when they have enough information, both in the area of technology and techno-commercial matters, and they use that information to facilitate the interactions.

Data supporting business success and business prospects of the technology/materials are very much essential in those exercises. According to the scientists, it is most important to provide evidence that a similar product has a market prospect. At the same time, ORG1 scientists are aware that industries too keep watch on current scenarios regarding such new materials and/or processes. Making a proposal without the support of knowledge on the current status might risk the credibility of ORG1. Hence ORG1 scientists regularly scan and compile information for ready reference during interactions with such industries. Table-19 highlights the examples of various dimensions of “Alliance Formation” with regards to information-gathering practices.

Table 19: Information-gathering practice in Alliance Formation

Characteristics	Examples
Convincing	*"if you want to convince the industry then you should have in your background this information .. otherwise you cannot convince the industry " (ORG1-SCT2-40)*
	"if you want to convince the people, you will give the data for example, for steel companies we give data for new steel .. show the demand and there is a shortfall .. so if you people can venture into that .. whatever structure into that" (ORG1-SCT5-20)
	".. if it is a sponsored project then convincing <without data> will be really very difficult task" (ORG1-SCT5-47)
	"oh yes .. if it is a large project, we have to prepare a report .. as I said, factual things have to be there .. someone has written something" (ORG1-SCT5-25)
Credibility	*".. we need a partner .. we are going for a particular steel .. so if I give a proposal without proper knowledge .. they know what is going on across the globe .. will say already someone has done it or they themselves might have done that .. no point .. why do I fund your research" (ORG1-SCT5-79)*
	"if we do not get those information, we have to skip that information .. it is happening many times .. many information are not really available..<on credibility if information is not there> yes (stresses)" (ORG1-SCT2-32)
	"*but without proper knowledge if I tell them that I am going to have that product .. which someone has patented .. they refuse .. and I have to <even in same area> use different process otherwise there will be patent infringement .. so I have to be very cautious .. otherwise they will not accept" (ORG1-SCT5-81)*

Even though information is so important and vital in *alliance formation*, there is no formal exchange of information. ORG1 scientists use the information extensively while making presentations to the companies. But the final proposals that are sent to companies/industries for financial consideration are very small reports bearing succinct information because, as reported by the scientists, the prospective industry partners would not have time to read a large report (ORG1-SCT2-42*)*.

5.4.2 Confidence building supported by information practices

Information-gathering practices lead scientists to collect "evidence" in order to establish that their works are not idiosyncratic but are, rather, part of a progression of research done earlier[29]. This is an important aspect of science research. Citing earlier works helps them in gaining the confidence of their research community. Taken from a different angle, this is the characteristic of an epistemic community where members build upon a specific school of thought.

Confidence building is not only necessary in publishing research outcomes, but it was also found important often when scientists engage in other interactions. A convincing proposal that could earn financial support must demonstrate that the applicant scientist has comprehensive knowledge about current knowledge. The project monitoring stage invites many questions from the project evaluators and unless well read, scientists cannot justify or satisfactorily respond to the evaluators. Table-20 gives examples of the notions of "evidence" and "convincing" in the process of confidence building.

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[29] There are other views of citations too. Authors cite to contradict. This has also been captured and reported in "identity".

Table 20: Information-gathering practices and confidence building

Characteristics	Examples	
	ORG2	**ORG1**
Evidence	“list of references .. I want to hypothesize some new formula or some new findings … so I have to give some support .. my thinking is not absurd … … supporting evidence – reference is our supporting evidence” (ORG2-SCT1-26 & 27)	“for the sponsors they know that <**through the tech report**> what I am doing is **incremental**… additional to what is available..,. in the market or in the literature …that gives the accountability” (ORG1-SCT4-40)
	“there would have been some publications .. even in public domain .. even if it is intellectual property right protected such as patent .. then you can buy that .. but if there is no scope of retrieving data .. there is no such evidences “ (ORG2-SCT3-19)	“the reviewers - when they see the paper, they search references. . they will see whether this work is a repetition, new or alteration and depending on that they will review the paper. . . . whether we have consulted the latest literature or not.. when we are doing a work, we consider latest research” (ORG1-SCT1-12)
Convincing	“I do not think here I could get any help <referring to her unique research concept> .. there is no such document, no such publications, no such reports.. so how can I get any help from the Internet.. under such circumstances, I never got any help from the Internet “ (ORG2-SCT3-17)	“<on a question on the risk if there is no literature support> quite a good risk .. if it is a sponsored project then convincing will be really very difficult task” (ORG1-SCT5-47)
	“actually in the beginning you have to do it largely <literature search> because you have to know the background, how you can justify that your work is essential .. to funding agency .. because why you will be given the money .. whether it is at all necessary .. so you have to do lots of Internet searching “ (ORG2-SCT3-46)	“see if I sit on the opposite side .. I am the person who will approve the project .. I will always give preference to those who know the present status, who knows the capability …. and if a person presents saying everything as “my capability” .. I try to give less point to them .. as a reviewer of that I always feel that he should know what is currently going on and what is capability also” (ORG1-SCT2-35
	“you have to write a paper or write a report .. monitoring also goes on ..by those who are funding .. at that time you have to make a report ..and you have to read a lot .. because you have to justify “ (ORG2-SCT3-48)	“if you want to convince the people, you will give the data for example, for steel companies we give data for new steel .. show the demand and there is a shortfall “ (ORG1-SCT5-20)
	“<on a question on how interpretation made with the help of citations becomes useful> ... there are reviewers of the paper .. they may raise questions .. why you have written so .. then I have to give my explanation again to satisfy them “ (ORG2-SCT3-14)	“if it is a industry sponsored project, … industry already has some idea what they want to do .. but if you want to convince the industry then you should have in your background this information .. otherwise you cannot convince the industry “ (ORG1-SCT2-40)
	“suppose I want to use some new technique . . so for that new technique I give reference – if I want to say – people may not believe it so I put some reference so that it is already there – not my own – so there is no risk in the process “(ORG2-SCT1-25)	“if we do not get those information, we have to skip that information .. it is happening many times .. many information are not really available .. <on the question if credibility hampers if information not found> yes (stress)” (ORG1-SCT2-32)

5.4.3 Establishing identity with the help of information-gathering practice

Scientists are sensitive about who they are, their credibility, and the novelty of their work when they interact with anyone. Not only as an individual scientist, but also as a representative of an organization, group or country they are extremely protective about their identity. As it emerged from the interviews, information-gathering practices equip them with adequate information and contribute to building/retaining their identity.

Identity has different shades. Scientists desire to be identified as knowledgeable and credible. They are also keen to have a community identity. Scientists are concerned about projecting themselves as knowledgeable individuals (Table-21: **Identity – knowledgeable self**). They often meet peers at face-to-face meetings such as project review boards and so on. These peers are subject experts and are in the forefront of research. Discussions in such meetings often extend beyond the scope of the specific research agenda. Scientists not only want to participate in such discussions, there is also a desire to establish their knowledge in those areas. On all such occasions, scientists want to rise above the situation. Going unprepared to such direct interaction platforms can be very embarrassing. Situation can also be very embarrassing if any challenge comes from contemporaries or juniors[30]. Overall they try to update themselves before such meetings and interactions. They sometime try to assess who else might be coming to the meeting, their areas of specialization and then accordingly make adequate preparations so they can participate in the dialog. As one scientist admitted, if he wants to be considered a peer, he must keep himself updated.

[30] Interestingly, one scientists agreed that if such challenge comes from a more senior person, that can be turned into learning opportunities.

Credibility is another aspect that scientists want to establish (Table-21: **Identity – credible self**). Whenever they submit research projects or write papers for journals, scientists examine a whole range of literature and try to establish the point of novelty and the credibility of their work compared to that published in the related literature. Thus, regular information-gathering practices often become necessary.

Collective identity (Table-21: **Identity – collective**) is also considered important by the scientists. In a meeting where scientists meet their international peers, they are sensitive about the fact that they are representing the country and should remain as much informed as possible. On other occasions when a scientist represents the laboratory, she/he remains careful so that the lack of knowledge does not bring shame to the organization.

Another interesting aspect of identity is ego. One ORG2 scientist candidly admitted that anyone proposing a study in her area and not citing her paper would have made her angry (ORG2-SCT3-70). This can be reversed to infer that scientists keep watch on the literature published by authorities in the field and cite those works lest they insult the reviewers.

Table 21: Information-gathering practice and identity of scientists

Identity	Examples	
	ORG2	**ORG1**
Knowledgeable self	*“you have to be educated about your area .. otherwise anybody can challenge you .. nothing happens but it becomes very embarrassing” (ORG2-SCT2-40)*	*“it always happens <requiring on his part to be prepared with information>.. it not only happens for sponsors.. it happen for monitoring committee… whenever <always> I have to present before a monitoring committee, I have to be <gives a sense of binding> aware not only about my projects but also on the state of the art “ (ORG1-SCT4-54)*
	“<on the risk of being embarrassed if not informed while attending any direct interaction>I think the same way .. and if you are a senior person .. the risk is more than if you are a young .. like if you are a lecturer or researcher .. you do not have any faculty position yet .. you may be ignorant of so many things .. when you are a senior professor you cannot be ignorant .. so there is profuse risk “ (ORG2-SCT3-75)	*“these are the people who are in the state of the art…for example we have a project from X development fund and the monitoring committee is composed of many people who are <stressed> in the XX industry….top brasses in the XX industry.. some are academicians.. they are aware <academicians and top brasses of industry> of the state of the art… so I have to be in touch with the state of the art < way to match the knowledge of others>. And I have to respond to their question.<forced to do this>.” (ORG1-SCT4-55)*
		“ the risk < of not being aware and present information> will be loss of face….as a representative of this laboratory, I am not aware of this <implies a failure in acting – keeping himself update>, it will cause loss of face.” (ORG1-SCT4-57).
		“<on a situation when someone is pointing out on his not knowing some information> I will feel very bad .. kind of embarrassment “ (ORG1-SCT2-45)
		“some of the things that help us is that we get papers of others for review .. from journals .. even if many of the time you are short of time .. I accept that .. just to know what is happening .. those papers are sometimes very informative .. during review process you want to go and cross check many other journals .. that gives lot of hold on information .. one major problem is that we do not have access to many of the journals .. but if you review the papers .. at least that category of journals we have access “ (ORG1-SCT2-46)
		” <on the chance of being challenged for not knowing some information> oh yes .. I claim that I am the peer in that particular area ….obviously I should know …. if there is a meeting like this .. I have to get myself updated .. first of all who are the people coming in that .. also it is not good idea if you keep mum .. unless you show up it is very difficult .. so you should talk .. but when you are talking, it must have some content .. when you are criticizing .. you must have knowledge on

Identity	Examples	
	ORG2	ORG1
		that ….. I check who are the people coming and what they are going to present .. I just keep an update on that .. it may not be possible that all the areas I am fully updated but try to get majority of cases" (ORG1-SCT5-77 & 78)
		"but at this stage yes, I should know the phenomenon-wise and concept wise .. otherwise it is embarrassing .. if I claim that I am also in the race for that area" (ORG1-SCT5-60)
		"<laughs> .. yes it is .. it depends on peers .. if the age difference is not so much then it is embarrassing .. but if age difference is high then no problem…. I will be in the process of reading that .. senior people say you have to read this ..<it is OK from senior people" (ORG1-SCT5-59)
Credible self	*"because a journal will accept your work only when it is novel .. you may do a lot of research work .. unless something novel comes out, it is not going to be accepted .. and acceptance by a journal is the only criteria .. for our development .. now when you have to say something novel .. you have to come out with entire literature review .. and place it such a way to convince the editor that yes I have something new .. now that requires lot of intelligence...sometime you can see what is novel .. sometime you have to manipulate....put the things in such a way that it looks novel…so you have to keep on searching the literature ..try to connect different literature and then come out with your hypothesis...based on their study, my hypothesis is important and I solved it" (ORG2-SCT2-38)*	*"first you do not want to duplicate what already has been done.. you want to make sure that whatever you are publishing is not duplicated...... how you are adding… you have to show novelty in your research… that novelty has to be vis-à-vis other researchers' works .. <novelty is shown by backing up through literature>" (ORG1-SCT4-75 & 76)*
	"if you read more, then you learn more, if you learn more you can give a better explanation for your work .. and if you write the better explanation.. it shows that your judgment is correct .. so whatever offer I got from elsewhere also .. offer means editorial offer reviewing offer .. everyday I get at least 5 papers for review .. mostly I decline … that depends on my eligibility" (ORG2-SCT3-25)	*"we go only through the project application. . . my knowledge base has already been used in that project application. . at that time whoever the reviewers are . . I believe they are more capable. . when they see that ok this project has something innovative and it is different from others then it is naturally the chance of getting fund is more" (ORG1-SCT6-10).*
	"there are some literatures some reports … I just want to take advantage of that and get my knowledge more and . . how can I say – I want to be more knowledgeable with the help of those things – whatever I doing on my own I want to take the benefit of that also and I want to improve my doings and my science and my experiment ….. <on how does it help in the	

Identity	Examples	
	ORG2	ORG1
	competition> to establish so that they think … yes she can do it" (ORG2-SCT1-17 & 18)	
Collective	*"when we are going to some international meeting .. then I am not only representing ORG2, I am representing my country .. so it is our responsibility to be conversant or to read everything .. whatever possible information is there ." (ORG2-SCT3-76)*	*"the risk < of not being able to present information> will be loss of face….as a representative of this laboratory, I am not aware of this … it will cause loss of face" (ORG1-SCT4-57)*

5.4.4 Information-gathering practices in support of gaining recognition

Recognition is very important to scientists. Recognition can be either from other scientists or it may be giving attribution to other scientists. From this perspective, scientists consider electronic resources and information-gathering practices very helpful. As their publications are archived in various resources, they view such resources as a platform to showcase their work and gain recognition from others (ORG1-SCT4-80). Information-gathering practices are used by scientists to keep watch on the work of competitors, and it creates pressure on the scientists to work quickly because whoever publishes first will be cited by others and thus will earn recognition first (ORG1-SCT5-73). Scientists who are confident that they are the pioneers in an area are also confident that others will come to know about their work and will have to cite them, resulting in growing recognition (ORG2-SCT3-42). One informant confided that peer appreciation in the form of knowing and recognizing one's work are all that matters, and without such recognition a scientist is an idle person (ORG2-SCT2-21). They are also careful about recognizing and thus acknowledging predecessor's work (ORG2-SCT1-28).

5.4.5 Scientific inquiry and the role of information practices

The role of information practices in scientific research is well known, and information is the backbone of scientific research. In this study the traditionally accepted role of information, namely merit and newness of knowledge are evident. There were, however, some additional views about information practices articulated by the scientists. Those are continuity, challenges, and successful participation in the scientific inquiry and how information practices help in these areas.

Doing research is the process of conducting scientific inquiry. The process of scientific inquiry is highly institutionalized through the review process at various stages – from proposal writing to presentation of findings. In that entire process, information gathering and subsequent information exchanges have various shades as viewed through the eyes of scientists. For instance, information helps to establish the merit of a research proposal (**Scientific inquiry – merit**). Having established the merit of the proposal they can argue why their projects are worth funding (ORG2-SCT3-46). Initial information search helps the scientists to understand how earlier research was done and whether they can surpass previous efforts, thus increasing their chance of being funded (ORG2-SCT3-09).

The aim of scientific inquiry is to create new knowledge (**Scientific inquiry – new knowledge**). This notion of "*newness*" has to be underscored in different ways. Knowing what has already been done prior to embarking upon a proposal is thus important. ("*we have to be very thorough about our information......make sure that there is no unnecessary overlap" -- ORG2-SCT2-17).* That there is "no point in reinventing the wheel" has been echoed by scientists of both ORG1 and ORG2 and here is the role of information-gathering practices (ORG2-SCT1-22). Scientists not only generate new knowledge *per se*, but they are also entrusted with generating new meta-knowledge, i.e., a review of what knowledge has already been created. Creation of this meta-knowledge certainly requires being aware and having access to the literature (ORG1-SCT6-13). At the time of communicating results of their research through papers, they have to establish the "newness" of their findings. To this end, existing data are collected directly and are used to interpret the findings (ORG1-SCT6-14). At the same time, the absence of prior data is also viewed by scientists as an opportunity to claim the newness of their work, although at times, they may feel insufficiently capable of convincing others (ORG2-SCT3-51).

So far, we know that scientific research, or any research, takes advantage of gaps, and that new studies are designed based on such gaps. The scientists in this study confirmed that they are concerned in establishing that their work exhibits continuity with earlier work. Scientific inquiry progresses in a continuous way. Hence though it is necessary to show the “newness” and merit of one’s work, it is equally important to establish that the produced new knowledge is not something abrupt. This implies that scientists need to constantly find and understand the status of science in a given research area (**Scientific inquiry – continuity**) and relate their findings to the past findings. By providing the state of the art report, they try to achieve this (ORG1-SCT1-06*).*

A very interesting statement was made by one scientist regarding the continuity of scientific research. By establishing continuity, they can also make themselves accountable to the sponsors with respect to the advanced nature of their work compared to earlier findings (ORG1-SCT4-40*).* One informant who works in plant genetics admitted that society is very sensitive to the outcome of research in this area and scientists, in addition to conducting scientific inquiry, also have to counter concerns of social activists. They have to convince these activists at meetings and it’s helpful if they can demonstrate that others are also engaged in such research (ORG2-SCT1-58).

Scientific inquiry constantly faces questions from peers. Scientific claims have to clear challenges and doubts before knowledge is made public through journals (**Scientific inquiry –**

challenge). Scientists consider it as challenge to establish that their views are correct (ORG2-SCT1-15*)*. Even very senior scientists respect such questions from the reviewers and attempt to satisfy them (ORG2-SCT3-13 & 14). The challenge can be in the form of a question on the correctness of procedure, findings, and so on. In the face of such challenges, scientists return to the literature to verify and defend their arguments. Another form of challenge faced by scientists completeness – has enough work been done? Consulting the literature exhaustively they try to establish the comprehensiveness of their work (ORG2-SCT3-49*)*.

The openness of the data in the Internet era poses another challenge. The Internet has facilitated access to vast stores of information and it is hardly possible to suppress any data because someone may detect such omissions and point them out. As a precaution, scientists try to be as comprehensive as possible in their searches (ORG2-SCT3-35).

Another form of challenge is faced by scientists when they present data in face-to-face meetings. One informant admitted that the dynamics in such meetings is completely different from the challenges faced from journal reviewers. The presence of many peers in the same place simultaneously brings a range of information in such meetings. Challenges can come from any peer who is better informed. Not being able to address such challenges outweighs the success of publishing the paper on that topic. Hence, scientists strategize to keep up-to-date before going to such meetings (ORG2-SCT2-39*)*. While information-gathering practices help scientists to face such challenges, when such practices are not successful, it becomes very hard for them to meet the challenges (ORG2-SCT3-17*)*.

Successful participation in the ongoing dialog within the community (**Scientific inquiry – successful participation**) is another mark of scientists. Such dialog may take place through the formation of a sound research project. Unless well informed, scientists may not be able to formulate research projects and will not get entry into the community ("*they submitted their projects .. they have not gone thoroughly through the literature .. so they could not frame the proposal properly" -- ORG2-SCT3-69)*. This is another indication on how scientists think it is important to learn how to find information and use it strategically.

5.4.6 Load sharing through information practices

Information scanning sometimes can be viewed as load sharing with other entities. On several occasions, scientists compile and produce information that ideally should be done by the entities with whom they are interacting. Thus producing such information shifts the load from the entity to the scientists. This, however, has become a practice within the scientific community. For example, administrative authorities require information about the performance of scientists in terms of impact factor of journals where their papers have been published, h-index, and so on. But it is the scientists themselves who help them by providing such information from citation indexes (ORG2-SCT3-82).

5.4.7 Performance evaluation reporting

Another way the scientists look at their information scanning for various bibliometric data is to support their performance evaluation. Information-gathering practices of scientists are not limited to finding scientific information only. Scientists are often stressed to establish their performance and look for other data to address this. It was the informants from ORG2 who very respectfully mentioned searching for information such as the impact factor of journals or citation counts. Being a grant-in-aid institute, ORG2 has been subjected to a few evaluations by the government. One of the points such evaluation teams underscored was the impact factor of journals in which they published their papers. The informants acknowledged that considering impact factor and the h-index as a mark of success started abroad and now is now adopted in India too (ORG2-SCT2-50*)*. This is also applicable when they are considered for promotion (ORG2-SCT2-47*)*. As well, such data is required by agencies offering various fellowships (ORG2-SCT1-14*)*.

5.4.8 Developing and maintaining relationships within a community

As mentioned earlier, the community is a remarkable entity with which scientists have to interact. Community members are dispersed all over the world but they are connected through publications. The community also overlaps with other entities such as journal reviewers, project review committees, peers in face-to-face meetings and obviously a large number of audiences who come to know about the research through their own information-gathering practices. The community sets the norms, provides a field for collaboration and networking, while at the same time community members compete. Scientists attempt to develop their own network so they can depend upon such members for their intellectual work. Information-gathering practices often help scientists learn who is working in their respective areas and to develop such a network, respond to the competition generated within the community, develop research problem that the community would approve, connect to other members of the community and also to inform the community. Table-22 provides various facets of community relationships and shows with examples how information gathering might help in each facet.

Table 22: Community relation – various facets

Community relation	Example
Cooperation	"*yes that will help me … if somebody at Edinburgh -- someone is sitting there and doing particular type of research I am doing … she or he is thinking in same way that I am thinking .. sometimes there is head block – I cannot progress further or vice versa – so if we can exchange our ideas then it can open the head block" – ORG2-SCT1-0*7).
Getting entry	*": <how electronic resources help in social world> people know each other – people know me by name ,,more number of people are referring . when they say that I have read your paper. shows standard of my work (the term social world did not go well) – it helps me in introduction" (ORG1-SCT1-24)*
Competition	*"absolutely .. like we know that <refers to some product> .. so I know who are the people working ..if I publish they would cite my paper or if they publish I have to cite their paper .. so that is a pressure .. but another way it is good also .. we know who are the competitors" (ORG1-SCT5-73).*
	"for example there are databases which can connect ..publications..you are interested in one author .. his publications and then you go to his … in this way you can create a hierarchy of papers….which could give you some idea about what is the current trend in the research .. .in fact you can read the minds of the scientists…actually visualize what they are trying to do ..given this you have to take into account your scientific interests, professional interests.. after all you are expected to perform….so only thinking about science will not help always" (ORG2-SCT2-19 & 20)
Community approval	*because your cannot do anything redundant now a days ...... now everybody knows what is happening in the world ... either you do something novel or you do not do anything at all…if you do something redundant, people get upset with you... even they will ask you to sit quietly and not to do anything .. so you have to be very careful in seminar talks ... so that you do not talk anything redundant" (ORG2-SCT2-62)*
	– it is a major risk ... you are totally out of business ... only thing you will have your job and salary .. and you will be totally out of business .. because it is a government job, I will not loose it ... otherwise that is the end " (ORG2-SCT2-33)
Link	*"first you do not want to duplicate what already has been done.. you want to make sure that whatever you are publishing is not duplicated….and apart from that you of course want to know what has already happened…. How you are adding… you have to show novelty in your research… that novelty has to be vis-à-vis other researchers' works.." (.ORG1-SCT4-75)*
Connect	*"the risk is that you cannot communicate actually .. it will be communication problem .. communicate to your stakeholders .. communicate to your peers also .. this is always true .. for all types of projects" (ORG1-SCT2-44)*
	"I match with my findings – I know they are important – how of the rest of the world they think its importance – so I have to match with other's information" (ORG2-SCT1-38)
Inform	*"and in fact we thought that there is no review in this field – so and there may (some technology details) and we found that this is the area that we were supposed to bring our one review for the benefit of international community of researchers" (ORG1--SCT3-19)*

5.4.9 Compliance in the form of technical reports

Information-gathering practices and subsequent information exchanges are also seen as a form of compliance with various institutional processes that are part of the work lives of scientists. For grant-in-aid projects, which are also scientist-driven research, proposal formats make it mandatory to submit a literature review (ORG1-SCT2-43). This procedure is the same irrespective of the funding agencies, namely any government department or NSF or the Welcome Trust. The format for application is “telling” or “binding” since one component of such a reporting format is to submit a literature review. Other scientists also agree that developing a state-of-the art report for technology is unavoidable (ORG1-SCT4-34).

While funding agencies make it mandatory to prepare literature-based status reports using a prescribed format, for ORG1 this practice has also settled over the years to apply to other types of research in which industries participate. One of the scientists recalled that though he had been in ORG1 for nearly 18 years, it is only about ten years ago when one industry participant suggested that a status report be prepared. Such an informal process has now settled into a formal one in ORG1 and for almost all major research projects they prepare such a report at the start, even though there is no prescribed request for doing so.

5.5 A few observations on the notion of *interactions*

Interaction – the term often used in this chapter – is very broad and hence may lead to questions such as how interactions among scientists themselves contribute to information gathering and information exchange. There also may be questions on whether there is any effect of such interactions on interactions with the entities as described in earlier sections. This section clarifies these issues.

There is no doubt that scientists within an organization interact among themselves in all three events as identified in previous sections. They share each other's expertise in order to face the external entities. In other way, it can be said that external interactions sometimes drive internal interactions and information gathering activities. Similarly, there were indications that scientists interact among themselves in order to find a way to interact with external entities, that is prospective research collaborators and exchange information. Beyond this point, in this research it is not possible to say precisely how such internal interaction is impacting information gathering or information exchange with external entities. There are several reasons that are highlighted here.

First, *interaction* has been framed within the construct *social actor*, in this study. Accordingly, focus was on *interaction* that takes place between an organizational member and an *external institutional body*. This set the direction of observation (action →origin of action). The research did not have much scope to look at the action with further granularities. The information gathering activity which could be a collaborative activity or an individual effort was the starting point.

Second, any further probe into the interaction at local level to support information gathering activities would have required the scientist to recall many finer details which are part of day-to-day activities. Capturing such details at micro level through interview process would have created a cognitive load on them. An alternate process could be either a quasi-experimental process or to follow scientists in their laboratory and observe them. This study did not have any provision of either of these methodologies as explained in chapter 3. Because of the combination of the research questions raised and methodology adopted, it is not possible to provide any picture on the impact of external interaction on the internal interaction or vice-versa.

There is no doubt, however, that the glimpse about internal interactions, that occasionally surfaced in the overall picture of information gathering can lead to a more detailed study on how such internal interactions contribute to external interactions.

5.6 Chapter summary

This chapter reports on what constitutes an organizational context, with whom scientists have to interact, what types of information demands are made in such interactions which trigger information-gathering practices by those scientists, what are the characteristics of information exchanges that take place between scientists and their organizational context, and how scientists view such information exchanges. These findings helped to build answers to the two specific research questions, which are (i) What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes, engage in meeting the demands of their social world (RQ1a)? (ii) How do information-gathering practices help those social actors meet the institutional forces of those interactions (RQ1b)?

The scientists of Indian academic and research organizations that were selected for this research have to interact with various individuals and organizations that are located outside the boundary of their respective organizations. Those external individuals and organizations are either institutions or representatives of some institutions. Those institutions include funding agencies, industries both in the form of research collaborators and customers, the journal review system, the scientific community, and the scholarly communication system.

Interactions with some of these entities create demands for information and scientists have to meet them in various ways. Hence the exchange of information as a resource often takes place between the scientists of these organizations and those institutional entities. Some information exchanges take place formally, through written reports. There are, however, several occasions when such information exchange takes place informally and verbally. Though bibliographic information forms a major component in such information exchanges, some are dependent on business and techno-commercial information.

These information exchanges and ultimately information-gathering practices help these scientists in several ways. Information-gathering practices were often found to help the scientist in selected cases in complying with the mandates of funding agencies, developing an alliance or partnership with industries, gaining confidence of those who would invest in their research, and developing and maintaining community relations in several ways. Information-gathering practices are also essential in abiding by different administrative norms.

In sum, information gathering activities are practiced by scientists of the organizations selected for this research in response to various information demands of various institutions located outside the boundary of their respective organizations. These information-gathering practices are translated into information exchanges during their interactions with those entities.

CHAPTER 6: TECHNOLOGY-IN-PRACTICE AND DIGITAL LIBRARY USE

6.1 Chapter introduction

The overarching goal of this research is to investigate how the practice of digital-library use by people in selected Indian academic and research institutes is shaped by organizational and social contexts. The question is divided into two parts. First, enquiry was directed at understanding how information-gathering practices that motivate digital-library use are connected to the organizational contexts of scientists. The study showed that different organizational and individual entities create an institutional environment for academic and research organizations. This institutional environment triggers various information-gathering practices by scientists. These findings have been presented in a previous chapter.

This chapter deals with the second part of the research goal, which was to investigate how digital libraries are used (or not used) to support information gathering activities of scientists and how different factors contribute to such digital-library use. This aspect was problematized through a research question – *what are the various extra- and intra-organizational factors mediating the practice of digital-library use in information gathering activities of organizational members* (RQ#2)?. More specifically, this research question aims to understand the characteristics of digital-library use by scientists (RQ#2a: *What are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level?*) and the issues that contribute to such use or non-use of digital libraries (RQ#2(b): *How are such* *practices accounted for by different extra- and intra-organizational factors*). The findings of these research questions are presented in following sections

To help the readers at this point, the methodological issue of foregrounding information gathering activities and not digital libraries is reviewed. The term digital library has a profound flavor of computer technology. Some people may not use digital libraries for various reasons, one of which is they are not very comfortable with technology, though it may be difficult to admit this. As a result, any reference to digital libraries in the beginning of a conversation might have resulted in idealized and not actual responses. To minimize the chance of this, informants were engaged in discussion to reveal how important their information gathering activities are. Digital libraries were to be foregrounded later. In the course of discussion, however, it was found that scientists mentioned electronic resources during discussions. It left no doubt that they were describing what they really do; they were not trying to build an image of digital library users. This strengthened the methodological soundness of the data collection plan.

Digital-library use has been viewed through the lens of a sociological concept – *technology-in-practice*. The rest of this introductory section is devoted to a brief discussion on this concept and the relevant literature.

6.1.1 Theoretical background

The notion of *technology-in-practice* was proposed by Orlikowski (2000) and it was developed out of structuration theory (Giddens, 1984), which is about how structures are developed, maintained and changed within social systems. Structuration theory posits that social practices are mediated through facilities, norms and interpretive schema. A social practice is developed by the members of a group depending on the facilities available to them (e.g., land, buildings, and technology), the norms that inform their ongoing practices, and their knowledge (both tacit and explicit) of prior action and the situation at hand. Using those facilities, knowledge as well as their habits of the mind and body, those members recursively instantiate and thus reconstitute the rules and resources leading to a visibly "structured" social action.

Technology-in-practice (Orlikowski, 2000) is the enacted structure of the action of *technology use*. A parallel has been drawn between technology use structure and supermarket use (Lave, 1988, pp.150–151). For the individual shopper, the supermarket is a repeatedly experienced, personally ordered and edited version of a setting of activity. Some aisles in the supermarket do not exist for a given shopper as part of her setting, while other aisles are rich in detailed possibilities. Similarly, the use of a technology involves a repeatedly experienced, personally ordered and edited version of some of the properties of a technological artifact. For example, people, at best, use repeatedly 25 percent of the functionalities of office software packages such as word processing and spreadsheets. Those properties become visible to users most of the time and are implicated as rules and resources, resulting in a particular structure of the use of those software packages.

While using a technology, people draw on its material properties as a source of rules and resources as well as on their skills, power, knowledge, assumptions, and expectations about the technology and its use, influenced typically by training, communication, and previous experiences. People gain experience about technology in various ways – by using other technologies, by participating in various communities, and also from the environment in which they work. In sum, experiences, knowledge, meanings, habits, power relations, norms, and the technological artifacts at hand – all contribute to the structure of the use of specific technology. User belonging to same community undergo same training session, socialize among themselves, have comparable on the job experience and all these lead to their display of similar *technology-in-practice*.

Technology-in-practice can vary among users as rules, resources and conditions for a technology use can be experienced differently by different individuals and differently by the same individuals depending on the time or circumstance. An example of this is the use of tax return software (Orlikowski, 2000). This tax return software may be used for printing blank forms, for learning current tax codes, or for learning the interface of such software, depending on the interest of the users. During most of the year, this software is typically ignored and no rules and resources are enacted as they are not implicated (implying no *technology-in-practice*).

Technology-in-practice, that is the structure of technology use changes as all social structure changes through human action. Users, over a period of time undergo changes in awareness, knowledge, power, motivations, time, circumstances, and the technology itself. For example, users may also choose to enact different practices of technology use. This may happen as they become more knowledgeable about using the technology (through attending a training class or watching a colleague's use) or because they have changed jobs and now need to use the technology differently in their new work community. Thus meanings, expectations, associations, and conventions attached to the technology and its use are not static.

Orlikowski (2000) explains how different work groups' interests, organizational demands on them and different perceptions can contribute to different practices within the same organization. She uses "Notes" as an example –software that was installed on the desktops of employees of a company. This software was very powerful in promoting and supporting cooperative work within the organization. It was found that two groups – "technical support" and "consultants" – were enacting different technologies-in-practice for the same software. "Technical support" members were free of a competitive culture, not subjected to "up-or-out" career tensions or "billable hours" pressure. Members of this group were found to use many features of the software and thus promoted their collective technical work and cooperated with each other. They also modified the technology over time as they added data to the databases and created or customized databases. This was one kind of technology-in-practice that emerged from this group.

Another *technology*-in-practice for the same software emerged from the members of "consultant" group. This group was found to use the technology in a minimal way. This group was subjected to stiff competition (up-or-out), higher performance (billable hours). The competitive culture strongly reinforced by the ''up-or-out'' career path was seen by many consultants as encouraging the development of individually distinctive competence. This increased their reluctance to use *Notes* to share expertise, and reinforced their firm's practice of rewarding individual effort and distinctive competence rather than cooperation and knowledge sharing. Similarly, this group was doubtful about the relation between the technology and the performance of the company. The training conducted for this technology was also very abstract and technical. Overall, *Notes* triggered their fear that use of its collaborative properties would threaten their status within the company and this resulted in minimal technology-in-practice (Orlikowski, 2000).

Technology-in-practice as an enacted structure of *technology use* makes visible the emergent and situated use of technology as shaped by organizational members. Such enacted structure is the result of how users experience some or all properties of the technology. By focusing on this emergent structure, a view of technology use emerges that can describe what users do with technologies as enactment. It can then be further extended to understand whether such emergent structure is associated with any specific work groups or is a result of some organizational factors.

In another study the concept of *technology-in-practice* explained how inter-organizational social structure came into force and made the users take note of material capabilities of a geospatial information technology (GIT) which were otherwise ignored and to enact those material capabilities (Harrison, Pardo, Gil–Garcia, Juraga, & Thompson, 2007). Sharing geospatial information across regions and integrating this information with other data set are core to successful use of GIT. In this particular case study, actors brought a set of diverse technical facilities and resources, pre-existing and newly adapted norms, and the interpretations of reality that were very specific to the organization. Members of different groups interchanged their knowledge, meaning system, learned from each other and this resulted into a rich technology innovation.

In drawing on these structural properties, users' experiences are shaped by material aspects of the technology, that is, its "*facilities,*" but they are also shaped by *norms* for appropriate behavior within an organization and with respect to a technology, and by *interpretive schemes* drawn from the institutional context through which structure is instantiated. Thus, an important part of analyzing a *technology-in-practice* is to understand how structural properties of the social system, through the modalities of facilities, norms, and interpretive schemes, shape users' tendencies to enact technology in particular ways, giving rise to the possibility of structural reconstitution.

Another case study of Geographical Information System (GIS) draws attention to cultural and educational aspects associated with limited use *technology-in-practice* of GIS (Walsham & Sahay, 1999). One of the examples of the effective use or "substantive use," as termed by the authors, of a GIS in this case would involve district forest officers using the GIS outputs on a regular basis to support decisions about what kinds of trees should be planted in particular wasteland areas in order to help restore these lands. This was found not to be happening. The main reason for this was the absence of a relatively stable set of key actors with aligned interests related to the GIS. The creation and maintenance of such key actors demanded a long process of changing social attitudes and structure. For example, GIS requires a map-orientation but maps were not deeply embedded in the social and cultural life of the case in study. In order to blend decision making process of administrators and output of GIS technology changes were necessary. The cultures of data sharing and cooperative work approach were also found essential for effective and substantive use of GIS.

These examples suggest that by using the lens of technology-in-practice or structuration of technology use of digital libraries by scientists it is possible to (i) identify the extent of using various features of digital libraries and (ii) to identify various factors that contribute to such patterns of digital-library use.

6.1.2 Technology-in-practice and research questions on digital-library use

In this study, *technology-in-practice*, that is, the enacted structure of the action of *technology use,* has been mapped on digital-library use. Overall the research question – *what are the various extra- and intra-organizational factors mediating the practice of digital-library use in information gathering activities of organizational members*? (RQ#2) – has been formulated to understand the structure of digital-library use and the factors that are instrumental for such structuration. This research question has been further split into two sub-questions. These sub-questions and the rationale for the formulation of these questions are discussed next.

As discussed earlier, the concept of *digital library* in this research has been conceptualized as a collection of electronic resources that are available to an organizational member. Such a collection includes subscribed electronic content, electronic contents under open access, locally developed repositories and any other channels of information transfer such as email, listservs, blogs, and so on. The analogy to supermarket use (Lave, 1988, pp.150–151) as mentioned earlier applies here. From the perspective of a user of a digital library, some of the component resources may be non-existent and some are prominently visible. This leads to repeated use of those visible components by that user. This is one level of structuration of digital-library use. At another level, the structuration takes place when a user repeatedly uses one or more features of digital libraries just as most of us use only a limited number of features of office software packages most of the time. This structure of use or *technology-in-practice* with respect to digital libraries has been captured through the question: *What are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level*? (RQ#2a).

After understanding the emergent use of digital libraries, this research also identified the factors that contribute to such use. As seen in the literature, factors which may play a role in developing a *technology-in-practice* are not necessarily confined to the technological features of those resources. Issues such as workplace incentive, training, orientation, and organizational environment can facilitate the use or non-use of any ICT. The research question (RQ#2b: How *are such practices accounted for by different extra- and intra-organizational factors?*) reveals issues that contribute to the emerging structure of digital-library use by Indian scientists.

6.2 Pattern of digital-library use by scientists of study sites

This section elaborates on the structure of the use of digital libraries by addressing the question #2(a): *What are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level*?

For the purpose of this discussion, electronic resources accessible by the scientists of an organization are divided into several categories[31]. Electronic resources, available through subscription, are broadly divided as: (a) bibliographic aggregator's databases;[32] (b) bibliographic publisher's databases;[33] (c) bibliographic special databases;[34] and (d) non-bibliographic

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[31] The naming that has been adopted for each of these categories partly aligns with that available in various literature. Standardization of such naming, however, was not aimed at this stage. The purpose of adopting the naming was to convey the type of resources covered under each category.

[32] These are the databases aggregating bibliographic citations and sometimes full text from journals/magazines published by different publishers. These databases are electronic counterpart of erstwhile A & I secondary sources. *Web of Science*, *JSTOR* archives and databases from Proquest, EBSCO are considered here for this category.

[33] These are databases produced by publishers on their respective contents. For example ScienceDirect which is produced by Elsevier on contents published by Elsevier belongs to this category. Almost all major publishers now bring out their own databases.

[34] This category includes databases of patents, standards.

databases[35]. In addition, other electronic resources that were also kept within the purview of the study are open access resources and institutional repositories. It must be noted that publisher-specific databases restrict contents to only those published in that respective publisher's books and journals. On the other hand, aggregator's databases provide information across publishers. Though both these categories use search engines, aggregator's databases are truly information searching devices and such search engines have varieties of features to help users search for information.

The findings of the question RQ#2(a) are presented separately for the scientists of ORG1 and ORG2. Because of disciplinary differences, the resources used by each of these two organizations are also different. After presenting the findings separately, a comparison is made of the differences and similarities in the practices for those two organizations.

6.2.1 Digital-library use by ORG1 scientists

Electronic resources available for ORG1 scientists can be found on their website. The organization has access to a number of bibliographic aggregated products namely, *METADEX*, *Web of Science* and so on. Various publisher-specific resources are from Elsevier, Springer, Wiley and various societies. In addition, patents and standards are also available to the scientists. Table-23 summarizes the pattern of use of various resources by the informants of ORG1. The highlights of the use of these resources are:

[35] Databases containing non-bibliographic data

(a) Google was frequently referred to as a search engine. Some of the informants were articulate in clarifying that Google is useful for general information;

(b) Publisher-specific bibliographic databases were frequently referred to with reference to information searching. One informant even mentioned that if she does not get satisfactory information in *ScienceDirect* (Elsevier's service), she tries Google;

(c) Two informants mentioned *METADEX*, one of the most important bibliographic aggregated service. One of those informants mentioned that he has abandoned using *METADEX*. Another informant was able to recollect how search is conducted in a structured way in *METADEX*;

(d) None of the scientists interviewed mentioned using *Web of Science* – another aggregated service – for scientific content information searching. One informant mentioned this service with reference to citation data only;

(e) Information available from virtual universities (specific sites maintained by individuals or groups) are also used;

(f) There was an additional perspective on the use of publisher-specific sites. When scientists receive papers to review from a journal, the respective publisher often allows them to consult its publications for a certain period of time. ORG1 scientists use the citations in the paper received for review as well as those publisher-specific journals to update their knowledge;

(g) Though a patent search is required before filing for a patent, a new reason for patent searching was revealed. As the organization is now trying to identify collaborators who will translate their research ideas, the scientists often use the patent search to help establish the novelty of their ideas;

(h) In a new organizational environment, these scientists are in need of market information on new technology/products. Such information is not available in conventional journals/books. Various company websites are now consulted for this purpose;

(i) Information is collected directly from manufacturing plant, whenever required, using personal connections, as such data is not available in any published source;

(j) Personal communication channels, such as email, are also used to receive information.

Table 23: Digital library use by ORG1 scientists

Informant	Resources in Digital Environment							Resources in Non-digital environment
	Structured[36] IR tools	General search engine - Google	Publisher specific collection	Special - patents	Special-Standards	Company websites/journals	Others	
SCT1		Yes	Yes				email	Direct data collection
SCT2	Metadex - abandoned[37]		Yes					Books
SCT3	Metadex - abandoned	Yes	ScienceDirect	Yes				
SCT4		Yes	ScienceDirect	Yes		Yes	Websites maintained by individuals	
							Market survey datasets	
							Virtual universities	
SCT5			Yes		Yes			
			AIP					
			Elsevier					
SCT6		Yes	ScienceDirect					
			Springer,					
			Wiley					
SCT7		Yes	Yes	Yes		Yes		
SCT8		Yes	Springer,	Yes	Yes		Websites maintained by individuals	
			Elsevier				blogs	
			ACS				association website	
SCT9		Yes	ScienceDirect				email	Books
SCT10		Yes	ScienceDirect	Yes				

36 These are publisher-neutral comprehensive information retrieval resources
37 Informants mentioned about these resources to stress that they are not using these resources anymore

Informant	Resources in Digital Environment							Resources in Non-digital environment
	Structured[36] IR tools	General search engine - Google	Publisher specific collection	Special - patents	Special- Standards	Company websites/journals	Others	
SCT11		Yes	ScienceDirect	Yes	Yes		country specific plant database	
							open archives	
SCT12		Yes				Yes	Blogs	
							Country specific plant database	
							university course catalogs	
							pop-up messages from companies	
							open archives	
SCT13		Yes (including Google Scholar		Yes			email	
SCT14	Metadex - abandoned	Yes	Elsevier					
	Compendex - abandoned							
	Citation index – for bibliometric data							
SCT15		Yes	Yes					Print journals

Various features of electronic resources used by these scientists (Table-24) can be summarized as below:

(a) Simple keyword search is the predominantly used feature of electronic resources;

(b) Electronic alert systems of various publishers are used by some of the informants;

(c) While one informant spoke about a very limited use of the advanced features of a resource, the rest repeatedly emphasized using keywords for searching. One informant categorically reported that he does not use any advance features;

Table 24: Digital library features use by ORG1 scientists

Informants	Simple keyword searching	Advance and structured searching	Browsing	Using e-alert/TOC service	Others
SCT1	✓		✓		
SCT2	✓				
SCT3	✓				
SCT4	✓			✓	
SCT5	✓			✓	
SCT6	✓				
SCT7	✓				
SCT8	✓				
SCT9	✓				
SCT10	✓				
SCT11	✓		✓		
SCT12	✓			✓	
SCT13	✓				
SCT14	✓			✓	
SCT15	✓		✓		

6.2.2 Digital-library use by ORG2 scientists

ORG2 library website properly lists and displays the various electronic resources under each of the categories as mentioned above that are accessible by the scientists. Table-25 summarizes the resources used by ORG2 informants as reported in the interviews. Two of the ORG2 informants are working in Plant Genetics area and one informant is working on microbiology (Human Genetics).

The important findings with respect to digital-library use by ORG2 scientists are:

(a) Google occupies a significant position as an information search mechanism by the informants in the area of plant genetics. On the other hand, for the other informant (human genetics), *Pubmed* was the mechanism for information searching. None of the scientists could remember the name of any aggregator's database for information searching. Interestingly, *Pubmed* does not figure in the website of ORG2;

(b) Apart from Google, publisher's packages are found to be the major information resources for the scientists, specifically those working in the area of Plant Genetics.

(c) The use of *Web of Science*, an important resource of a kind different from aggregator's databases[38], was mentioned during the discussion but the scientists' uses of it always referred to finding information such as the impact factor of journals. This resource was

[38] *Web of Science* can be considered as a value-added aggregator's database. It aggregates information from different publishers. At the same time, value is added by linking citations and providing various bibliometric information on journals.

never mentioned in the context of scientific content information searching. More discussion on this can be found in following sections.

(d) Often, *Google* and *Internet* were used interchangeably and used as a conflated term. For example, when one informant was asked to give a demonstration on searching on Google, he opened the browser which was set to Google as a default and then from the search history of the browser, brought out the URL of *Pubmed* and started searching. Similarly when lightly probed after referring to the Internet as a searching mechanism, some informants mentioned that they go to specific publisher/journal websites for searching;

(e) Citation managers are also referred to as resources;

(f) Special databases such as sites where various government departments upload various information are used for very specific cases;

(g) There are instances of non-use of digital libraries in favor of using non-digital resources. Such non-digital resources are personal communications, printed books, and so on. One of the informants mentioned that some part of her support data is collected directly from farmers;

Table 25: Digital library use by ORG2 Scientists (Biotechnology)

Informant	Resources in Digital Environment							Resources in Non-digital environment
	Structured[39] IR tools	General search engine - Google	Publisher specific collection	Special - patents	Special-Standards	Company websites, journals	Others	
SCT1 (Plant Genetics)	Citation index – bibliometric data	Yes	Yes				email	Direct data collection from farmers
							Other search engines	Personal contacts
							Data-specific website	
							Thesis – local archive	
							Citation software	
SCT2 (Human Genetics))	Citation index – bibliometric data	Yes	Yes				Citation software	Books
	Pubmed[40]						Information network	
							Personal contacts	
SCT3 (Plant genetics)	Citation index – bibliometric data	Yes	Yes					Books

[39] These are publisher-neutral comprehensive information retrieval resources

[40] Pubmed is a free publisher-neutral search engine-cum-collection. There is no mention of Pubmed on the website of ORG2 Library.

Various features of electronic resources used (summarized in Table-26) by ORG2 informants are:

(a) Keyword search is the feature used by all informants. In fact, searching is often referred to as "very simple" by most informants. Keywords include subject keywords and author's names;

(b) ORG2 scientists avail themselves of registering with Table-of-Contents services with various journals and receiving updates;

(c) Only one ORG2 informant (Microbiology) reported using various advanced features of *Pubmed*;

(d) All informants reported searching for bibliometric data such as the impact factor of journals, h-index, and so on. The reference to the use of *Web of Science* was typically associated with finding this type of information.

Table 26: Digital library features use by ORG2 Scientists (Biotechnology)

Informants	Simple keyword searching	Advance and structured searching	Browsing	Using e-alert, TOC service	Others
SCT1 (Plant Genetics)	✓		✓		Bibliometric data search
SCT2 (Human genetics)	✓	Advance features of Pubmed	✓		Bibliometric data search
					Free summary/books
SCT3 (Plant Genetics)	✓		✓	TOC	Bibliometric data search

6.2.3 Digital-library use – similarities and differences between study sites

The points of similarity with respect to digital-library use between the two organizations' scientists are:

(a) Google is predominantly preferred to any aggregator's database for information searching; there was one exception – an ORG2 scientist reported using *Pubmed*, an aggregated database preferentially over Google;

(b) Publishers' databases are used extensively for information searching;

(c) Citation databases were referred to in the context of finding the impact factor of journals;

(d) Non-use of digital libraries was the result of non-availability of certain information in conventional information resources;

(e) In neither of these two sites did scientists consult other channels, such as blogs or wikis.

Digital-library use of ORG1 scientists, however, differed from that of ORG2 scientists in the following ways:

(a) In their information-gathering practices ORG1 scientists have started using websites of various companies. Due to a new organizational policy that mandates industry collaborators, information cannot be found in the conventional scientific literature alone.

On the other hand, ORG2 continues to have a stable policy with respect to its identity as a grant-in-aid organization, and, thus, its scientists participate in scientist-driven fundamental research only. They continue to use bibliographic databases for the most part, with occasional use of special data sites;

(b) Special databases such as patents are used by ORG1 scientists from a new perspective – those are used not for filing patents but to update their knowledge and to convince their possible industry collaborators about the newness of their technology and how worth the investment it is;

(c) Though scientists of both sites reported their involvement in reviewing journal papers, ORG1 senior scientists viewed this task as one of the ways to keep themselves up-to-date.

6.3 Factors facilitating/constraining digital-library use

The lens of *technology-in-practice* sensitizes us to the fact that the use structure of a technology is associated with several factors beyond the technological features or capabilities of that technology. Understanding such factors is as important as it is to observe the use structure. This section reports the findings in this regard for digital-library use by scientists. More specifically, this section addresses the question – *how are such digital-library use practices accounted for by different extra- and intra-organizational factors* (RQ#2b).

Digital-library use, as found in this research, has various shades. These uses can be identified as non-use, delegated use, selective use and normal use. The term “non-use” is linked to those incidents when information requirements could not be met by consulting digital libraries and hence various other channels were used by scientists to support information gathering activities. “Delegated use” of digital libraries happens when scientists use digital libraries to support their information gathering activities but they delegate the task of searching to someone else within the organization. However, they still continue to have some experience in using digital libraries and occasionally use these resources by themselves. The term “selective use” is linked to those situations where informants reported their use of a certain components of digital libraries while ignoring some others. The term “normal use” refers to all other utterances by informants about their use of digital libraries.

The factors associated with digital-library use patterns as reported in the previous section are grouped as: (i) environmental; (ii) technological; (iii) organizational; and (iv) personal. Table-27 and Table-28 present those factors as emerged from data from the interviews with ORG1 and ORG2 scientists respectively. It may be noted that while some of those factors facilitate digital-library use (identified as *enabler*), some other factors lead to avoidance of digital-library use (identified as *restrictive*).

Table 27: Factors enabling/restricting digital-library use by ORG1 scientists

Informant	Environmental	Technological	Organizational	Personal
SCT1		Click of mouse - enabler	ICT infrastructure - enabler	Time saving - enabler
		Steady server - enabler		Training – on job - enabler
SCT2	Rich resource (volume and variety) - enabler	Learning load - restrictive	New research policy - enabler	Habit of search - enabler
			Job accountability - enabler	Pleasure of searching - enabler
			ICT infrastructure - enabler	Training – doctoral study - enabler
SCT3	Information in full text - enabler	Accessibility - enabler	Workload - restrictive	Perception - restrictive
			Search support - enabler	Training – doctoral study - enabler
			ICT infrastructure - enabler	
SCT4	Rich resource (volume and variety) - enabler	Accessibility - enabler		Training – on job - enabler
	Awareness of other's access - enabler	Internet speed - enabler	Search support - enabler	
		Other interfacing ICTs - enabler	ICT infrastructure - enabler	
SCT5		Internet speed - enabler		Habit of search - enabler
				Training – doctoral study - enabler
SCT6	Rich resource (volume and variety) - enabler		Support for information procurement - enabler	Time and labor saving - enabler
			ICT infrastructure - enabler	Perception - restrictive
SCT7	Awareness of other's access - enabler	Accessibility - enabler	New research policy - enabler	Habit of search - enabler
			ICT infrastructure - enabler	
SCT8	Digital information out of scope of typical resources - enabler			Training – on job - enabler
	Information withheld - restrictive			
SCT9	Non-availability of new information digitally - restrictive		Lack of information support for new research paradigm -	Training – on job - enabler

Informant	Environmental	Technological	Organizational	Personal
			restrictive	
SCT10	Rich resource (volume and variety) - enabler	Accessibility - enabler	ICT infrastructure - enabler	Habit of search - enabler
		Learning load - restrictive	Workload - restrictive	Time and labor saving - enabler
			Search support - enabler	Training – on job - enabler
SCT11	Rich resource (volume and variety) - enabler	Accessibility - enabler	ICT infrastructure - enabler	Time and labor saving - enabler
	Information noise - restrictive			
SCT12	Non-availability of specific information digitally - restrictive	Ubiquitous Internet - enabler		Habit of search - enabler
		Accessibility - enabler		
		Learning load - restrictive		
SCT13		Accessibility - enabler	Search support - enabler	Time and labor saving - enabler
SCT14	Rich resource (volume and variety) - enabler	Accessibility - enabler		Habit of search - enabler
				Training – doctoral study
SCT15	Rich resource (volume and variety) - enabler	Learning load - restrictive		
	Non-availability of specific information digitally - restrictive			

Table 28: Factors enabling/restricting Digital-library use by ORG2 scientists

Informant	Environmental	Technological	Organizational	Personal
SCT1 (Plant Genetics)	Information withheld - restrictive	Accessibility - enabler	ICT infrastructure - enabler	Time saving - enabler
	Availability of site specific information - enabler			Achievement recognition - enabler
				Training – on job - enabler
SCT2 (Human Genetics)	Rich resource (volume and variety) - enabler	Learning load - restrictive	Work load - restrictive	Pleasure of search - enabler
		Accessibility - enabler	ICT infrastructure - enabler	Time and labor saving - enabler
		ICT tools interfacing - enabler		Training – on job - enabler
				Training emulated from CD environment - enabler
SCT3 (Plant Genetics)	Non-availability of specific information digitally - restrictive	Accessibility - enabler	ICT infrastructure - enabler	Habit of search - enabler
		Learning load - restrictive	Search support - enabler	Time and labor saving - enabler

6.3.1 Environmental factors facilitating/constraining digital-library use

The information environment that contributes greatly to digital-library use can be viewed from two perspectives. One of these is the availability of full content and not just a citation from most of the resources. Earlier information resources provided citations only; the full content would then be procured separately, which was referred to as back-up service. The technological advancement has changed the search scenario, to a great extent collapsing the back-up service and information search facility. This has had a great impact on using bibliographic information. As one scientist compared earlier times with the present, he commented that information available earlier was not so significant because, earlier, the content of a citation was not easily available ("*.no there were some CDs but only abstracts*" – ORG1-SCT5-66). Relating digital-library use with the availability of full text thus validates the age-long basic philosophy of information services, that is, back up services are as important as knowing the citations. Current electronic resources that package both the citations and respective articles together to varying degrees meet the demand of back-up services instantaneously, or at least very quickly.

This new information environment has also changed several work practices. Journals, while offering review jobs to scientists, also allow them to have access to major journals of the same publisher for a limited period. Scientists often do not have access to some or even most of these journals. They view this facility as an opportunity to upgrade their information base.

As large volumes of information are now available electronically, scientists search intensively in order to ensure that they do not miss any information. There are two driving forces behind this intensity of searching. One is that the practice of leveraging the journal reviewing system for personal education, as mentioned above, is known among the scientists. They now know it is easy for the reviewers to verify any piece of information or claim made by them. Hence to stand by their claims they need sufficient evidence. We have seen in previous chapters that scientists view their information gathering activities as a way of supporting the credibility of their research and as a way of collecting evidence in the face of challenges from journal reviewers. This is the link between scientists' information gathering activities and the support offered by the current electronic information environment.

Another driving force is the awareness that others in the field also have similar access to such vast information. This awareness prompts scientists to engage in intensive searching of digital resources because they want to know who their competitors are and how they can make their own space in that competition. At the same time, they also look for collaboration. Thus scientists' perspective on their information gathering activities as supporting competition and collaboration within the community are transformed into their digital-library use.

One other aspect of the information environment is the non-availability of certain types of information in digital media. Operational data from manufacturing plants is one such example, which, if found at all in any archive do not provide current information. When scientists require such data, they do not try to search any digital resource; they collect the data themselves. Similarly, for research management data, scientists depend on their internal management information system.

Certain types of information are not available in any published source for one or more of following reasons: (i) the restrictive nature of the data; (ii) the nature of the scientific problem investigated; (iii) the nascence of the issue; and (iv) the location of the research. Sometimes, scientists withhold certain information for various reasons and other fellow scientists have to depend on their personal channels such as informal meetings and email for information.

Research agendas that are quite new or not relevant internationally do not generate information in digital media. For example, one scientist reported that she hardly got any help from digital resources or the Internet as the problem she was working on was quite new and was very specific to Indian conditions. International journals do not see the importance of such problems and hence do not accept publications related to such areas resulting in non-availability of information through normal channels.

The location of the scientist may provide another reason for non-availability of information. A scientist was working to develop a very specific technique in a laboratory not normally dedicated to such problems. She had a double-edged problem. The area being completely new, there was very little information available through journals. Additionally, since the laboratory did not normally support research in this area it did not procure relevant resources. With both these aspects put together, she hardly ever has any incentive to use the digital resources available at her locality.

In summary, the information environment of these scientists can, at best, be described as skewed towards certain types of information and as a result, for some cases, scientists may not depend on digital libraries.

6.3.2 Technological factors facilitating/constraining digital-library use

The current trend of availability of large volumes of digital media information is only one of several important factors that contribute to digital-library use. As this availability is intricately associated with technologies, how enabling or constraining such technologies are also matter. Technologies are enabling when they ensure effortless connection and handling. Considering that this is the age of mobile technologies, the ability to use such devices with digital libraries can also be seen as an enabling factor.

Any technology demands a certain amount of learning, which, depending on the cognitive demand it makes, can be another facilitating or limiting factor. The interviews revealed that the technological features that matter to users for digital-library use could be broadly categorized as access mechanisms, ICT tools, and learning load.

Technologies are enabling when the same ensure effortless connection and handling. There are various layers at which such effortlessness can be identified. One such layer is usefulness of gadgets that can be used by scientists. Backup devices such as pen-drives are not only small in size, but also portable and can hold a “small digital library” – as one scientist said – that can be carried and read anywhere. Another layer is the learning load. Any technology demands certain amount of learning which, depending on the cognitive demand it makes, can be another facilitating or limiting factor. Referring to a specific aggregator’s database – one supposed to be the most respected information retrieval system in his area – one scientist reported how he dislikes learning the structured way of retrieving information from that system and though he had to use this resource at one time, he has now switched over to another resource that does not demand as much of his time to learn. Surprisingly, there was also another perspective, and this is discussed in more detail in one of the following subsections.

Technological features which matters to users for digital-library use, as emerged from interviews could be broadly categorized as access mechanism, ICT tools and learning load.

6.3.2.1 Digital-library use as a function of access mechanisms

One utterance came from many informants regarding the use of digital resources is “easy.” However, when asked to elaborate on how or why this is so they found it very difficult to describe. “How can I say how easy it is?” said one informant. What emerged from the discussion is that the “ease” of use can be associated with the accessibility of these resources. The accessibility, in turn, can be viewed at two levels – simple operations and the time factor.

According to the informants, electronic resources are easy because using them requires simple operations -- just type and get the information. Such simple operations help to identify required information from the massive information archives. If required, users can also customize the data, which was difficult to do in the past for printed resources. The speed with which data can be retrieved is also another aspect of access. Required information is retrieved fast, thus saving the time of the researcher.

6.3.2.2 The Role of ICT tools in electronic access

New ICT tools also contribute positively towards the use of electronic resources. Wireless Internet connectivity helps connect to the resources from anywhere. Portable gadgets such as laptops and removable backup devices accentuate the benefits of this wireless connectivity. Digital libraries are not only accessible, they are portable too. Small back-up devices can be used to download and carry required information. One scientist described how easy it is to make a copy of an article on a small flash-drive or on his laptop and read it while travelling. He looks forward to the use of even smaller gadgets. Citations managers are another interesting technology support. Scientists not only use the digital libraries as part of their information gathering activities, they can also download required information from those citation managers and make a bibliography in no time. The integration of various ICT tools, both at the hardware and software levels, helps digital-library use more meaningful to scientists.

6.3.2.3 Learning load as a factor in electronic resource use

Very few informants were able to articulate what is "easy" about Google, the platform from which they start many of their searches. One informant explained that using METADEX requires some level of expertise – one has to know how to frame search queries in a structured fashion. He admitted that he had stopped using *METADEX*. Scientists with their busy and otherwise demanding schedule avoid this load. The successful use of digital libraries demands an investment of time and learning. One scientist described how various complex features of *Pubmed* can be used to get very specific information. Interestingly, this is the opposite of what other scientists reported. At one of the sites, the older scientists demonstrated a clear dislike for resources that placed a cognitive load on them. Responding to a question on whether she would be interested in using new resources, one scientist confided she would be, provided she did not have to invest much time and energy in learning how to use them. One of the scientists described how the searching was difficult for printed resources and thus searching used to be avoided.

Even though no correlational study was done on the choice of resources creating less learning load on age or other factors, it appeared that: (i) older scientists prefer less learning effort; (ii) scientists with very busy schedules prefer resources that require less learning effort; and (iii) scientists from the discipline that has more institutional influence on the resources to be used prefer a resource produced by such an institution. The section of scientist who works in human genetics give much value to *Pubmed*, which is produced by a division of the National Library of Medicine – one of the most highly respected institutions[41]. The scientist who preferred using *Pubmed* also knew that it is produced by NCBI. No other scientist interviewed could say clearly who the publishers of the databases they used were.

Such findings explain why Google is used by many scientists. A simple and quick search interface that demands less learning and time load is attractive even though such a search may result in a less comprehensive result.

6.3.3 Organizational factors facilitating/constraining digital-library use

Notwithstanding the favorable information environment and technological support facilitating handling of digital electronic resources, for organizational members such as the scientists in this study, there are other issues that facilitate or constrain digital-library use. The benefits of technological developments in digital libraries that have taken place outside the organization can also reach the scientists through ICT[42] and the infrastructure policies of that organization. There

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[41] This researcher started collecting data from another site where mostly scientists work in human aspect of biotechnology. Unfortunately, because of political disturbances in that part of the country, she could not go back to complete the data collection. But two scientists who were interviewed also affirmed their dependence in *Pubmed*

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are other non-technical issues too. One of these is the organizational policies that guide the type of research activities to be undertaken by its scientists. The more an organization is committed to knowledge generation, the more its scientists will require various information resources. Organizational issues which can further structure the use of digital libraries are discussed next.

6.3.3.1 Organizational policy leading to various digital-library use

Digital-library uses vary, both in terms of intensity and variety, depending on organizational policy. As scientists get engaged in scientist-driven research or industry-driven research, they have to constantly strive to upgrade their knowledge and also have to establish the soundness of their knowledge. For this purpose they use electronic bibliographic resources. These bibliographic resources are also used by scientists when they engage in activities related to publications, since publishing in good journals is the mandate of academic and research organizations. However, within ORG1 as senior scientists move to research administration, the demand for publications on them is eased and they do not use bibliographic electronic resources as much. Interestingly, these senior scientists now use their editing assignments as a way to keep themselves updated. As they review research papers of their junior colleagues or receive such assignments from publishers, they examine the reference lists provided in those papers in order to learn the latest developments. These scientists also take the opportunity to update their knowledge while reviewing since publishers open their archives to the reviewers as part of the reviewing agreement. This culture of the publishing world fits nicely with the scientists who have otherwise very busy schedules and do not get an opportunity to stay current.

A different type of digital resource is used when organizational policy changes from pure academic research to industry oriented research. As the very recent change in the policy of ORG1 focused on reducing government funded research and increasing industry oriented research, the scientists of the organization found it of utmost importance to find an industry partner. In order to negotiate convincingly with industries, scientists required more business information than technical information. This leads to the use of not only different types of information but also different types of resources. The scientists who are part of the new initiative of ORG1 reported searching the websites of various companies engaged in developing similar processes or products. They also use house journals of various companies available on the Web. Resources which earlier had no visibility to the scientists are now drawing their attention and thus resource-wise, a new use structure is emerging.

In sum, organizational policies can shape who will use digital libraries. Such policies can also be instrumental in expanding the scope of digital libraries by including new types of content.

6.3.3.2 The role of ICT infrastructure in digital-library use

ICT infrastructure within an organization is an important issue with respect to digital-library use. To look at it from another perspective, the Internet use within an organization is largely dependent on this infrastructure and digital-library use is also dependent on it. This infrastructure includes computers, Internet speed, and the local area network. Several scientists compared the situation in earlier years with the present. Scientists of both organizations described the inconvenience in the past when computer facilities were centralized and limited in their respective organizations. Scientists had to make a provision of time for consulting digital libraries since they had to go physically to such computer centers or information centers. As the resources were shared, there used to be restrictions with respect to time allocated for using Internet facilities. Senior scientists were not comfortable in sharing such resources with their juniors. ORG1 scientists mentioned that in all their project proposals, they used to allocate money for procuring computers over which they would have more control.

The current situation is improved. Both case sites have good local area networks within the office campus and scientists' workplaces are connected to this network. As organizational policy, each scientist is given a computer. This has eliminated the need of going to another place and sharing resources with others. Some scientists emphasized that access to a local area network has been a great support for using digital libraries. This improvement in infrastructure has become instrumental in their using digital libraries in a relaxed manner and at their own convenience. One scientist commented that now library and laboratory works are interleaved. Whether such infrastructure could add to the quality of the information retrieved was difficult to measure since the quality of retrieval depends on many other factors such as search strategy and so on, but there is certainly more use of such resources. One scientist candidly admitted that in the all-print era, such extensive searching was not possible. With very little variation, almost all senior scientists described how tedious it was in olden days to collect information from printed resources and maintain it on cards.

Most of the scientists explained that their time and energy are now conserved. Going to the library for study demands that separate time be allocated and planned. Digital-library use, to a great extent, depends on how it is deployed within an organization with the help of ICT. A good ICT facility, connecting users to the Internet from their work table becomes instrumental in saving users' time to go elsewhere for consulting such resources. Collapsing laboratory work and consulting digital libraries is gradually becoming the work culture of academic and research organizations.

The quality of the Internet as infrastructure also contributes to digital-library use. The difficulties faced by slow Internet speed and lower bandwidth were referred to as obstructing factors in the Internet and digital-library use.

6.3.3.3 Digital-library use and its relation to workload

Within an organization, the nature of the job and its associated workload also affect digital-library use. At one level, there is pressure on scientists to remain updated in order to *survive* in the competitive market. They need to consult bibliographic resources in order to know the current status of technology so they can develop meaningful and competitive research proposals, defend their knowledge claim made in scientific publications, and establish their knowledge status to peers. They need to consult various citation databases for bibliometric information so that they can defend their claim for an award or a fellowship, or strategize their publications. They have to consult the management information system developed within their own organization so that they can respond to the queries of higher controlling bodies who monitor the progress of research All these demands make the scientists reach for bibliographic resources, resources providing citation information, resources providing business information and so on.

On the other hand, scientists who have become senior within ORG1 are required to take up much research related administrative responsibilities, including negotiation and travelling. The commitments in higher positions leave little time for them to consult various electronic resources by themselves. All interviewed scientists of this group admitted that ideally they should have consulted the resources themselves, and even with their busy schedules, they do try to set aside some time for consulting them. The time they are able to dedicate to this, however, cannot meet their total information requirements.

There was one exception, however. One ORG2 scientist explained that now that he is senior, he does not have to do as much laboratory work and spends a good amount of time in using these resources. This is contradictory to what was reported by senior scientists in ORG1 who reported shortage of time leading to less consultation of bibliographic databases. The possible explanation for this difference can be that when organizations mandate a wide range of research for their scientists, time management becomes very important. ORG1 scientists not only do small research projects initiated by themselves (scientist-driven research), but they are also part of various industry driven network projects in which they and scientists from other organizations participate. Managing research of such a large scope demands a great deal of administrative work related to research. Thus senior ORG1 scientists find it difficult to consult electronic resources regularly though all of them admitted that they want to consult such resources regularly. Thus seniority does not always lead to less or no use of digital libraries.

6.3.3.4 Organizational support system and delegated digital-library use

If workload creates hindrances to the use of digital libraries, as described in section 6.3.3.3, organizational support in the form of additional manpower facilitates the use in a delegated manner. Digital libraries are used in delegated mode when there is provision for support staff who can consult digital libraries on behalf of others. Senior scientists who are engaged more in research administration do not get adequate time for consulting electronic resources and thus delegate the task of consulting digital resources to others. ORG1 provides additional support system to these scientists to manage their research related activities by appointing junior level personnel. These senior scientists delegate the majority of their information requirements to support personnel who regularly conduct searches. Similarly, scientists who have a large research program managed by a group of junior scientists or research scholars under them, find it difficult to conduct searches for everything by themselves. In this case, too, each scientist or scholar is delegated to conduct information searching in their respective areas. This is contrary to the practice followed by junior scientists or scientists conducting small research projects who conduct information searches themselves.

6.3.3.5 Digital-library use for performance evaluation

Awards, fellowships and special grants are ways of recognizing a scientist's achievements. Scientists aiming for such recognition are required to submit their nominations. Those nomination documents must include various citation related information on their publications. In addition, from time to time ORG2, as grant-in-aid organization, is subjected to special review. At that time ORG2 scientists have to submit various data related to research. Citation information on their publications is one such kind of data and thus scientists often consult electronic resources of this genre. At the same time, it is worth noting that such emphasis on bibliometric data with regards to performance evaluation has made the scientists view citation indexes partially or in a different way that was not intended by the producer of such databases. This can be likened to unintended consequences, as described in the characteristics of research conducted under the paradigm of social informatics.

6.3.4 Personal factors facilitating/constraining digital-library use

Digital-library use is also affected by the personal traits of scientists. Though these personal traits are driven and facilitated by environmental, technical and organizational factors, nonetheless, these traits together shape digital-library use. Those individual traits are discussed here.

6.3.4.1 The habit of using digital libraries

Most scientists reported their regular habit of searching for information. Some of them could specify the periodicity of their search such as once or twice a week. Other scientists could not give such specific information but mentioned they often browse when they have time. As mentioned earlier, senior ORG1 scientists delegate their searching to support personnel. Even those scientists admitted that had they been able to manage time, they would have gone for regular information browsing by themselves.

6.3.4.2 Perception of resources as a factor for selective use of digital libraries

Scientists' perceptions about resources make them prefer one resource over others. As it emerged, one scientist *thought* that Google covers everything and that is the reason for that scientist's always approaching Google first. Similarly, another scientist's perception that the range of *ScienceDirect* is much higher than *METADEX* drives him to search *ScienceDirect* most of the time. In general, scientists had the idea that specific publishers' sites provide *enough* information and it does not occur to them that such databases restrict information to the respective publishers only. Another example in this regard is scientists' perception that citation indexes such as the *Web of Science* are associated with bibliometric data. Reward and career advancement within an organization require good publications as one of the several measures of achievement. This measure is captured by several citation related data such as impact factor of journals and h-index. Mostly scientists relate the use of *Web of Science* to finding such data. Apparently, according to their perception, these citation indexes only help in finding such data (and not other information).

Similarly scientists' perception about citation index like *Web of Science* is associated with bibliometric data such as impact factor of journals. The rich content and particularly many valuable feature of this resource completely escape the notice of the scientists. As mentioned in earlier section 6.3.3.5, this can be described as an example of unintended use of technology. Rewards and career advancements within the organization require good publications as one of the several measures of achievement. Organizations emphasize information such as the impact factor of journals and the h-index as measures of the quality of publications. As this information is available in one of the publications related to *Web of Science*, scientists relate the use of *Web of Science* to finding such data. This can also be treated as an example of how the powerful organization can be instrumental in making its members develop the image of a resource.

6.3.4.3 Desire for personal achievement as a factor in electronic resource use

Desire for personal achievement is another factor driving scientists to use electronic resources. Their competitiveness is recognized in various ways. Scientists are keen to establish their credibility with project review teams and peers. They are concerned about getting continuing support for their research projects and about maintaining their reputations or in other ways "surviving the market". One of the keys to this survival is to propose research projects that are not duplicative and at the same time connected to the research trend in the specific area. To this end, they need to consult information resources so that they can have up-to-date, comprehensive knowledge about what is going in the field and who the key players are.

6.3.4.4 Digital resources as labor-saving devices

One factor, overwhelmingly mentioned by scientists was that using digital resources is very labor saving and stress reducing compared to print days. Almost all informants reported that going to the library has been reduced tremendously and they appreciated that the digital resources have saved their time and energy and that now they can interleave their laboratory work and library research from their table.

6.4 Chapter summary

This chapter reported the findings related to the various use structures of digital libraries by the scientists of two academic and research organizations and the associated factors for such use structures. Scientists of both the institutes selectively use a few of all resources available to them. As well, they use a few features of those digital resources. The associated factors for such digital-library use can be viewed along four dimensions, namely, environmental factors, technological factors, organizational factors and personal factors.

The current digital information environment is very meaningful to the scientists as it provides citations and content together. This environment has also brought a new work culture that presents the scientists with both threats and opportunities. There are threats because the same information is available in the hands of the competitors. There are opportunities because it provides the scope for collaboration.

The technological factors that add to the environmental factor of digital-library use are access mechanisms, various ICT tools and the learning load on the scientists. Availability of information is meaningless unless there are simple ways to access and use it. Similarly, various ICT tools – both hardware and software – are integrated with digital libraries thus making it very useful for the users. However, despite these environmental and technological factors, users may avoid certain digital resources because the cognitive demand those resources make on them.

The benefits of the information environment and the technological environment can only be maximized through the organizational environment. Intellectually, the more the organizational policies create mandates on the scientists to tread new paths in research, the more scientists use different types of digital resources. Physically, the way an organization provides ICT facilities to its scientists influences how comfortably and diligently those scientists use the digital resources. Operationally, organizational support provided to busy scientists who are otherwise engaged in many research administration tasks facilitates their continued use of digital libraries by delegating the use to the support personnel. There are also interesting use structures during performance evaluation of the scientists. The current culture of organizations to emphasize the quality of journals in which the scientists should publish has been instrumental in seeing a particular digital resource as a support tool in this regard. In that process, they were found to completely ignore the content value of that resource but focus on the evaluative capabilities.

Finally, various personal factors also contribute to the digital-library use by the scientists in such organizations. The habit of searching regularly, perceptions developed about the resources, and the opportunity for personal achievement work together with other factors motivating scientists to use digital libraries.

CHAPTER 7: VERIFICATION STUDY

7.1 Chapter introduction

This chapter presents the results of a verification study which was conducted at the end of the original research. The verification study aimed to ascertain the trustworthiness of the original study and its findings.

The research aimed to understand how digital-library use in Indian academic and research institutes is being shaped by organizational and social contexts. Four specific questions pursued in this study were: (i) what are the various patterns of interactions in which people as social actors, in Indian academic and research institutes engage in meeting the demands of their social world? (ii) how do information-gathering practices help those social actors meet the institutional forces of those interactions? (iii) what are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level? (iv) how are such digital-library use practices accounted for by different extra- and intra-organizational factors?

The study was conducted using qualitative and naturalistic research methodology. Using a multiple case study approach, data were collected primarily through the guided interviews of scientists working in two scientific research organizations in India. The recording of those interviews were transcribed and subjected to inductive content analysis leading to the emergence of various themes. Those themes were used to address the research questions of this study.

This rest of this chapter is devoted to describe the need for, and the rationale, design and findings of the verification study.

7.2 Verification study – its relevance

Trustworthiness of a study is one of the vital aspects of research. For studies that use experimental design and draw conclusions based on statistical procedures, trustworthiness is addressed by internal validity, external validity, and reliability. This research was conducted under a naturalistic, qualitative and interpretive paradigm. The researcher herself was the instrument for data collection. The findings of the research were interpreted by her, as well, by using theoretical sensitivity. Hence the trustworthiness of the study should be supported by credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985). There are several ways to establish the trustworthiness of a qualitative study, such as, triangulation, peer debriefing, and member check.

Triangulation is one of the ways to establish the trustworthiness of the findings. Triangulation was conducted between the accounts of two members from the same group within an organization, and between the member's account and the organizational picture as it emerges from documentary and other sources.

Another process towards establishing trustworthiness, which was followed throughout the data collection and analysis, was peer debriefing. Regular weekly meetings were held with another doctoral student discussing the modification of interview questions, observations and categories that emerged.

Reconstruction gives more credibility to the findings of a naturalistic, qualitative study. Member check is an important tool that can be used towards establishing the credibility of reconstruction (Lincoln & Guba, 1985). For this reason, throughout the study an in-process member check was carried out. As themes began emerging from the first few interviews, these themes were then presented to the next interviewee in the form of light probes. In order to eliminate any chance of influencing the interviewee, those questions were placed at the end of the interview only. Further, a terminal member check was also conducted on a few selected themes though the response rate was very low.

Another extended form of member-check was conducted in the form of a Delphi-like study at the end of the main research. A few scientists from another organization were invited to participate. Some of the important findings of the research were placed before them as statements and their opinions, based on their experiences, were requested. This process was adopted to sample check if some of the themes are transferrable in another context.

7.3 Verification study based on Delphi technique rationale and design

This verification study was designed after a well-known research method – Delphi technique. Delphi is a structured group communication process in which data is elicited and collated from a group of experts or panelists (Busha & Harter, 1980). This technique is suitable when one or more of the following conditions exist:

(1) the purpose of the study is to generate consensus of opinion of a panel of experts on a selected issue. A well rounded consideration of an issue is possible when all the experts' views are brought together.

(2) such people whose opinions matter, are located in geographically diverse places and bringing them for a meeting is expensive;

(3) the experts have an investment in understanding or contributing to the phenomenon under study;

(4) the experts need to reflect on several issues before giving their opinions and hence the time restriction under which a meeting is conducted, creates a hurdle for such reflections; and finally;

(5) there is a likelihood of emergence of extremely opposite opinions from the experts/panelists which in any meeting may result in a group dynamics leading to the dominance of a powerful group. The adverse effects of this group dynamics can be eliminated and the experts are enabled to express their opinion freely, by keeping the identity of each of the experts/panelists, unknown to others.

The method is based on the judgment of the selected experts, and does not rely on previous historical data being available. In addition, the method is typically intended to provide a judgment or opinion on the specific subject area, rather than producing a quantifiable measure or result. This technique has been found useful for planning and forecasting.

The steps that are to be followed in a study employing Delphi technique are outlined below:

1. A group of experts are selected and contacted;

2. The first phase explores the subject being researched, giving experts the opportunity to contribute information. Generally, information is collected, in this phase, through open ended questions;

3. In the second phase, experts' opinions are collated and an understanding is developed on how the group views the issue. This structured view is presented back to the experts, as controlled feedback, indicating points of disagreement and the degree of disagreement on each point. The experts are given option to revise their earlier stand on contentious issues. At this stage a structured questionnaire may be sent to the experts. This round may be iterated more than once;

4. If significant disagreement is traced, the third phase is used to explore that disagreement and determine reasons for differences.

5. In the fourth phase, a final evaluation is done on the opinions of the experts and points of agreements are filtered out.

The verification study adopted a Delphi technique though the study was not intended for planning or forecasting. However, the technique provided an opportunity to know the opinions of organizational members of another comparable site, on the pictures of digital-library use that emerged from the study. It also gave a scope to generate new pictures, of digital-library use, that did not surface in the main research. Besides, though the participants of this verification study were not geographically dispersed, keeping the time and cost of data collection at a manageable level was a concern of the researcher. Hence this technique was adopted.

The core features of the study are:

(1) All experts were selected from a third organization. Keeping in view that the main study followed case research method to focus on organizational context, it was appropriate to select experts from another case;

(2) Based on the findings of the main study, several theme statements were developed and placed before experts;

(3) Generally, in studies using Delphi technique, experts are asked about their opinions. In this verification study, experts were asked to give their opinions on the theme statements based on their experiences and then to narrate those experiences, if possible, in support of their opinion. This helped verify that the opinions of the experts were grounded in reality.

The organization selected for this part is structurally the same as ORG1. It is also one of the research organizations devoted to industrial research in the area of special materials. It has access to a fairly good number of electronic resources, although, from the responses of the experts, it emerged that there is shortage of funds that affects this collection. Twelve scientists were invited to participate in the study and five of them responded.

7.4 Findings of the verification study

The questionnaire was developed in the form of statements (Appendix-1). Eleven themes from the main research were used to develop statements for the verification study. Those themes were on how information gathering and digital-library use help in (i) Alliance formation, (ii) Confidence building, (iii) Identity – knowledgeable self, (iv) Scientific inquiry – challenges, (v) Scientific inquiry – successful participation, (vi) Compliance, (vii) Community relation and competition . The rest of themes were on how digital-library use is affected by (i) Learning load, (ii) Labor saving devices, (iii) Organizational work load and delegated use of digital libraries and (iv) Information environment and non-use of digital libraries. The findings of this study are presented in Table-30.

The table indicates that there are strong agreements on several themes as below:

(i) Digital libraries help scientists to present a strong case for their research proposal outcome and thus leads the way to the formation of partnerships between industries and the research organization (**Alliance formation**);

(ii) Digital libraries help to establish the link between the research proposal and the past work done – this leads to funding agencies' confidence in the research proposal (**Confidence building**);

(iii) Challenges posed by powerful editors of journals, particularly when they make suggestions for more experiments, can be successfully countered with the help of digital libraries (**Scientific inquiry – challenges**);

(iv) Digital libraries help researchers propose a research scheme which can be acceptable to the research community (**Scientific inquiry – participation**);

(v) Digital libraries are truly labor saving devices and collapse the distance between laboratories and libraries (**Labor saving devices**);

(vi) As digital libraries are accessible by competitors, scientists meet the competition by making exhaustive consultation of digital libraries (**Community relation – competition**);

(vii) There is still non-use of digital libraries in those areas for which digital libraries are not available (**Environmental factor – non-use**);

There was moderate agreement on the following:

(i) Digital libraries that demand learning load, are generally avoided (**Learning load**);

(ii) Scientists with high workload and with support from organization do not use digital libraries by themselves; they delegate the task to their support system (**Work load and delegated use**);

There was complete disagreement on the finding that consultation of digital libraries is required to comply with rules and is done perfunctorily just to meet the requirements (**Compliance**). One of the scientists elaborated that though they cannot control whether the reviewer might go through the report carefully, they do not want to leave anything to chance and hence must make this part of the proposal extensive. That this theme was put intentionally in negative tone (Appendix-1: statement-6) such strong disagreement actually strengthen the original finding that compliance from funding agencies strongly forces the scientists to engage in information gathering using digital libraries.

It may be noted that for the themes, except "**Compliance**", the degree of disagreement, where found, was only partial. Those disagreements actually did not negate the themes. Neither did such disagreements add new dimensions to the themes. For the theme "Alliance formation", the scientist who partially disagreed commented that "Indian industries are hardly interested in funding research". This implies that the scope of "Alliance formation" with Indian industries is not very high. Similarly, the disagreement on "**Confidence building**" qualifies that such situations occur for research funded by the government. Similarly, for the theme "**Scientific inquiry – successful participation**" and the use of digital libraries in this regard, one scientist pointed out that not all information is available in electronic format thus underscoring that information gathering is important for this theme by entire requirements may not be met with electronic environment. This in fact, strengthened another theme "**Information environment and non-use of digital library**" that emerged from the study. Please consult Table-24 for more details.

As the response from the scientists did not lead to any major disagreements, this study was closed at this phase.

Table 29: Findings of the verification study

Theme	Agreement	Disagreement	Comment
Alliance formation: Digital libraries help establishing the benefits of a product and process – this leads to the formation of alliance between industries and research organizations	Agreement was strong. Two specific points highlighted were (i) industries sometimes, are not only interested in the outcome but also want to know who are the scientists involved in such research which can be quickly found from the resources (ii) industries are keen to see the value of the outcome, in its commercialization	Only point of disagreement was that Indian industries are hardly interested in funding research	
Confidence building: Digital libraries help to establish link between the proposed research and past knowledge – this leads to the earning of confidence of funding agencies	Agreement was strong – it is not only link but also the strategy to change an ingredient to research, based on lit review was important. Another informed the importance of comparison of all past work to the current and highlighting the comparison, particularly for projects with international counterparts	Only point of disagreement was that this kind of exercise is important for government funded research	
Identity – knowledgeable self: Digital library is important for scientists in the process of establishing their identity as knowledgeable self	Agreement was there for situations when speaking to wider audience such as seminar, conferences - how	Disagreement was for project meetings – the points of discussions were generally focused and scientists own knowledge is sufficient	Irrespective of disagreement, every one concurred that they have to continuously monitor current literature
Scientific inquiry – challenge: digital libraries help scientists to meet the challenges posed by powerful editors	Strong agreement was for those challenges which suggest to do some experiments afresh – scientists then go back to the literature, compile data from reports published showing that similar experiments were already performed, results of those experiments and link with their own findings		
Scientific inquiry – successful participation: Digital library prepare scientists to participate in discourse within community successfully	Strong agreement in general	Disagreement was on the non-availability of electronic version of every resources	
Compliance: digital library is used as compliance	Partial agreement – the reason is high level scientists may sometime delegate this task to their juniors who would not pay attention to this part	Strong disagreement – generally they have trust in reviewers' scrutinizing this part	This question was placed in a negative tone; It was presented as if the compliance is to meet the formality outwardly.

Theme	Agreement	Disagreement	Comment
Learning load: Digital libraries demanding cognitive load are generally avoided	Moderate agreement – reasons are late learners of electronic medium and heavy work schedule	Disagreement – when extensive data mining is necessary, even difficult systems are learned and used	
Labor-saving devices: digital libraries now save labor and time of scientists	Strong agreement – particularly one scientist elaborated how they can check data now from the laboratory itself without going to the library	Little disagreement on those cases for which electronic resources are not available	This aspect was further verified through another question against which everyone responded that now they can connect to Internet from their office work table
Work load and delegated digital-library use: organizational work load and support system lead to delegated use of digital library	Moderate agreement		In principle, it was agreed upon that scientists must keep themselves up to date
Community relation – competition: digital library is now accessible by competitors – this awareness make the scientists consult the same extensively	Strong agreement		The disagreement was not on the matter that others have access and thus raising the level of competition – disagreement was that scientists sometimes still found not being exhaustive
Information environment and non-use of digital library: Non-availability of certain types of information lead to non-use of digital libraries	Strong agreement		

7.5 Chapter summary

This chapter reported the findings of a verification study which was designed using a modified Delphi technique – an approach that uses structured group communication. The study was conducted using a panel of scientists (treated as experts in this study) selected from an organization similar to ORG1 – the case selected for the main study.

The findings of this verification study confirm that with minor qualifications, the themes that emerged from the main research hold for this verification site as well. Under similar organizational contexts, digital-library use can be attributed to various institutional forces that exist in the organizational environment and at the same time, the use takes specific structures which can be attributed to various extra and intra-organizational factors.

CHAPTER 8: CONCLUDING CHAPTER

8.1 Introduction

This chapter devotes to the discussions, conclusions, limitations, implications and the future study. A summarization of the findings is made and those findings are then discussed in the light of the theoretical constructs used in the study. The conclusions, based on the findings, follow this discussion. The contributions, limitations of the study, implications of the findings and the direction for future research are highlighted at the end of the chapter.

8.2 Discussion

Successful use of any information and communication technology is not merely using its technological features perfectly. The technology must fit into the social environment and meaningfully serve the purpose, for which it was introduced into that environment. This is a very pertinent way of looking at any technology use within an organization that invests in developing technology infrastructure.

Unless this environment is taken into account and examined, justification for the financial investment for the technology becomes impossible (Kling, 2000). This issue of looking at the environment – understanding the use of technologies within it – is even more relevant to organizations located in an economy that is still in the process of progressing and that has been investing immense sums of money for expensive infrastructures with the goal of generating the capability of its use for the betterment of the country.

The context of use, however, is a very large and vague canvass. In this study an attempt has been made to precisely capture some of the components of organizational context that drive the members of an organization to use (or non-use) digital libraries. A broad research question was formulated. The question was how digital-library use is being shaped by organizational and social contexts of Indian academic and research establishments. This section provides a succinct overview of the overarching and specific research questions and the theoretical constructs used. Following this overview, discussions of the findings in the light of the theoretical framework are presented.

8.2.1 The research questions and the theoretical constructs – a glimpse

The set of research questions presented in Chapter-1 are as follows:

<table>
<tr><td colspan="4">Overarching research question: How is the practice of digital-library use by people in Indian academic and research institutes being shaped by organizational and social contexts?</td></tr>
<tr><td colspan="2">RQ#1: How do the social worlds of an organizational member influence and shape her/his information-gathering practice?</td><td colspan="2">RQ#2: What are the various extra- and intra-organizational factors mediating the practice of DL use (including non-use) in information-gathering activities of organizational members?</td></tr>
<tr><td>RQ#1(a)</td><td>What are the various patterns of interactions in which people as social actors, in Indian academic and research institutes, engage in meeting the demands of their social world?</td><td>RQ#2(a)</td><td>What are the various emergent practices of use of digital libraries, both at the digital library level as a whole and at the feature level?</td></tr>
<tr><td>RQ#1(b)</td><td>How do information-gathering practices help those social actors meet the institutional forces of those interactions?</td><td>RQ#2(b)</td><td>How are such practices accounted for by different extra- and intra-organizational factors?</td></tr>
<tr><td colspan="4">Conclusion: How do the organizational contexts in Indian academic and research institutes shape DL use by organizational members?</td></tr>
</table>

The more specific questions, developed to answer the two major sub-questions of this research, namely RQ#1 and RQ#2, are:

(vii) What are the components of the contexts of members of an academic and research organization?

(viii) What is the institutional nature of those components?

(ix) What kind of information demand is made on organizational members by those constituents?

(x) How might information-gathering practices can be considered as helpful for those organizational members in meeting such information demands?

(xi) In the process of consulting digital libraries in order to support such information gathering activities, what structure of digital-library use emerge? and

(xii) How might the organizational context account for such digital-library use structure?

Answers to these questions were facilitated by using two theoretical constructs, namely *social actor* and *technology-in-practice*. *Social actor* is an organizational individual whose actions are responses to interactions with various institutionalized entities. These institutional entities are located outside the boundary of a specific organization but members of an organization often have to interact with them while discharging their organizational responsibilities.

Two Indian academic and research organizations were selected as cases for this research. Scientists of each of these organizations were organizational members in this study. In viewing them through the lens of *social actor*, the information-gathering practice and digital-library use of scientists in Indian academic and research organizations were often found to be triggered by interactions between those scientists and various entities outside their respective organizations. Those entities have certain institutional characteristics and their information demands become workplace demands for those scientists.

Technology-in-practice is the structure of the use of technology and this structure is facilitated by various organizational characteristics and not only by the capability of the technology itself. Using this lens, the research elicited a structure of digital-library use that could be associated with a variety of organizational factors.

A theoretical explanation of the findings and the concurrence with and differences from the literature are presented in the following sections.

8.2.2 Components of organizational contexts and information demand

The core of the construct *social actor* is that a socially rich description of context is possible when the entities outside the boundary of the organization are considered. Interaction with those entities is mediated by the exchange of some resource and certain routine actions with them are then carried on to facilitate such resource exchange. Information-gathering practices using digital libraries can settle in as routine actions and this can support information exchange during the interaction with external entities. Such practices can sometimes settle in as rules, some as norms and some other situations demand that organizational members either follow others or recognize as intelligent individuals that the interactions demand information practices using digital libraries.

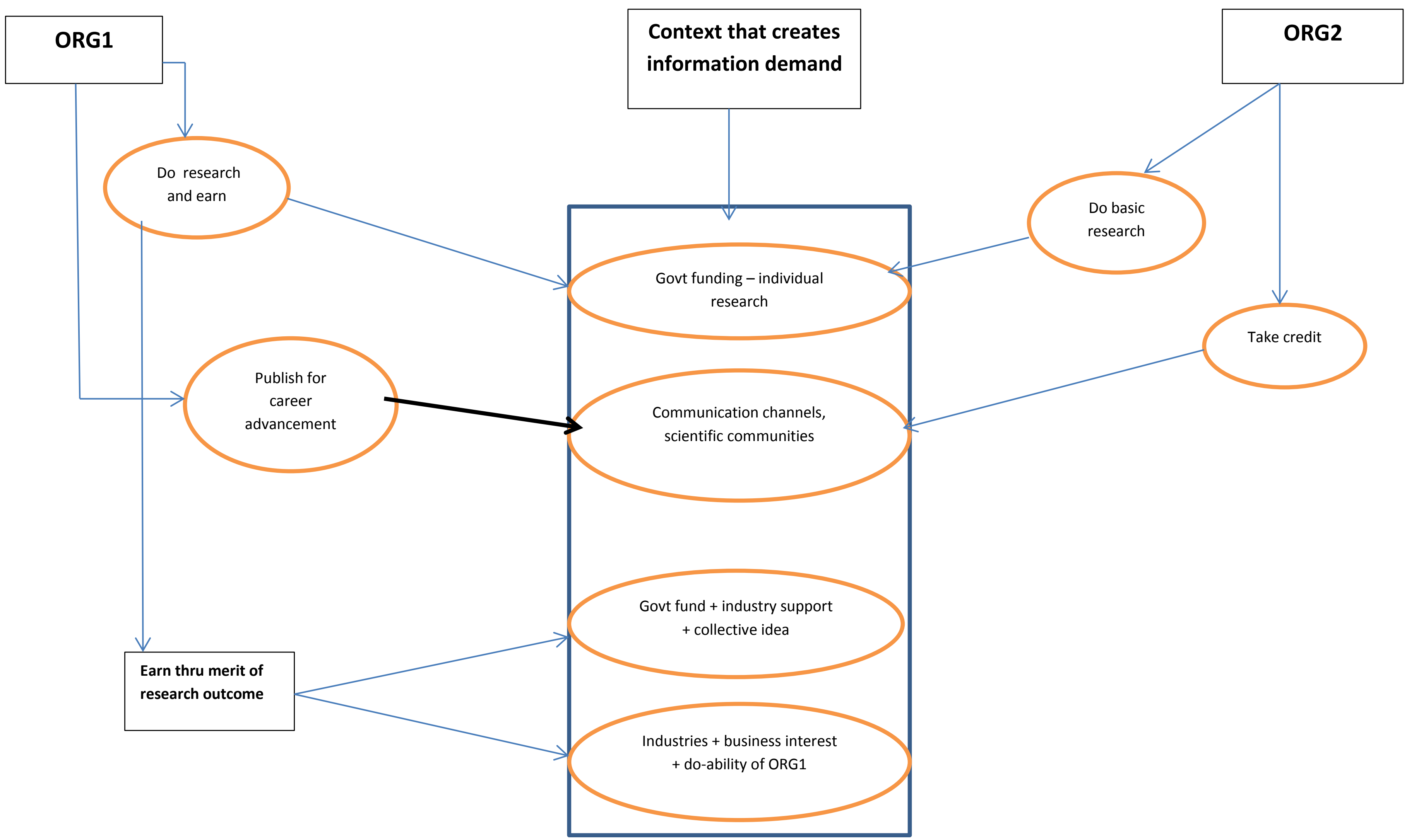
Mapping scientists of organizations selected in the study, onto the construct of s*ocial actor*, helped to reveal:

(i) **Whether information-gathering practices of scientists are triggered by entities residing outside the organization and the institutional characteristics of those entities** – the findings of the research in this regard suggest that there are many occasions in which the scientists have to interact with external organizations or individuals and those interactions demand information exchange. Those entities have distinct institutional characteristics that become visible to the scientists. Those scientists found that information exchange helps them to comply with the information demand of the interactions. In that process information-gathering practices of scientists and digital-library uses become a routine job within the organization.

(ii) **Whether such information-gathering practice meaningfully lead to information exchange between the organization members and those entities** – the findings showed that scientists could often associate their information exchange and information-gathering practices to different meanings, depending on the nature of entities with which they interact and exchange information.

Figure-6 provides an overview of the organizational contexts of both the selected organizations.

Figure 6: Organizational context generated through organizational policy



8.2.2.1 External institutional entities of regulative structure

Some of the entities scientists come across do have the characteristics of a regulative structure. Those are mainly various government funding agencies and some funding agencies located in other countries. Interactions with these entities require information exchange and it must be made in a formal way. Applications for funds must be made in a prescribed format, which includes a direction for submission of a literature review. Another such agency of this nature is patent granting authority. The formal application for filing a patent requires a review of all relevant patents in the specific area.

When scientists engage in individualistic research and require financial support, they depend upon various government agencies and comply with this information requirement whenever they apply for funds. This is a major activity of scientists – all scientists who were interviewed reported their attempt to obtain funds for their own research. Patent filing, however, was not a very intensive activity as it is considered one of the achievements during career advancements. Besides, not all types of research lead to patents. These government agencies do not have an official regulatory structure such as the US Food and Drug Administration. Interactions with such agencies, however, are unavoidable for the scientists of these two organizations.

It was noted that despite the differences between the two organizations, scientists of both the organizations interact with this entity. ORG2 policy requires that its scientists do basic research. Funding for such research can come only from various government agencies and from a few foreign organizations. Hence their interactions with this entity are obvious. ORG1 is mandated to do research and help industry. Interestingly the mandate for scientists in ORG1 to bring in earnings through research was implemented in a different way. In order to show earnings, ORG1 scientists began pursuing basic and individual research with the help of government funds. As well, at the time of career advancement, ORG1 scientists have to demonstrate their output in the form of published papers. They confided that getting papers published out of industrial research is difficult. According to them, fundamental research produces results that are comparatively easy to publish. These two issues – earning and publishing – were often found to be the reason that ORG1 scientists pursue basic research and funding from government agencies. This way of meeting the organizational mandate causes them to interact with entities having a regulative structure.

8.2.2.2 External institutional entities of normative structure

Normative institutional structures are generally carried through training or membership in professional/trade organizations. A member of a specific organization picks up the ways of doing things that are approved by that organization. Information-gathering practices of scientists in this study could also be attributed to such normative practices.

Scientists acknowledged the value of their doctoral training on information-gathering practices. This was strongly emphasized by those who received their doctoral degrees in countries such as the US or in the elite institutes of their own country. Comparatively, those who were trained in an Indian university setting did not emphasize their doctoral learning processes as much. These scientists, as well as older scientists, acknowledged that their major learning took place when they went abroad to pursue advanced research. This picture of learning of information gathering is not surprising because during the print era and even in the beginning of the electronic era, Indian academic organizations were starved for information resources, as pointed out in the initial chapter. Besides, during those times, formal training on information literacy was not a general practice in academic settings.

But mere training cannot be sufficient for developing information-gathering practices as the norm in one's work life. The information demand from the environment works as the main ingredient for setting the norm. One ORG1 scientist said that even a few years back it was not the practice to develop a literature review for many industry-initiated research projects. In one such project, the industry partner suggested preparing a literature review on the technology. This scientist explained that since then, it has become the practice for ORG1 scientists to prepare literature reviews for all such projects. The informal practice which started at the behest of an industry partner is now established as a formal practice.

For both of the organizations, a large part of normative information-gathering practices could often be attributed to interactions with the scientific community. Communications with other scientists through publishing in journals and presenting papers at conferences/seminars are part of a scientific life. Moreover, for both the organizations, publications are considered important measures of achievement at the time of career advancement. The entire range of activities regarding knowledge dissemination and communication can be viewed as interaction with the epistemic community/invisible college. The followings sections describe these two social organizations and highlight their possible role in the information gathering activities of scientists.

8.2.2.3 The epistemic community and invisible college as normative structures

Any study involving knowledge creation cannot perhaps avoid a discussion on epistemic community and invisible college – two institutional entities spread all over the world and controlling and influencing knowledge generation. Though the current study is primarily on digital-library use, we have seen that a major part of the use of digital libraries is associated with knowledge creation. Hence it is appropriate to look at the role of these two institutions on the information-gathering practices of scientists in Indian academic and research organization. Brief descriptions of each of these two organizations are given below. These descriptions are followed by an examination of how scientists in the current study are linked to these organizations and how memberships in these organizations influence information-gathering practices.

8.2.2.3.1 The epistemic community and invisible college – a brief description

An *epistemic community* is an overarching social organization populated by people having special knowledge relevant to a certain task. The knowledge can be tacit (Ha°kanson, 2005), coded (Gittelman, 2007), or both. Membership in an epistemic community is generally global in nature. With regards to science researchers, the objectives of the epistemic community are the production of knowledge itself (Knorr Cetina, 1999) and to purge knowledge of the personal, context-specific and idiosyncratic features. These objectives are attained by the community members adhering to well-understood rules and codes of conduct governing the creation and dissemination of the knowledge (Amin & Cohendet, 2004; Cowan, David, & Foray, 2000). Some of the characteristics of an epistemic community that are pertinent to this discussion are: (i) members of the community communicate substantive research findings through publications that have to undergo the peer review process (Allen, 1977, p. 41); and (ii) members receive prestige, citations and rewards arising out of publications, and they develop connections within the community.

Another social organization, similar to an epistemic community involving scientists, is an *invisible college* (Crane, 1972), which is a network of productive scientists. Invisible colleges contribute to the growth and productivity of a field in terms of publications. During the growth of a field, a few lead and productive scientists are often cited by others across different groups. One way to publish rapidly is to apply the same procedures, tasks, or pieces of equipment over and over, introducing new variables or slight modifications (Crane, p.55). Researchers, in the pursuit of career advancement by number of publications, produce papers out of studies along these lines. In that process, they cite earlier works. Thus, social circles of research areas have invisible colleges that help to unify areas and to provide coherence and direction to the field. The central figures of a field and some of their associates are closely linked by direct ties and develop a kind of solidarity that is useful in building morale and maintaining motivation among members. This network is manifested through the chaining of citations. Thus, over a period of time, some papers of some authors are highly cited by others implying that those authors have developed their followers or groups. Members of such groups communicate with each other to discuss various issues related to their research problems. Such groups are formed around the most productive scientists.

8.2.2.3.2 Information-gathering practices and normative structures

Further discussions in this connection must be limited in this study since the details of the similarities and differences between these two social organizations are outside of the scope of the current work. For the purposes of the current discussion it can be said that the scope of an epistemic community is much larger than that of an invisible college in terms of membership[43], issues[44], and collaboration. The scope of the invisible college is limited to the growth and productivity of a subject area in terms of publications. Second, the discussion here is limited to how the epistemic community and invisible college might provide context as a normative structure that makes information demands on the scientists and thus triggers information-gathering practices.

Scientists of both the cases under study attempt to publish in internationally reputed journals. Publication is an organizational mandate for these scientists. In addition, scientists tend to publish irrespective of the nature of the organizations where they work (Gittelman, 2007). By doing so, they communicate substantive research findings that have to undergo peer review process. Out of these publications they receive prestige, citations and rewards. This process makes them a member of their respective epistemic communities. Similarly, publications enable scientists to participate in the growth of their respective fields and to become natural members of their respective invisible colleges. Making a departure from this point, the following discussion will highlight how information-gathering practices of these scientists are influenced by these social organizations.

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[43] membership can be discipline-wise or practice-wise such as open source software development
[44] Code for membership, prestige, rewards

As scientists communicate their substantive research findings to their epistemic community they undergo scrutiny through the peer review process. During this process doubts about the findings are raised or clarifications on some issues are sought. At that time, scientists look for supporting information and consult various resources to establish that their views/findings are correct. Thus, developing community relations, gaining recognition, and scientific inquiry are a direct outcome of the role of the epistemic community on information-gathering practices. Scientists also reported regularly scanning information in order to ascertain their position within the epistemic community. They keep watch to see if their papers are being cited, specifically in journals with a high impact factor. While it is pleasing to know that one's paper has been cited in a journal with a high impact factor, it is also an alert of probable competitors. Scientists often reported that keeping track of trends in publications helps them to set a target to publish ahead of competitors so that the paper gets a chance of being cited and it can elevate the position within the community. Alternately, keeping track of information also opens up the possibility of networking and collaboration and thus developing a group within the epistemic community. These are all efforts towards maintaining community relationship.

Scientists in this study viewed receiving offers for editorship of journals or for writing a review paper as marks of recognition of their knowledge. Once they acquire the recognition, they strive to retain it and engage in regular scanning of information resources so that they can stay updated. Table-31 provides a succinct view of how the scientists in this study attempt to retain the membership of their epistemic communities and invisible colleges with the help of information-gathering practices.

Table 30: Information-gathering practice and the social organizations of knowledge creation

How information gathering helps	Epistemic community	Invisible college
Keep updated about developments and retain the identity of "knowledgeable scientist"	Rewards in the form of editorship of journals or invitation for writing review article	
Citing to establish that current work is built on earlier work	Acknowledging and paying respect to earlier works	Following a group, strengthening a group, raising citation count of a school
Collecting evidences when challenged	Seek support from epistemic community or establish new identity	
Identify similar work	Scope for collaboration, developing network	
Identify who has cited	To identify competitor	
Assessing the trend of publication	Strategy for earlier publications in order to get credit through citation	
Collecting citation data on the publications of self	Produce evidence while aspiring for rewards, grants	

There are, however, doubts about the production of "neutral knowledge" by an epistemic community (Miller & Fox, 2001). More on this is discussed in Section 8.2.5.2.

In sum, the epistemic community and invisible college are part of a normative structure in the organizational environment of the scientists. Organizational policy that considers publications as one of the achievement of scientists brings epistemic communities and invisible colleges – entities with a normative structure – into the organizational field. This often leads to information-gathering practices being established in the organization as a norm.

8.2.2.4 External institutional entities and cognitive structure

On several occasions, the scientists in this study recognized intuitively that information-readiness is the way to survive an uncertain situation, for example, interactions with which they were not familiar. They found the best strategy was be information-ready and exchange such information during the interaction and extract benefit from it. In fact, the recent policy revision within ORG1 that earnings from research must be implemented in a true market sense has opened up the external organizational environment for ORG1 for industries to enter the scenario. Because of this new way of implementing existing policy, the organizational environment of ORG1 now has more different types of entities than does ORG2. This has resulted in an information demand on ORG1 that is also different from that on ORG2. In order to successfully interact with industries, ORG1 scientists often search for new types of information. In that process they expand the scope of digital libraries by searching websites and house journals of various companies. They can then successfully present such information during negotiations and earn the confidence of prospective industrial research collaborators.

Another example of such an intuitive practice of information gathering occurred when scientists are expected to meet peers in face-to-face meetings. Those peers are “knowledgeable individuals” and scientists make every endeavor to remain information ready so they can participate in any discussion. Sometimes scientists attempt to understand the background and area of specialization of the peers, specialists and industrialists with whom they might meet and prepare accordingly. Information scanning is directed towards this preparedness.

Entities of regulative or normative structure provide clear signals to scientists, either through instructions or through training, that information exchange is the way to facilitate interactions with those entities and also allow scientists enough time to prepare for information. On the contrary, entities of cognitive structure push the scientists to an uncertain situation. As the scientists enter the market – with true objective of earning – where they have to convince the industries about the merit of the research conducted by the organization, benefits of collaborating with their research, there is no structure which scientists can follow. Compared to other types of research, this is an endeavor to earn research funding. But there is no formal format through which project proposal can be submitted to industries. To overcome this uncertain situation and to convince industries, scientists collect information from various digital resources and present those information during the negotiation which can prolong for quite some time. The scientists take the help of information exchange under the belief that industries are also aware of what is happening, they can be convinced only if it is shown that scientists are also aware of what is happening and how successfully that knowledge can be transferred to some technology or product. This belief that information is one of the ingredients to convince industries drives them for information gathering and results in information exchange during all face to face interactions.

Similarly, scientists engage in face to face meetings with others that bring certain degree of uncertainty. As a scientist speaks before an audience, he can be unexpectedly caught unaware of some information, if he is not well prepared. Besides, speaking with peers may sometimes lead to another related area. This is also a situation of uncertainty. Here too scientists believe that the audience/peers always keep track of current information and to match their knowledge, she/he must be information ready. Both the cases of uncertainty and resorting to information gathering based on the belief that others engage in similar activities are the examples of mimetic isomorphism – *organizations modeling themselves after others to dispel fear of uncertainty* (Elliot & Kling, 1997). It can be summed up by saying that direct interactions with external entities always create a situation of uncertainty and social actors depend on their belief system which guides them for information gathering activities.

Thus DL use often settles within the organizations under study not only as response to rules or norms but also for the intelligent assessment of the users about the unpredictable situation and mimicking others in terms of information gathering. This cognitive structure or mimetic isomorphism is the essence of new institutional theory on which the construct *social actor* is based. The presence of this cognitive structure in the informants under study extends credence to the premise that organizational members are *social actors* in regards to DL use.

8.2.3 The dimensions of social actors in present study

Lamb and Kling (2003) characterized *social actors* along four different dimensions. Those dimensions are affiliation, environment, interaction and identity. This section describes how information-gathering practices of scientists as *social actors* can be mapped onto these four dimensions.

Affiliation is the network of relationships connecting an organizational member with other organizations. This relationship may be developed at the organizational level or directly by members. The findings suggest that different types of affiliates produce different information demands. Depending on the type of affiliates scientists see their information gathering activities differently. When the affiliate is a government funding agency, information practices help them in complying with directives. On the other hand, when the affiliate is a prospective research collaborator, information-gathering practices help them in alliance formation with such industries. For affiliates such as journal editors/peers, information-gathering practices help them in collaboration or competition.

The environment is the stabilized, regulated, and/or institutionalized practices that circumscribe organizational actions and is created by the type of affiliation the organizational members develop with others. Lamb and Kling (2003) described how the strong influence of national and international fiduciary standards drive real-estate brokers to consult electronic information system. In some cases, the environment encourages the building of electronic information systems that in turn are used by the organizational members. For scientists of research organizations such an environment leading to information-gathering practices was often found stabilized by international practices in the area of knowledge generation. As one scientist in this study stated, the application format for funds at various agencies is similar to that of any international funding agency. Similarly, one scientist remarked that the practice of inclusion of metrics such as the impact factor of journals in career advancement documentation was imported from other advanced countries. It has resulted in an awareness and requirement for such information. As well, as scientists interact with international journals in order to get their papers published in them, information practices might be largely governed by the world culture in this regard.

Interaction is the package of information that is exchanged with affiliates and also the media of such exchanges. Different types of affiliates demand different types of information packages and modes of exchange. Lamb and Kling (2003) found such exchange always took formally. In this study, formal information exchange often happened, such as in producing a technology report. For the most part, such exchanges were for the purpose of seeking research funds, either from government agencies or from international organizations that are aimed at supporting scientist-driven research projects. Some exchanges that had been initiated informally, such as with industry partners, were now established more formally.

But for the majority of interactions the information exchange takes place informally. Scientists of both organizations emphasized that informal information exchange is equally important for them, particularly during meetings. Such meetings are attended by specialists, peers, and so on. Scientists remain aware that knowing the information and suitably presenting it during discussion is important. ORG1 scientists often described that their information-readiness, at the time of negotiation with an industry, should be reflected during the meetings. The formal project proposal should be a very concise document as “no one has time to go through a voluminous report”.

Identity is the presentation of the self either as an individual or as a collective entity. It was perceived by the informants who participated in the study that such an image of self would be enhanced when affiliates are shown that organizational members can work fluently with ICT (Lamb & Kling, 2003). For example, it was important for a broker to present his ‘track record” or for an attorney to demonstrate to her client that her expertise covers certain areas. Preparation of various packages with the help of various ICT tools was perceived by the members as advantageous and competitive. In order to present the collective self, those who lacked the skill of ICTs, hired up-to-date skilled staff or trained current members.

Identity is very important to the scientists – both as individuals and at the collective level. Scientists are conscious of projecting who they are and how knowledgeable they are. All scientists across the two study sites felt they must be viewed as well-informed by others with whom they come across in a meeting or conference. However, there was no hint that these scientists linked their identity to their ability to use ICTs. They were more focused on displaying themselves as “knowledgeable selves”. It is important that others at a meeting, for instance, must recognize their information awareness. In submitting papers for publication, in order to get them accepted they highlight how their papers excel and are different from others. They do not think it is important for others to know they got such information from a digital library. At the same time, these scientists are aware that their competitors also have access to such information infrastructure. Hence submitting a proposal which is a duplication of work, or not citing a scientist who is already well known in the field are not taken kindly by the community. Not keeping track of information may make them “out of community”. Thus not using the ICT might lower their stature within the community but its use is now an accepted norm.

This difference between the literature and the current research is probably because the notion of *social actor* was developed based on the work done in the late nineties. At that time, various ICTs were just getting introduced. As shown in Chapter-4, both the organizations selected for the study now have access to sufficiently sophisticated ICTs and hence ICT use has become almost mundane within the community and society at large.

8.2.4 Digital-library use patterns through the lens of technology-in-practice

Even though information-gathering practice and subsequent digital-library use were found to have been routinized within the selected organizations, this research brought another lens to bear on how digital libraries are used for information gathering within those organizations. Digital libraries have a technological component and this aspect was expected to have added another layer in developing the practice of digital-library use. Another construct – *technology-in-practice* – was used to understand this aspect of technology use.

Technology-in-practice is the use structure of technology or to put it simply, the pattern of repeated use of a technology. For any technology, a few of the features are repeatedly used by the users and thus a structure of use becomes visible. This use structure may vary. The same person may display different use structure at different points of time. Different groups in the same organization may also exhibit different use structure. Such use structure can be attributed to various organizational factors and not to the technology *per se*.

The pattern of digital-library use that emerged from this study could be identified as non-use, delegated use, and selective use. Non-use, or limited use, of a technology could be associated with a specific group in earlier studies (Orlikowski, 2000). The reasons why a particular group was not using *Notes – a specific* software – or was using its features minimally were:

(i) The group was subjected to strong pressure with respect to their time – each of their working hours was billable:

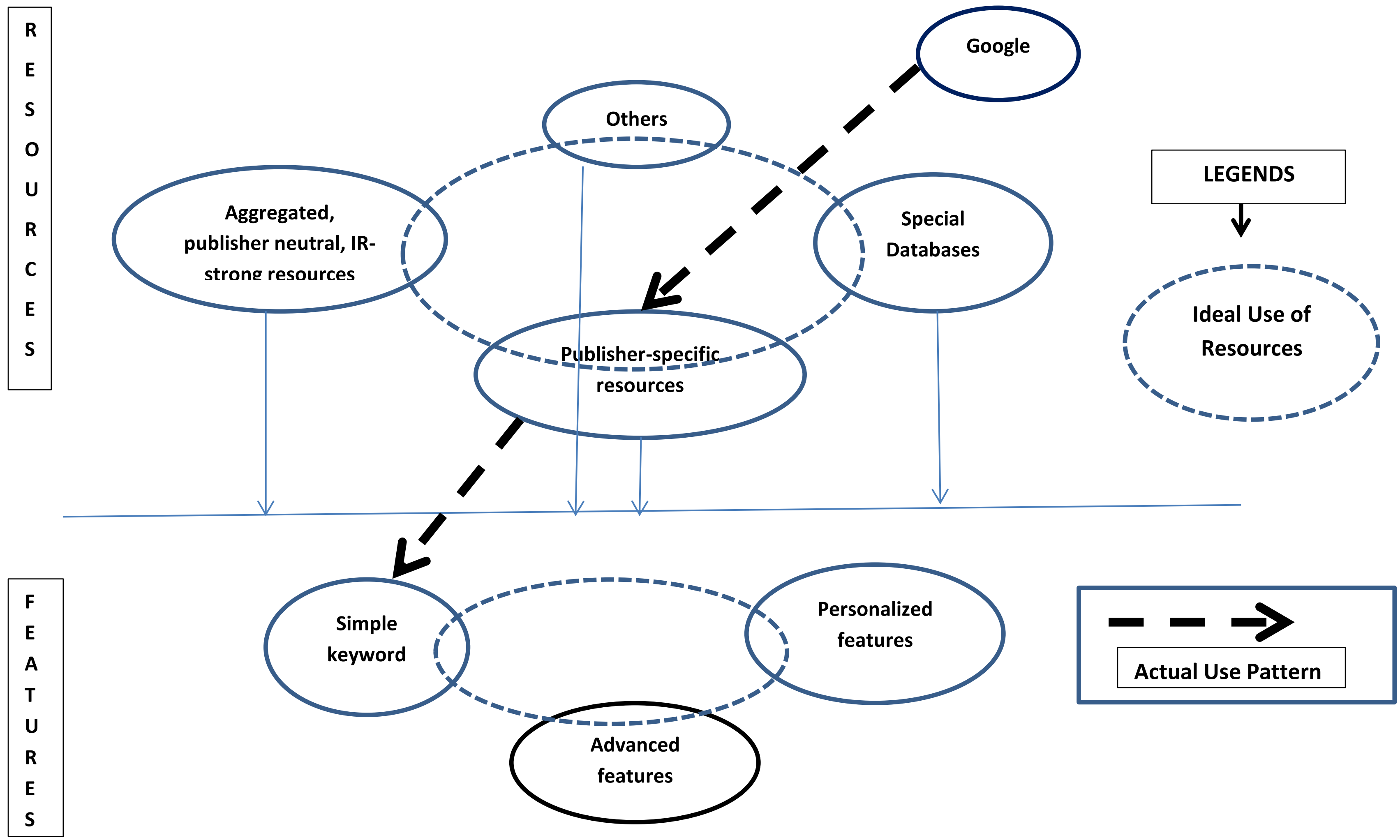
(ii) The members of the group faced strong competition within the organization for retaining their job.

These two aspects dissuaded the members of that group from investing time in learning *Notes* or sharing information through *Notes,* which might have made them less competitive.

Figure-7 depicts the overall idea about the digital-library use within the organizations. The figure shows the overall availability of various types of digital resources and features or capacity of such resources. Ideally, a trained user or information scientist is expected to use a mix of all types of resources by using all types of features available. This is not happening, however. It may be noted that the notion of *non-use* and *delegated use* could not be captured in this figure. The figure shows the pattern of use only.

Non-use of digital libraries, in the current study, could not be attributed to any differential organizational policy for any of the organizations selected. Non-use happens when scientists know that a certain type of information is not available in digital media. For example, ORG1 scientists' requirement of data from industrial plants cannot be met readily through any digital archive – hence for such information they do not use any digital resource. Two specific cases of non-use demand a separate discussion which is presented in section 8.2.5.3.

Figure 7: Digital Resources – Ideal and Actual Use



Overwhelmingly, scientists were found to use digital libraries selectively. Selective use has various shades. It could be traced at two levels – at one level it was selective use of resources and at another level it was selective use of features of any resource.

Organizational policy often could be associated with two different use structures within ORG1. While junior and middle level scientists use Google and publisher's packages predominantly, senior scientists search for the websites and the house journals of various companies. Such uses were found to be associated with the following reasons:

(i) Senior scientists of ORG1 have to take more responsibilities in research administration and take more initiative to bring in industry partners for research. This leaves very little time for them to use digital libraries by themselves;

(ii) The organization provides a support system in terms of manpower so that senior scientists can delegate their information seeking requirements;

(iii) Having reached the maximum of their career advancements, these senior scientists are not required to show performance through publications and hence do not engage in government funded, scientist-driven fundamental research, extensively, that leads to publications; and

(iv) Senior scientists are more involved in research proposals for which they look for industry collaborators – a new feature of ORG1. This activity leads them to use websites and house journals of various companies in search of various market and techno-commercial information.

The general use structure for both organizations, apart from that mentioned above,[45] can be described as selective use with the following characteristics:

(v) Search for information starts either at Google or at publishers' sites;

(vi) Scientists of both ORG1 and ORG2 have access to an array of aggregated databases, covering multiple primary resources, which are the ideal point to start to search for information. However, those facilities seemed to remain unused by these scientists.

(vii) At feature levels also, those scientists referred to simple keyword search. A few scientists were specifically asked during the interviews whether they use any of the advanced search features and the reply was negative.

This selective use structure and scientists' repeated utterances of "easy to use" across both the organizations indicate the scientists' preference for using simple systems over complicated systems that demand more learning. One scientist at ORG1 described how earlier he used one such aggregated database but has given up on its use since the system is very structured and needs learning. He and many other scientists, however, admitted that Google search results in too many hits and is not good for a subject specific search.

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[45] There was one deviation in the use structure and is discussed in section 8.2.5.1

The other reasons which might contribute to digital-library use, albeit selective use structure, are:

(i) Environmental – the availability of vast amounts of information online – both citation and full content together – encourages the use of such resources. At the same time, such an information environment that is also accessible by other scientists makes the environment in which a scientist has to survive very competitive;

(ii) Technological – technological advancements, such as quick access to resources over the Internet and interfaces between such resources with small and mobile devices are some of the facilitating factors;

(iii) Organizational – organizational infrastructure of ICT deployment, which translates into each scientist having her/his own computer as well as Internet connectivity from their own office space are great facilitating factors for digital-library use. Users could specifically distinguish this current facility from that of an earlier one when they had to run to a centralized place and share such ICT facilities with others. This brings a sense of democratized environment in which information is available to all, both in principle and in practice. When such democratization does not happen, for example in a case in which ICT facilities used to be favorably deployed for senior scientists and excluded junior scientists from use (Adams, Blandford & Lunt, 2005) – different use structures might emerge;

(iv) Personal – all of the above three factors have culminated into an image of digital libraries in the mind of scientists. Now they find digital libraries as time-saving and labor-saving device as they do not have to run to the library – thus saving time, and not having to move heavy printed journals – thus saving physical labor. Scientists now feel that their laboratory and library are together. Nonetheless, some of their perceptions about the comprehensiveness of a resource or difficulties in learning a resource are also contributing to their limited use of such information facilities.

8.2.5 A few special observations and possible explanations

Case study based qualitative research has an important limitation. That limitation is about coming across some strikingly interesting finding from a single data point. The research paradigm does not provide the scope for establishing whether such findings are idiosyncratic to one specific informant. At the same time, only qualitative research can help to unearth such interesting findings. As some structure has to be brought on the findings during final analysis, some of such interesting findings may not find a place in that structure. But given the very real nature, such findings deserve some explanation based on educated guess of the researcher. There were a few observations emerged from the study that were different from the predominant findings. These came from individual scientists or were about individual digital resources.

One of the findings was about using a specific resource – the ideal type of resource – by one scientist. This finding was completely opposite to what has been observed mostly. Another was about a particular situation of a scientist and her non-use of digital resource for reasons beyond what have been reported by most of the scientists. The other was the non-use of a very reputed resource for a very surprising reason. All three findings are presented here with possible explanations.

8.2.5.1 Field difference, social organizations and digital-library use structure

An exceptional case was found in which an ORG2 scientist working in the area of human biology described a digital-library use structure that was different from that of others. He asserted categorically that his search always starts with *Pubmed*. He also demonstrated some of the ways of conducting his searches that left no doubt that he uses many advanced searching features of this tool. He admitted that learning to search *Pubmed* requires an investment of time because the advanced features are complicated. However, he patiently learned those complicated features over the years. From the perspective of information professional this is an ideal process of searching for information, but it is markedly different from that practiced by others, including other ORG2 scientists doing research in Biotechnology (plant genetics) who reported using either Google or specific publishers' sites. We can speculate on this variation by bringing to bear the theories reported in the literature.

PubMed is a service that provides free access to MEDLINE®, the NLM® database of indexed citations and abstracts to medical, nursing, dental, veterinary, health care, and preclinical sciences journal articles. It was developed by the National Center for Biotechnology Information (NCBI) at the National Library of Medicine (NLM)[46]. An ideal information search should always start with services such as *Pubmed* (or the equivalent for other fields of specialization) because (i) such services are publisher neutral and more inclusive and thus by using such services users can have access to information published by many sources; and (ii) the search engines and

[46] http://www.nlm.nih.gov/services/pubmed.html

retrieval system help to conduct searches in the more structured and advanced manner that is required to retrieve very specific information.

One possible explanation could have been organizational policy which keeps senior scientists very busy in research administration and thus allows very little time to invest in learning complicated system. This is applicable for senior ORG1 scientists. However, as ORG2 scientists are not mandated to take up large projects, such time constraints are not applicable for ORG2 scientists working in any branch of Biotechnology. Hence organizational policy cannot be a strong contender to explain this different use structure.

We can now turn our attention to the discipline-specific social organizations and their influences on various fields. In related studies involving scholarly communications, the role of social organizations has been unambiguously recognized (Kling & McKim, 2000). For example, being major publishers in respective fields, these organizations shaped the communication of findings in open access channels differently for many years. The comparison of restrictive policies promoted by societies in the areas of psychology and chemistry with those of computer science and physics illustrate this. Prior to and in early 2000, the American Psychological Association instructed authors not to post articles on the Internet, intended for sending to its journals[47], while the American Chemical Society declared[48] that any manuscript posted on the Internet will be treated as "already published" and will not qualify for submission to its journals. The Association of Computing Machinery, on the other hand, liberally allows authors to post pre-prints and post-prints on any personal server. Such policies adopted by scholarly societies led to differential practices of posting in preprint servers by scientists of different disciplines. In

[47] However a new instruction dated November 1, 2008, relaxes some of such restrictions (http://www.apa.org/pubs/authors/posting.aspx)
[48] Modified condition is effected from January 1, 2014

addition, in some disciplines, such as biology, it is a practice for scientists to use different digital corpora to submit their findings.

There are some other characteristics of social organizations of a discipline that shape scholarly communication processes. Those are scientific orientation of a field, strategic and functional dependence within a field, concentration of communication channels, links to market, size of the research field, and so on.

Fields with a variety of scientific orientations may require the scientists to consult multiple sources in various ways (Talja & Maula, 2003). Strategic dependence is the extent of coordination of research programs and functional dependence is the extent of demonstrable usefulness of a researcher's result for others' research (Fry & Talja, 2007). Depending on the weight given within a field on this dependence, scholars may have to consult resources widely or narrowly.

The concentration of communication channels (number of journals) is another important characteristic of a discipline (Matzat, 2009). If the results of ongoing research are published in a small number of journals, the research studies are much more visible than those in fields with a low degree of concentration. This visibility, in turn, lowers the risk of harming one's own career advancement through the sharing of information using channels such as Internet Discussion Groups. If the link of the research to the commercial market is too strong, scientists would be inhibited in sharing information informally – leading to the distribution of information only through formal channels. In larger research fields, researchers are unknown to each other, which may lead to informal communication and thus may discourage researchers from communicating informally with each other through discussion groups (Matzat, 2009). The core of these points is that depending on certain characteristics of a field, scientists may avoid informal communication channels and thus use formal channels such as established journals or conferences for dissemination of their research results.

Keeping in view the above possible explanations, the strong use of *Pubmed* and not Google or a publisher-specific site by this scientist can be explained as follows:

(i) As ORG2 wants its scientists to pursue fundamental research that can be carried by the respective scientists without being bothered by coordination with other laboratories, the strategic dependence required by this scientist is almost nil. In fact, this scientist candidly admitted that he does not take up large projects that require a great deal of coordination with laboratories with large facilities. For him, the functional dependence is important in the sense that he requires that information that would be useful for his own research.

(ii) His field of research is strongly related to the market, specifically the pharmaceutical market. Hence the research results are most probably published in standard journals so that the authors do not lose their credits.

(iii) *PubMed* is brought out by National Library of Medicine (NLM). The high stature of NLM within the professional field instills confidence in the quality of information provided by *Pubmed* and reifies its presence.

By contrast, ORG1 is a place where scientists from different disciplines work together. The participants in this study included scientists of a variety of backgrounds, namely, metallurgists, chemical engineers, physicists, chemists and even bio-chemists. Thus any one particular group of scientists, physicists, for instance, contributed to developing new materials and their scholarly communications were not limited to physics journals only. Strategic dependence is as important as functional dependence for ORG1. Hence no single discipline-specific social organization guides the information behavior of these scientists.

8.2.5.2 Misplaced identity of a technology – the case of Web of Sciences

Another interesting observation was on the use of a very highly specialized information resource – *Web of Science*. This is the Web version of an erstwhile abstracting and indexing print resource, namely, *The Science Citation Index*. *Web of Science* has a cognate publication that is *Journal Citation Report* (JCR). *JCR* provides lists of journals in each discipline. Within each discipline, journals are ranked according to a measure known as the *impact factor*. The impact factor for a journal is the ratio of the number of total citations received by the journal in any given reference year to the number of articles published in that journal in the previous two consecutive years. Thus, the impact factor is a measure of average citation to a journal – that is, one of the metrics of the performance of a journal. In addition, *JCR* also generates and provides other bibliometric information, among these the half-life of a journal, an h-index of authors, and others. The *Web of Science* offers many features that are comparable to those available in other bibliographic databases; however, it indexes only those journals listed in *JCR*. Notable among other searching features is information on how many times a retrieved item has been cited and the details of those articles that have cited the item. This facility can be used to develop a chaining of citations and a citation map.

Both the organizations selected for study subscribed to *Web of Science*. The interesting points are (i) scientists of both the organizations associated this resource to bibliometric measures, specifically, to the impact factor of journals; and (ii) they admitted they do not use this resource at all for their information searching. Some of the scientists were specifically asked whether they were aware of this resource. The typical responses were either she/he knew that it provides measures such as the impact factor of a journal or that they were not familiar with it at all. The lack of awareness of this resource was surprising because the websites of the respective libraries were checked before commencing with interviews and it was listed on both.

Lack of awareness of *Web of Science* can perhaps be explained by the simile drawn between supermarket use and technology use by organizational members (Lave, 1988, pp150-151). As described earlier, like some of the supermarket's aisles, some of the properties of a digital library, remain invisible to the users. Drawing parallels to this example of supermarket use, it can be inferred that at least for the scientists who participated in the study, across both the organizations, *Web of Science* was not included in their repeatedly ordered, personally experienced and edited versions of the settings of electronic resources.

Two terms appeared off and on during the interviews. The first one was "earning" and this term was limited to the discussions with ORG1 scientists. The other was "publishing in good/high impact factor journals" that appeared during the discussions with scientists of both the organizations. Some time since the end of the eighties the notion of "good journal," meaning those with a high impact factor, was promoted within the organizations pursuing scientific research. In ORG1 there were many of discussions about improving publication standards and thus the visibility of the scientists. ORG2 scientists recall that the notion of “good impact factor journals” was brought into their organization about ten years or so ago.

Career advancement is an important part of organizational life. At the point of career advancement scientists’ performances are measured by several indicators. Publishing papers in journals with a high impact factor is one such indicator. It’s worth mentioning here that scientists see two aspects of their research – outcome and the output. Outcome is considered in terms of technology/product developed or ideas advanced. Output is considered in terms of publications in journals/conferences, patents filed, and so on. One ORG1 scientist frankly admitted that sometimes outcomes of their research is not so significant, but output is always important as it counts at the time of career advancements. Funding agencies also measure the success of the research in terms of output.

There are also other occasions when scientists refer to the “high impact factor of journals” and its importance in their working life. One ORG2 scientist mentioned that she always published in high impact factor journals and the organization could not ignore that performance while considering her reappointment. Several scientists mentioned that while applying for any grant/reward they always provide the list of their publications and the impact factor of the journals in which they published. One ORG1 scientist showed the communication from the editor of a journal on how publishing a review article by their group in that journal had increased its impact factor. An ORG2 scientist described how he continuously monitors whether citations to his publications are made from any journal with an impact factor higher than the journal of the cited article.

In ORG1, however, there are scientists who do not agree about the rationale of using the impact factor as the absolute measure of the quality of a journal. To a question on how he uses *Web of Science*, one ORG1 scientist related that he does not as he does not believe that impact factor is an appropriate measure of the quality of a journal. But, he also admitted that another colleague of his provides him that information regularly. Even if they do not use it, though, they too associated *Web of Science* with the impact factor of journals and not with information searching.

The strong promotion of the notion of "high impact factor journals are good journals" by organizations, with the aim to promoting the quality of publications by their scientists has created a strong image in their minds that this resource can provide only such information. This image of *Web of Science* has further been strengthened by various funding/rewarding agencies seeking information on impact factor of the journals where an applicant has published. The powerful content and search facility remain completely invisible to the scientists. As a result, as far as could be ascertained in this study this resource is never associated with information gathering activities.

The above phenomenon can be explained as Orlikowski (2000), stressed that while using a technology, people draw power, knowledge, assumptions, and expectations about the technology and its use. Training, communication, and previous experiences influence these aspects. Users also draw on their knowledge of and experiences with the institutional contexts in which they live and work, and the social and cultural conventions associated with participating in such contexts. In certain situation such expectation can override the capability of the technology as it was found for *Web of Science*. The content and powerful search features were completely ignored and the resource was either used for a minimal reason or not used at all.

8.2.5.3 Non-use and epistemic communities/invisible colleges

Two more cases of non-use of digital libraries warrant some discussions. One ORG2 scientist described her non-use of digital resources for one specific type of research. According to her, there is no information in this area because advanced countries did not have such agricultural problems until very recently. Hence in all the time she was working on this very country-specific problem she had problems finding information. She also struggled to get her papers accepted in good journals published in advanced countries since the editors of those journals would not admit that a problem such as the one on which she was working existed.

Another scientist reported an almost identical problem. This scientist originally trained in bio-chemical science moved to ORG1 and initiated her research in a new setting different from her area. The problems she faced were (i) the field being very new, the research was still limited to observation levels; (ii) there was not much published in journals; and (iii) she being placed in an engineering laboratory, which was yet to accept this new research paradigm, found it difficult to access the minimum resources that are available because she was the only scientists who would use such expensive resources.

Though one view of the purpose of an epistemic community is to produce “neutral knowledge,” there is a different view, however, according to which knowledge is dependent on perspective.

Earlier projects, histories, and perspectives guide scientists to figure things out, and thus science is culturally and historically situated (Miller & Fox, 2001). This view of epistemic community and invisible college can possibly explain why the ORG2 scientist does not get enough information support. As the issue that she pursued was not global in nature, it finds a place neither within a given epistemic community nor within the scope of an invisible college. Hence no information is generated in her area that can induce her to use digital resources. This also shows how the information environment can be created by these two social organizations. Because of the lack of published reports, gaining the confidence of peers and getting papers published become extremely difficult. Information-gathering practices make her aware of such difficulties, but at the same time it becomes a challenge – the absence of published information enables her to claim the newness of her knowledge claims.

While for this ORG2 scientist the information environment is created by the global epistemic community, for the other scientist in ORG1, the epistemic community is more localized. As the organization is mandated to work in engineering areas involving non-biological materials, an individual researcher attempting to develop a link between the two paradigms of research finds difficulty in getting information infrastructural support within the organization. Whatever the reasons are, in both cases the situation leads to non-use of digital resources.

8.2.6 Digital-library use – observations across cases

In a multiple case study, findings should be same or should be different for predictable reasons. This is the strength of research following this strategy (Yin, 1994). It was a conscious choice of the researcher to select two organizations of different types in order to see whether the organizational contexts, when sufficiently different, lead to shape digital-library use differently. This section discusses how the findings were similar or different for these two cases and possible factors to which such similarities or differences could be attributed. To begin with, a summary of the characteristics of both the organizations is presented in Table-32.

Table 31: A comparative view of two organizations under study

Characteristics	ORG1	ORG2
ORGANIZATIONAL CHARACTERISTICS		
Field of specialization	Heavy engineering industry covering minerals, metals and materials	Bio-technology
Organizational goal	To actively participate in industrial research for the benefit of the country	To actively participate in basic research promoting fundamental understanding
Governance structure	Controlled by government	Controlled by government
Mandate	To earn through research	No mandate
Characteristics of research projects undertaken	Government-funded, scientist-driven research; Government-funded, industry participated research; Large network projects with other research organizations	Government-funded, scientist-driven research
New direction in research	Completely industry supported research	None
Research project size	Medium to large in terms of project cost	Small to medium in terms of project cost. Mostly of small size
ICT FACILITIES		
Internet facility	100 MBPS line provided by government through NKN project	100 MBPS line provided by government through NKN project
LAN facility	All offices and laboratories are connected through LAN	All offices and laboratories are connected through LAN
Computer facility	Each scientist has at least one computer	Each scientist has at least one computer
DIGITAL LIBRARY FACILITIES		
Support	From government sponsored consortium as well as from the budget of the organization	From government sponsored consortium as well as from the budget of the organization
Types of resources	Aggregated databases, publishers' journal packages, patents, standards	Aggregated databases, publishers' journal packages, protocols
Local digital collection	Institutional repositories	Institutional repositories

Table-32 indicates that both the organizations have on par ICT and resources facilities. This certainly leaves out any explanation of a digital divide in terms of resource and access among the scientists of these two organizations. Hence the nature of each organization in terms of goals, policies and program can be considered to be the only discerning context.

How similar are the organizational environments for ORG1 and ORG2 and how such similarities are reflected in the digital-library use of the scientists of these organization?

Figure-6 reveals that there are certain similarities in the organizational environment of both these organizations. Both the organizations support scientist-driven funded research and taking part in scholarly communication is mandatory for these organizations. For funded research, the funding agencies are the major stakeholders. The standard and explicit procedure for funding creates a rule like structure that make information gathering as compliance and digital-library use can be viewed as part of that compliance. In addition, for scholarly communication, scientists of both organizations are often pressured for digital-library use. The stress on publications and the link between publications and career advancement in both organizations effectively made the normative structure of the environment similar for both organizations. In addition, scientists of both the organizations participate in various seminars, conferences that lead to face to face meetings. These interactions bring a degree of uncertainty about their interactions with external entities, primarily peers, and cognitive structure drives scientists to consult digital libraries to meet the unexpected information demand from such interactions. Overall, scientists of both the organizations consult digital libraries of bibliographic information in all these cases.

The similarity between both the organizations, in terms of types of external entities, information demand created by such entities, digital resources used by scientists may give rise to the speculation that irrespective of organizational context, the digital-library use remains same and thus context does not matter. However, as mentioned earlier, the reason behind the similarity between both the organizations resulted because of the way the mandate of "earning" was implemented in ORG1 by considering research grant from other government agencies as earning. This implementation made ORG1 scientists to participate in individual research projects funded by other government agencies. This implementation brought similar kind of external entities in the organizational environment of ORG1 and ORG2 that lead to similar type of information demand and use of digital libraries. This made ORG1 look similar to ORG2 and results in many similarities with respect to information-gathering practices between these two organizations. In fact, until a few years back, when ORG1 started to moving to other types of research, there was probably no difference between ORG1 and ORG2. As long as there are similarities in organizational context, similarities in the findings related to digital-library use confirm that cases under similar contexts should show similar findings (Yin, 1994).

How different are the organizational environments for ORG1 and ORG2 and how such differences are reflected in the digital-library use of the scientists of these organization?

As ORG1 moved to research areas in which industries are also stakeholders, its organizational environment expanded. Its scientists now participate in research projects that are funded by government and research agendas are developed jointly by industry and ORG1. Such research projects sometimes involve other research laboratories and academics from reputed organizations. Unlike scientist-driven research, for which information gathering using digital library takes place as compliance, this activity has developed more as a norm, from an informal to a formal activity for the researches involving industries. According to a scientist, this activity was not followed even a couple of years back and started as one of the stakeholders suggested. An informal demand from industry for a technical report has now been transformed into a regular and formal practice of producing such reports. Research projects of this type are reviewed or evaluated by committees made up of industrialists, technocrats and academics. Face-to-face interactions with such people in those meeting often bring an uncertain situation and cognitive structure guides scientists to be information ready in those meetings. Digital libraries are used in support of information gathering activities in order to cope up with such uncertainty.

Very recently, the notion of "earning" has been implemented in ORG1 in a market oriented fashion. ORG1 is now targeting industries for partnering with their research projects. In this changed scenario, industries are entering as external entities into the picture of the organizational environment. Though it is too early to make any conclusive comments on how this new component will finally shape the information activities within ORG1, scientists involved in this area already feel the need for different information practices and have been orienting themselves in this regard. They are looking for new sources for information and new ways of packaging it for exchange with industry. Scientists realize that information exchange is important during the process of negotiations. But neither there is any prescribed rule nor any normative direction on how to conduct such information exchange. Scientists believe that it is important to convince those prospective partners by providing information on latest developments in the field, the business scope and also where can be the prospective market of their product. Thus not only technical information, but also market information is also becoming an important constituent in information package prepared and exchanged. In order to collect such information, scientists often use different kinds of digital resources – namely, websites of various companies or house journals posted by such companies. Thus digital-library use of ORG1 scientists is different from that of ORG2 in the sense that not only ORG1 has different entities in their organizational context but they also use different types of digital resources.

Scientists of each of the organizations use some special databases. ORG1 scientists use patent databases for their business negotiations. There were also report from some of them of their use of the Web based archives of lecture materials and other materials maintained by individual scientists. Such materials are useful for their self-development and also conducting classes. Similarly, some ORG2 scientists reported use of special databases to update information on their findings – that is the prevalent way of intimating their peer community about their new findings, use of genetics databases for verifying information. Besides, one scientist reported of occasional use of some government sites to collect biotechnology related data. Such data is helpful for preparation for a discussion with people engaged in movement related to environment pollution.

The discussion above shows that organizational environment of ORG1 contains more variety in terms of external entities than that of ORG2. Though there are some overlaps between the types of digital resources used by scientists of these two organizations, there are differences too between the types of resources used by them. There are however, striking similarities between these two organizations, in their use of technical features of digital libraries. This has been despite the difference in the fields of specialization that are served by each organization. Overall, scientists of both the organizations were found to prefer simple resources, use minimal features of resources and almost completely avoid certain resources.

8.3 Context, its nature and location – the researcher's reflections

With the findings of the study at hand, certain questions emerge on the context. Those questions are whether context really matters in digital-library use, are users aware of their context, are there relations between external context and internal context and so on. This section attempts to address some of those issues.

Does context really matter in digital library use? The findings indicate that technological exploitations of digital libraries – using the types of resources and technical features of those resources – are predominantly same for both the cases. This may give an impression that organizational context does not matter in digital-library use. This impression, however, is not correct. Certainly for both the organizations, the use of technical features of DL emerged same but this is one of several layers of use in this study. The reasons explained here.

As discussed in section 8.2.6, though outwardly ORG1 and ORG2 are different, implementation of certain policy in a particular manner within ORG1 reduced the internal difference between these two organizations. In this respect, the information demands generated by external entities are the same and digital-library use acquires same meaning for both the cases. This similarity is expected as in a multiple case study, the findings for similar cases should be same (Yin, 1994).

On the other hand, as new dimensions are added to the organizational context of ORG1, the organizational context of ORG1 expands (Figure-6). This new and expanded organizational context creates new types of information demand and digital-library use acquires more meaning.

As a result, compared to ORG2, ORG1 now has more variety in information demand from external entities, its scientists are using greater variety of digital resources and digital-library use in ORG1 has more meanings.

It will be an educated speculation that in future if ORG1 stops scientist-driven, government—funded research (a possibility expressed by one of the informants) and drives for only industry collaborated research, its organizational context will be very different from that of ORG2. Such difference may be reflected in their information gathering activities, in terms of types of information and information resources.

Another example of the difference in context leading to difference in information gathering can be found from the literature. In the introduction it was mentioned that ORG2 in Biotechnology area was selected in order to compare the findings with the literature. From the literature (Lamb, King and Kling, 2003), the information gathering activities of a pharmaceutical company that was placed in a strong competitive market and surrounded by compliances of various authorities, appeared to be very extensive and aggressive and up to date until the point of submission for renewal of license. The sense of “winning and retaining the market” by using information gathering activity as one of the means, was very clear in the literature. Such extensiveness and competition was not found in the information-gathering practices of ORG2. It was one time, routine activity as compliance to the funding agencies in ORG2.

The next question that arises is whether there is any relation between external and internal context and if so, did it play any role in this research. The study suggests that ultimate DL use has several layers and is often mediated by contextual factors at different levels. These different levels of context are interconnected with each other and produce a resultant force on DL use. While *social actor* helps to identify external contextual factors, *technology-in-practice* points to both external and internal contextual factors.

Interactions with external entities in the form of formal organization, social organization and individuals often trigger DL use that acquires a meaning in such interactions. At the same time, global information environment, specifically the availability of citation and content together and awareness that competitors too have access to these resources create an impetus on DL use. Thus information demand from external entities and global information environment complement each other resulting in scientists' use of digital libraries. The other component of external context that further accentuates the use is the technological environment comprising accessibility, portability, interfacing capability of DLs with other ICT tools.

Internal context, however, also contributes to DL use. Within the organization, its research policy determines the external environment and also creates a division amongst the science workers. This external environment and internal division results into a specific use structure in terms of resources. As we saw, ORG1's policy to conduct research in collaboration with industries have driven the senior scientists to approach for such projects and interactions with industries demand that those scientists consult digital resources that are different from those used in other research projects. Such division leads to specific contexts for individuals in terms of tasks to be performed, role of a member within the organization etc. All these make up what has been referred to earlier as "within the organization context or internal context". At any point of time such internal context may vary from one scientist to another leading to different type of information gathering. This context may even vary for an individual scientist over a period of time.

ICT policy of organization too contributes as internal contextual factor that must be reckoned with. Without a generous ICT policy under which scientists are free from any worry to access and consult DLs directly from their workplace, a different picture might have emerged.

Thus at any moment, there are interplay between internal context of an individual scientist and external context of the organization. In this study, however, this interplay did not affect the findings as the starting point of observation was the information-gathering practice of individuals (a resultant action of her/his internal context).

The next issue is whether context resides in the mind of the user or context is a researcher's construct. The findings suggest that technology users are aware of the power relation between them and external entities. For example, even very senior scientists admitted that a reviewer' question must be honored with sufficient information support. This awareness of users about the powerful position of the external entities has been acknowledged in the notion of *social actor*. On the other hand, this researcher did not see that the informants view those external entities as "context". Users view the interactions with those external entities as part of their job. It is only observable when informants could describe how their information gathering is linked to those external entities.

A related question is whether each scientist has a different context. It must be recognized that at the actual moment of operation, each scientist has her/his own context. This is particularly true while internal context is considered for scientist. But that is a very micro view of context. Such individual contexts are also fleeting in nature and difficult to capture beyond experimental level as recognized (Fidel, 2012). In fact for any scientist such context also changes very frequently. This study did not attempt to capture context at such micro level.

The choice of easy-to-use resources and simple features of resource by the scientists sensitize us about the quality and relevance of information that are retrieved by the scientists. Information Science has always stressed on relevant and quality information. This is the point of departure of the design efficient information retrieval system. Complicated search features have been developed to help retrieve information with a balance between recall and precision. The findings of this study make us to think on the position of relevance with respect to the findings. The researcher's reflections on this matter are presented here.

Information gathering, preparing technology report/bibliographies have long been entrusted with professional librarians/information scientists. It is still probably done in many places. However, in the two cases selected for this research, scientists themselves were involved in their information gathering activities. In some cases this activity is delegated to juniors who help them in their research. While by training, librarians/information scientists are likely to use credible information resources and using many more advance features of such resources, scientists seem not to be very aware of the process of establishing the relevance. It is certain that they find out relevant information – otherwise it would have been difficult for them to survive – but they do not follow the standard procedures. Notwithstanding the availability of standard information finders and of powerful features supposedly to increase the relevance of retrieved information and the information professionals' concern about helping users getting relevant information, actual users in the current study seemed not to be concerned whether they were missing relevant information. Though the issue of quality and satisfaction was not rigorously pursued, there was no indication that informants were not satisfied with retrieved information that they used for various purposes. Informants mentioned about the difficulties when the Internet is slow but sounded very accommodative that Google often retrieves too general materials.

All these as mentioned above leaves room for speculation on how much importance is given to relevance in real world, whether the abundance of information now has reduced the importance of relevant information, whether there is a tread off between relevance and quick information, or what has been observed is a very specific trait for the cases that were selected. More importantly, the question arises is whether there is a paradigm change in how users look at the issue of relevance "relevance". As this research never targeted to measure the quality/relevance of the information, it is not possible to provide any conclusive evidence in favor or against any such hypothesis that by using digital libraries in a limited way, scientists are missing quality/relevant information. Future studies may attend this particular area. The findings, however, aligns with the characteristics of social actors – people are not users of digital library. In their extreme busy schedule, they hang on what worked easily for them – centrality is not on technology or its output, it is on what works easily.

The findings give rise to another question on whether context matters same or differently for different users. Going by the notion of multiple case study (Yin, 1994), similar context should produce identical results or different results for predictable reasons. This is corroborated at least by the present study. Context can be compared to the large sky, a fraction of which was possible to capture through this research. The study looked through the eyes of the informants at their digital-library use and traced the external entities that made up that large sky. Incorporating more number or different types of organizations could have brought more granularity of organizational context. Quantitative paradigm of research considering context as external variable would have been more helpful to establish whether context matter differently for different people Moreover, the direction of observation in this research was from action (information gathering) to context – this direction is required to be changed in order to garner support for any hypothesis in this regard.

This study contributed to develop a larger picture, based on individual account, of organizational context and its components that pressure organizational members in using digital libraries. This also met the initial target of the research, that is, to develop a description of context which is largely absent in the literature of information need, seeking and use. However, in comparison to the micro-view of context of individuals which is very fleeting in nature and difficult to capture beyond experimental studies, this macro-view of organizational context is more stable and can be expand when more organizations of different types and in different cultures are included.

This research started by pointing to the limitations of using usage data as the only measure of digital-library use. Bishop (1998) pointed out that usage data cannot say how scientists use such download. By developing the meaning of use, this research sheds light on how digital libraries are exploited in the workplace of scientists.

8.4 Conclusion

This study was conducted within the paradigm of qualitative and naturalistic research, using the case study approach. It did not take any of its findings outside the selected cases for measuring the statistical significance of those findings. Hence, it is not claimed here that the following conclusions are universally true. Besides, the context is ever-changing. Organizations change their policy or the way of implementing the existing policy, as found in the case of ORG1. New developments take place for technological infrastructure. Thus change of time and space that make up the boundary of a case can influence the phenomena that take place within it. The point of departure of this study was to explore whether a descriptive account of the context of digital-library use can be developed and whether such context might shape digital-library use. As far as the selected cases are concerned, organizational context could be captured in terms of various components and those components could be attributed to information-gathering practices with the help of digital libraries. The findings can be summarized as:

(i) Predominantly Information Scientists view digital libraries as tools at the hands of information seekers such as scientists who use this tool in order to fill their knowledge gap in the process of creation of new knowledge. There are, however, other views of digital-library use. From organizational perspective, knowledge creation is the business of those research organizations that appoint scientists for doing research. These research organizations, like any other business organization, are located within varying degree of technical and institutional environments made up of various entities. Scientists have to interact with these entities as part of their organizational responsibilities and such interactions create information demand on them. Scientists are obliged to meet those information demands as they recognize the power relation between them and those entities. Digital-library use of these scientists can often be associated to meet these obligations. Thus digital-library use acquires different meanings for the scientists depending on who is creating the information demand.

(ii) *Social actors* are new institutional view of technology users within an organization. They not only use technology in order to meet compliance or norms but also use it based on the belief that *others* who matter in their workplace use that technology. Thus technology use results as mimicking those *others*. This mimicking others either by observing or through belief structure is an important aspect of new institutional view. Such mimicking takes place when individuals under study are in an unpredictable situation that does not guide them either through rules or through norms what should be the best way to cope up with the situation. When a research organization enters a market driven situation, as we found for ORG1 or when it is a matter of competition within the knowledge world as we found for the scientists from both the organizations, scientists are placed under such unpredictability. They attempt to win the situation and digital library use becomes helpful in such situation. However such uses of digital libraries are often the result of their belief that *others* also use this resource and a successful interaction with those *others* requires consulting digital libraries. This is the *social actor* view of scientists under study. As the *social actor* view of scientists helps to see how digital library use can be related to demand of organizational environment, it also helps to see how this ICT enabled tool helps to meet organizational goals.

(iii) Despite an array of meanings of digital-library use emerged depending on the entities of organizational environment with which the scientists of selected organizations interact, the process of actual use was found almost similar for both the organizations with some variations. Often the action of use was not related to content or technological merit of a resource. Rather it was a resultant action of the information environment, ease of access and use of a resource, organizational facilities provided to access such resource and several personal issues such as habits of searching, perception about a resource and the likes. As a result, often scientists were found to use the easy search engines like Google and avoiding systems that create learning load, the resources which provide full content rather than citation only. There were of course some data points that showed a different picture but such picture was not common across the data points of the study. This aspect supports the notion of technology-in-practice which stresses that the capabilities of a technology are available same to anyone who has access to it; however, the actual use depicts that some of those capabilities are recurrently visible to users and such visibility can be attributed to various organization-related reasons.

Hence, it can be concluded that for the organizations selected for this research, the use of digital libraries is often the result of workplace demands. These demands are created by various institutionalized entities outside the boundary of those organizations. At the same time, the use of digital libraries as technology is shaped by another set of contextual factors from both within and outside the respective organizations.

The meaning system attached to digital-library use, as emerged from the study, connects the digital-library use to the organizational responsibilities of the members. This does not mean that the research minimizes the role of digital libraries in information seeking which is triggered by the desire to acquire knowledge or by the knowledge gap faced by the scientists. But often information gathering activities and digital-library use were found associated with organizational responsibilities in this research. This association indicates the social relevance of digital libraries.

In the introduction, it was mentioned that this research is as much about the context as it is for digital-library use. The study shows that it is possible to draw a larger and stable picture of context – organizational context in this case – compared to transient immediate context of information seeking. More importantly, this research did not relegate the context to a mere background – context had an active association to digital-library use.

8.5 Implications of the findings

The implications of the findings of the research can be viewed along several dimensions. Those are theoretical implications, methodological implications, and practical implications such as information literacy training, system design etc. Those dimensions are discussed here.

8.5.1 Theoretical implications

The findings suggest that the selected theoretical constructs – social actor and technology-in-practice – were helpful lenses to explain the digital-library use of scientists. It was possible to have inner view of how scientists of study sites relate their DL use to different situations that are generated from forces external to the organizations. Thus, the findings overcome, at last partially, the limitation of download data to reveal whether an attempted access to DL is associated with an intended use (Bishop, 1995). The findings also suggest that though outwardly all information gathering activities look same – those are in response to fill the information need of individuals – those activities have inner meanings that are indicative of digital-library use. Those meanings take shape depending on “the other” with whom the user is interacting, and how powerful “the other” is in that interaction. The findings also showed how the digital-library use is being institutionalized within the selected cases – a core capability of the construct *social actor*. At the same time the outcomes of the research also suggests that the constructs are applicable beyond business firms (Lamb & Kling, 2003) or specific ICT (Orlikowski, 2000).

8.5.2 Methodological implications

Case study based qualitative research attempts to provide deep insight into the phenomenon under observation and build the picture inductively. This process may lead to such questions as: (i) is there a way to confirm that every type of digital-library use within a case was captured (ii) could it happen that findings in the current study is too skewed given the fact that there were only 3 informants from ORG2 as against 15 from ORG1 (iii) how to ensure that all data that emerged from the research were properly captured. Some reflections of the researcher in these issues are provided here.

For none of the cases, all prospective data points could be covered. This, however, is the characteristics of the research paradigm and methodology adopted. The study aimed to build the picture of the organizational context of DL use and captured as many types of relation between DL use and organizational entities as reported. In that process, all relations, as described by the informants were considered even though a few relations were reported just by one informant because that helped to add a new dimension in the digital-library use within the organization. As highlighted in Section 3.4.2, care was taken to recruit scientists working in different types of projects. In all likelihood the research did not capture the entire list of relationship between DL use and external entities. However, it can be said with certain degree of confidence that the research captured an exhaustive list within each case.

Were the findings too skewed in favor of ORG1 from where 15 scientists participated as against 3 participants from ORG2? In other words, was it possible to see a different picture had more scientists from ORG2 participated in the study? Or was it possible to see a different result, had a large organization in the area of Biotechnology been selected instead of ORG2? In this connection, it is important to go back to the backgrounds of both ORG1 and ORG2 which have been discussed in Chapter-4. It may be recalled that organizational policy and the mode of its implementation together contribute to create organizational environment. The policy of ORG2 encourages its scientists to do research with the help of grants received from various government agencies and those researches are generally individual scientist oriented. This is where the organizational context is different for ORG2 from that of ORG1 whose scientists are required to do industrial research and earn in a more business like environment. As long as the organizational context is same, the findings are not likely to be affected by the size of the organization. Besides, for ORG2, nearly half of the scientists, engaged in the research in Biotechnology, participated in the study. However, if the study could involve a biotechnology organization of different type, it is quite likely that some more typologies with respect to DL use would have emerged from the data.

8.5.3 Practical implications

The practical implications of the findings are directed to such areas as information literacy programs, and system/interface design. The premise of these implications is that relevant and quality information can be obtained through effective use of systems and one or more of these directions help getting such quality and relevant information. At the same time, this approach places importance to the centrality of the technology. Keeping this in mind, some practical implications of the study are discussed here.

Almost without exception, the informants in the research confirmed that do not turn to libraries always for getting required information. It remains to be verified with actual data whether libraries in organizations under study and elsewhere are shrinking in terms of manpower in this regard and whether the job of searching is not delegated to librarians (with an expectation that use pattern will be different). However, forcing the users to turn to librarians for their job will be against the spirit of information literacy and current digital environment. The objective of information literacy programs is to develop lifelong learners and empower users. Current digital environment certainly favors this empowerment and users should turn to libraries in seeking help in information gathering, only when they think that they are not getting satisfactory information. At the same time, in all probabilities, it is not possible for a scientist to turn to libraries while preparing for a seminar or before going to a meeting for evaluation of her project. Besides, some of the interesting happenings as found in the study that library and laboratory are now interleaved cannot be turned back in this electronic age.

Information literacy programs can be used in two ways as intervention. First, the value of authoritative information should be highlighted. Second, information literacy program must be initiated at an early stage of education of individuals. For all the scientists who were interviewed, learning the use of digital libraries happened when they were on job. An earlier sensitization not only on the value of information but also the value of authentic information sources and maximizing the use may change the situation. It may be recalled from the study of Walsham & Sahay (1999), training the users on maps was thought one of the ways for meaningful use of GIS. However, success of such information literacy program can be expected if the paradigm of relevant and quality information still holds good.

It is an educated guess that now as well as in coming days, users will first be introduced to Google and then to any specific DL. The implication is that Google's simplicity will always be known and appealing to users. The world of digital libraries, on the other hand, is still complicated and more importantly, fragmented. It is fragmented in the sense that no single DL can meet all the requirements of a scientist in a single sitting. Providing a single window to all resources may be a good solution. Federated search engines, Discovery services are new tools in this regard that are coming to the market. However, each of these two services has its own demerits, both technology and business wise. Besides, both this category of services are expensive. So it still remains to be seen how these services are picked up and bring any change in DL use structure in coming days.

8.6 Contributions of the study

The contributions of the study are:

A new way of understanding the use of a technology:

The use of a technology is generally measured in terms of numbers – number of people using the technology, or the number of times the technology is used. This has been predominantly the case of measuring the use of digital libraries. Such numbers have, so far, been used as strong indicators of the use of digital libraries.

The number of uses, however, cannot tell us how the technology is put to actual use. This is particularly true for usage statistics of digital libraries. For example, if measuring the use of the Internet by ordinary people is the objective of a study, a specific segment, such as the banking segment for instance, may be chosen. Then the study can collect data on how many customers of different banks have utilized the online or mobile banking facility and the Internet use statistics may be correlated to such banking segment data. This kind of correlation can reveal the extent to which the Internet is used for a very important aspect of life.

In information environments supported by organizations whose primary objective is knowledge creation and to contribute to the self-sustenance of society, it is much more difficult to ascertain such a correlation. Besides, in many information environments users' hoarding habits are a known information behavior. Thus, a part of download data may be due to such a habit.

This study looked into how the environment poses challenges to scientists regarding knowledge claims made by them and how digital libraries help them in meeting those challenges successfully. With respect to an organizational environment, such challenges are raised by those to whom those knowledge claims matter. By identifying those entities, this research developed a more detailed description of the context, which was by and large absent in context-based information behavior research. The research then also revealed the possible meaning of digital-library uses by those scientists in the process of responding to the challenges from such entities.

A new way to understand the social relevance of digital libraries

Another contribution of this study is to understand the social relevance of a technology in an environment that is culturally different from the one where it was developed. So far, qualitative studies on digital libraries/ICTs paid attention to how actual users might contribute to their development and use. However, many ICT-enabled technologies are developed within one specific economic and cultural environment. Those technologies are then globalized as other countries/cultures adopt those technologies with a view to improving their social lives. As each technology is inscribed with cultural values of the place of origin, it is worth investigating how such technological properties are appropriated in another culture.

Some of the findings of this research on the digital-library use structure show that though digital-library use has a meaning for the scientists who use it, the use structure has some interesting features. The observations on the use of *Web of Science* or high use of Google by scientists in their search of information attest to such peculiarities.

8.7 Limitations of the study

Digital-library use is a global phenomenon and hence a question may arise on whether the findings can be comparable with similar organizations within the country as well as organizations in other countries. The research does not make this claim although the verification study confirms some of the findings to a great extent. The findings of this study are limited to the selected cases only, and generalization to any population was not the objective of this study.

Organizations are different depending on their objectives and also on the economic and social environment within which they are set. There are research organizations in India that work in highly confidential areas, such as defense or nuclear science. As government totally funds those organizations, scientists of those organizations are unlikely to look beyond their organizations for research funding. Unless organizations develop affiliations with external bodies/individuals, the external organizational environment does not get created for them and it may be difficult to establish that digital-library use within those organizations is in response to the demands of such an environment. Similarly, research organizations in other economies and cultures may have different environments. Unless those are taken into consideration, it is not possible to come to a conclusion regarding how the environment contributes to digital-library use.

It should also be noted that this study was designed to complement the studies based on usage/download data. This study did not attempt to provide any link between such usage data and the findings of the research. However, a future study linking these two aspects should be meaningful.

The study also did not attempt to develop to any meaningful measure that could be exploited to measure the actual usefulness of the digital libraries. Developing such measures was out of the scope of the current research.

8.8 Future study

Some of the issues to which future research can be directed are:

(i) Developing an indicator that can capture the successful integration of digital libraries within their social environment – such indicators may complement the findings that are available from studies based on download/usage statistics;

(ii) There seemed to be certain shortcomings in the information literacy training that is offered to users. Mostly such literacy training is limited to how various features of a system can be used. The study findings obviously show that despite such training, users are not interested in most of those features. It may be worth examining whether the information literacy training programs should orient themselves towards the value of information-gathering practices. It may not be sufficient to train users on how to identify the reliable sources of information. Training on how reliable information can be successfully used may sensitize future generation of users greatly.

(iii) The new digital environment, in most cases, is packaging content and citation together. How such a feature contributes to the meaningful use of digital libraries and what the indicators for such meaningful use can be could make up another fruitful study area.

In other words, the findings of this research open up the possibilities of future investigations in at least three areas. These are: developing new measures of use which can complement the existing measure of use through download statistics, exploring new ways of conducting training for information literacy, and developing an understanding of the meaning of "use" of digital libraries as technology.

8.9 Chapter summary

The findings of this case study, conducted within the paradigm of qualitative and naturalistic research, are limited to the selected cases only. This concluding chapter described the findings in the light of existing literature and highlighted the areas of concurrence with and deviations from earlier studies. The chapter, at the end, brought to the attention of the readers some of the areas of future studies.

The point of departure of the study was a search for an explanation of digital-library use. Digital libraries make up an expensive ICT-enabled information infrastructure in an organization. Predominantly the use of digital libraries has been measured in terms of the number of contacts between users and the infrastructure. Such measures, however, cannot explain what happens before and after such contacts. The study focused on the context to better understand the phenomenon of digital-library use.

The context was further narrowed down to the organizational environments of two Indian academic and research organizations. There were two reasons for this choice. The choice of using the organizational environment as the context for studying digital libraries in the first place was made because it is the organization that arranges for the infrastructure to be used to meet the goals of the organization. The choice of India – a country where the abundance of digital libraries took place only in this millennium – was made because an organization is always governed by various policies of a country. Those policies – technological, economic, and political and others – of a country accentuate the organizational environment, that is, context in this study.

The study borrowed two constructs, namely *social actor* and *technology-in-practice*, from the area of organizational sociology to capture the components of organizational context. The findings of the study showed that often the use of digital libraries can be related to organizational factors at various levels. At the same time, some of the contextual factors can outweigh the technical capabilities of digital libraries and thus can lead to a pattern of its use by the organizational members. In that process, the study also showed that context of information practices can be described in terms of specific components.

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APPENDIX 1: Questionnaire for the verification study

Study Background

As part of your scientific work, you probably consult journals, books, patents and many other resources. A substantial amount of such resources are now available electronically and your institute subscribes to those electronic resources. You may have access to some such electronic resources through other organizations when you visit those organizations. There are also many resources/archives available free on the Internet. Keeping in mind your own use or non-use of such electronic resources, please go through each of the following statements and give your own views as requested against each statement. It would be really helpful if you can give some examples from your own experiences wherever requested. To help me understand your perspective, I'd also appreciate a reason/example from your own experiences whenever you disagree, partly/wholly with a statement.

Statement-1

With the aim of attracting research funds from industrial firms, scientists realize that earning the trust, regarding the merit of the research for which fund is required, from such prospective research collaborators is most important. Naturally industries are interested in a good return on their investment in the long term and convincing industries about such benefits is a big challenge. It cannot be accomplished by simply stating the case. Scientists have to prepare a strong case and back up their arguments about the merit of the case by delving into published literature and/or proven data/information. If the research is about a process, scientists attempt to find reports on how industrial firms can benefit from such a process. If it is about a product, scientists look for data on the demand of such product so that funding industry can be assured about the market prospect of the product. Scientists must prepare comprehensive information and have it at hand and present such information aptly and appropriately during the process of negotiation with industries. Alternately, scientists are also required to prepare a report from such literature/data /information and give the report to prospective research collaborators.

Electronic resources and the Web together form a very helpful tool in this process of making strong information based case and subsequently in developing partnership with various companies/industrial firms who might potentially fund research conducted by you as a scientist of your organization.

Options:

1. Fully agree (if you fully agree can you tell us a real story in which you were involved in preparing such information package and presenting them to industries and how did you value that work?)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-2

An important outcome of a research is a knowledge claim. Previous knowledge serves as the foundation of such a claim. Hence establishing the link between current research and previous knowledge is important. It is very important that funding agencies, who would invest in a research, are able to see this link. When funding agencies see the link, they become assured on the issue that there is continuity between previous knowledge and the knowledge claim that the proposed research would be producing. In that way, it helps to earn the confidence of the funding agency. Citations to previous works establish such links.

Electronic resources are extremely important as those are often consulted by scientists to search for previous works and to establish links between current/proposed research and existing knowledge.to such works. These resources are thus powerful tools in gaining confidence of funding agencies.

Options:

1. Fully agree (if you fully agree, can you tell us a real story from your experience and then tell us how it was helpful?)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-3

Scientists run into their peers quite often – at a project review meeting in which peers come as reviewers, for example, or in a meeting of experts in which peers come to exchange ideas. Some peers may have great reputations in their subject areas. Discussions with such peers in meetings quite often cross the scope of any one specific research problem. Scientists wish to be seen themselves before others, at least as knowledgeable as those peers are.

You as a scientist, before going to such meetings, routinely consult electronic resources to have some knowledge on current relevant topics so that you can actively participate in such discussions with peers and other presents in such meeting also find you knowledgeable and at least at par with them. **To this end, electronic resources are very helpful tool.**

Options:

1. Fully agree (if you fully agree can you tell us a real story in which you were involved in preparing with such current information and how did you value that work?)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-4

Scientists communicate their findings through scholarly papers in journals. The selection review process for those journals can be very rigorous. Editors of such journals command great respect from scientists/authors. When such editors raise doubts about claims made in a paper, scientists become very careful. It becomes an extremely challenging task to defend the claims made in their papers. Scientists consult electronic resources, identify previously done related work, and develop their argument to support the claims made.

Electronic resources are thus important tools to meet these challenging tasks.

Options:

1. Fully agree (if you fully agree, can you tell us some incidents in which you faced such challenges and could overcome the same)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-5

In order to get fund for a research, scientists must submit research proposals to possible sources for funding. Producing a research proposal is not merely paper work. It is the process of initiating a discourse with the research community. In everyday life, when we start a discourse on an issue, we must have some ground knowledge and opinions about the issue. Similarly, in order to write a research proposal acceptable to the research community one must have sufficient ground knowledge in the respective areas.

Electronic resources help in developing such ground knowledge. One must not attempt to submit a research proposal without consulting such resources.

Options:

1. Fully agree (if you fully agree, can you tell us any experience of yours in this regard and your own evaluation of the experience)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-6

Each government funding agency has a format through which application for funding must be made. According to those formats, it is mandatory to submit a literature review. Scientists consult electronic resources in order to prepare such literature reviews. **However, one need not work very hard for making those literature review comprehensive because reviewers generally do not read those reviews very thoroughly.**

Options:

1. Fully agree (if you fully agree, can you tell us any experience of yours in this regard and your own evaluation of the experience)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-7

While selecting an electronic resource for consultation, you will always prefer those that are simple to use. You avoid those resources that are not straightforward and that demand time for learning how to use them.

Options:

1. Fully agree (if you fully agree, can you tell us any experience of yours in this regard and your own evaluation of the experience)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?

3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-8

Using electronic resources is quite different from using a conventional library stuffed with printed books and journals though many of the electronic resources used to be available only in print format even just a few years back. Ideally, now there is no need to go to the library as these electronic resources can be access from the scientist's desk. This saves both the energy and time of scientists which can then be directed to more direct searching and use of information. Now laboratory work and library work can be done simultaneously.

This has become possible because organization has provided adequate facility so that scientists can connect to the Internet as well as to these resources from their table.

Options:

1. Fully agree (if you fully agree, can you tell us any experience of yours in this regard and your own evaluation of the experience)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-9

Scientists who have already reached senior positions within an organization get involved in jobs related to research administration. The time demand of such jobs is too high to allow for regular consultation of electronic resources. At the same time, it is most important for any scientists to remain up to date. Senior scientists thus delegate the task of consulting electronic resources to junior assistants.

Options:

1. Fully agree (if you fully agree, can you tell us any experience of yours in this regard and your own evaluation of the experience)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-10

Scientists are now aware that peers in their respective fields also have access to electronic resources and also have information at their fingertips. This awareness makes them very attentive to being as exhaustive as possible in their search for information using electronic resources.

Options:

1. Fully agree (if you fully agree, can you tell us any experience of yours in this regard and your own evaluation of the experience)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Statement-11

Electronic resources are not the only source for information. Scientists require many types of information related to their jobs at hand for which they have to consult other types of sources, even non-electronic resources.

Options:

1. Fully agree (if you fully agree, can you tell us any experience of yours in this regard and your own evaluation of the experience)
2. Partly agree (if you partly agree, can you please indicate the areas where you disagree. Is there any other aspect which has been omitted in the above statement?
3. Completely disagree (will you please explain with your own experience)
4. Any other view on this statement (will you please explain with your own experience?)

Question-1:

When you want to search for some information, related to your work as scientist, where do you start searching for most of the time and why?

Question-2:

Within your organization,

1. Where do you use computers and Internet when you are in your organization?
2. Is there any other arrangement for other scientists?
3. Do you have to share computer with other scientists?

4. Do you have to go to library or computer center to access computer and Internet?
5. How helpful the current computer and Internet facilities are within your organization? Can you compare it with the same facilities within the organization a few years back? Can you compare the facilities you have seen elsewhere, outside the organization?

Question-3:

By the term “digital library” what do you understand? Can you name a few things, which in your opinion are digital library?

APPENDIX 2: Selected quotes from ORG1 scientists

Sr No	Reference	Quotes
1	ORG1-SCT1-06 (**Scientific inquiry – continuity)**	<searching for information> Just to have information regarding . . suppose I am doing some work. . if it is a new thing. . I do not how to start. . what has been done. . so first I have to search what has been done and where people are. . should I go beyond that . . can I go beyond that . it gives me idea about the work I am going to do. .
2	ORG1-SCT2-01 **(scientist-driven research)**	particularly for last two years, there is large deviation in the goal of our organization… we are emphasizing more on industry research where the industry is directly funding
3	ORG1-SCT2-09 **(scientist-driven research)**	initially we were much more concerned about publications .. that trend went for a very long period .. now publications we have to do .. being a scientist we have to do publications ..
4	ORG1-SCT2-10 **(Market collaboration)**	.. now it is more on how our research can be acceptable to the industry .. marketing and more on like that
5	ORG1-SCT2-14 **(Market collaboration)**	we went to different (??) industries and using a presentation .. what is the utility of this material.. if India you go back five years .. there were five or six companies who were using this material … now the situation is that 23 companies are making transformers using this material .. bringing the material from abroad .. slowly there is a demand and the demand will increase in the days to come … so we are rather educating the industries on what is the use of the material
6	ORG1-SCT2-35 **(Knowledge evaluation)**	Q: how does it put you in advantageous position? A: see if I sit on the opposite side .. I am the person who will approve the project .. I will always give preference to those who know the present status, who knows the capability and what I have to do .. most of the time I favor those things .. and if a person presents saying everything as "my capability" .. I try to give less point to them .. as a reviewer of that I always feel that he should know what is currently going on and what is capability also .. if everything he says that "I have done" .. that means there is something wrong .. I give him less marks than the person who says this is the status, this is my capability and I want to do these things
7	ORG1-SCT2-42 (**Alliance formation**)	Q: so you still keep tab on information and require when you present orally (he concurs) A: yes this information we are giving when we are giving presentation but when the proposal is going it is hardly one or two pages
8	ORG1-SCT2-43 **(Compliance)**	Q: (referring to his stint in abroad) how much stress is given by large research foundations like NSF ;A: always but that type of stress is given here if you go for GAP project .. but if you go for industrial project when it is coming from industry .. you require some information but not that state of the art type .. for GAP project it is there .. their format is also telling .. it is binding ..but the format if you see for NSF and our DST… the information based format is almost the same .. means I am telling about subject information … even if you say about European Commission's project .. they are more structured .. as with information .. but NSF and DST .. more or same
9	ORG1-SCT3-07 **(Industry-guided-research)**	and I think from ORG1's point of view that was one major networked project – networking was done not only within <group's name> but outside <group> with <names academic institutions> and of course industries and they are involved (insts) besides . .<name large industries> organizations and . . . . (plants)
10	ORG1-SCT4-19 **(Scientist-driven-research)**	They are customers in a sense…they are very selfless customers….apart from the report they do not take anything….The IPR remains with us…to a large extent.. so what they get out of it is something you have to ask them…. But we get a lot of things
11	ORG1-SCT4-34 **(Compliance)**	you develop a state of the art with reference to the technology of your proposal.. for any proposal you have to provide a literature search < "have to" indicates that it is unavoidable" >

Sr No	Reference	Quotes
12	ORG1-SCT4-40 (**Scientific inquiry – continuity)**	for the sponsors they know that <through the tech report> what I am doing is incremental… additional to what is available..,. in the market or in the literature …that gives the accountability … they can judge with regards to that < he provides a yardstick, through lit search, to the sponsors for judgment>
13	ORG1-SCT4-54 **(Knowledge evaluation)**	– it always happens <requiring on his part to be prepared with information>.. it not only happens for sponsors.. it happen for monitoring committee… whenever <always> I have to present before a monitoring committee, I have to be <gives a sense of binding> aware not only about my projects but also on the state of the art .
14	ORG1-SCT4-80 (**Recognition**)	my publications are archived in electronic resources… look at my publications… read them…know about the areas that I am researching…it is both ways… I know about other people and they also know about me…. So recognition wise it is very important
15	ORG1-SCT5-08 **(Market collaboration)**	yes but for us we get students but they go to IIT .. but slowly we are going away from that … we are targeting more towards sponsor-specific project … of course SSPs are tricky things … you have to convince them that look we can do this and you can benefit .. it should be shown that they should have some value from that … then only they will give this project .. otherwise why they will .. because money counts in the industry
16	ORG1-SCT5-57 **(Community-competition)**	Q: there is something called as top of the information .. have you felt any pressure ever to be on top of the information? And also to show that you are at the top of information; A: yes sometimes it is required .. we had that project in trial .. before that we had to compete with <names the company> .. they regularly manufacture .. in the project meeting it was initially thought that they are with us .. but they were on the other side of the table .. they are also metallurgist .. at that time, convincing them, it was required that you should be on the top of information .. whatever I said it should be last word in that particular area
17	ORG1-SCT5-73 (**Recognition**)	Q: people do this information search not only to know information but also to know who are the competitors <he confirms>; A: absolutely .. like we know that <refers to some product> .. so I know who are the people working ..if I publish they would cite my paper or if they publish I have to cite their paper .. so that is a pressure .. but another way it is good also .. we know who are the competitors
18	ORG1-SCT6-10 **(Knowledge evaluation)**	say funder we go only through the project application. . . my knowledge base has already been used in that project application. . at that time whoever the reviewers are . . I believe they are more capable. . when they see that ok this project has something innovative and it is different than others then it is naturally the chance of getting fund is more.
19	ORG1-SCT6-11 **(Knowledge evaluation)**	. and if I go with a good preparation and I defend this <before proposal defense committee>, this knowledge helps me tremendously. . and that way I may be proving myself better than who has not gone through it. . and naturally that helps me to get the fund
20	ORG1-SCT6-13 (**Scientific inquiry – new knowledge)**	– I have been invited to write the reviews. . I have written four scientific reviews. . and I took lot of knowledge. . for review in a particular research field you have to know what others have done. . so that information has gone directly to the. . now it is published and rated as one of the highest downloaded
21	ORG1-SCT6-14 (**Scientific inquiry – new knowledge)**	. I am still writing. . got <mentions an assignment>. . to write a review on nano. . other thing that you did not mention but I would like to say that . . suppose we are writing a research paper. . that time many times we use to interpret our results . . somebody has found it . . so there is no point in reinventing the wheel. . so this gives a very good base . . somebody has found it, I can directly say that my data supports . . I also get data directly to calculate or to . . how the information go as a product

APPENDIX 3: Selected quotes from ORG2 scientists

Sr. No	Reference	Quotes
1	ORG2-SCT1-05 **(Scientist-driven-research); (Compliance)**	: it is not risky – actually as I told you earlier when we submit a proposal to the funding agency, they distribute it to different reviewers – so it is just a preamble of a thing – why this particular point came to your mind – why not others – <describes the importance of the problem>
2	ORG2-SCT1-14 **(Performance evaluation)**	sometimes we -- these days the impact factor of the journal is very important – so sometimes if I have to go somewhere and apply for some fellowship or something I have to mention in which journal I have published in last three years and how the impact of those journals so looking at impact factor quickly and enter and I find out the impact factor
3	ORG2-SCT1-15 (**Scientific inquiry – challenge**)	not only project stage – suppose I am writing a paper and I am giving a hypothesis . . . my finding is this and this can be interpreted in that way and when I send it to some journal, journal also they are getting reviewed by the reviewers and one of the reviewers raised a point -- no that cannot happen – it is not this but it could be that -- so I have to check whether he or she is right or I am right – so I have to go thru all the other references related to this topic what are others are thinking -- the persons who are working in this area what approach they have taken -- so they have taken this experiment – so they have got this data – I have done this experiment and so I have got this data – so can it be linked? so or somewhat – so I consult with – it always happens
4	ORG2-SCT1-17 **(Community – competition)**	sure – actually in my . . . web science . . . there are some literatures some reports and I am – I just want to take advantage of that and get my knowledge more and . . how can I say – I want to be more knowledgeable with the help of those thing – whatever I doing on my own I want to take the benefit of that also and I want to improve my doings and my science and my experiment – so in that
5	ORG2-SCT1-18 **(Community – competition)**	"Q: how does it help you over the competitors – to show that you are knowledge (establishing); A: to establish so that they think she can do it ; Q: you mean the funder; A: yes"
6	ORG2-SCT1-22 (**Scientific inquiry – new knowledge**)	yes because I also – I am also thinking about something – somebody has done it there is no point of doing then I have to switch
7	ORG2-SCT1-28 (**Recognition**)	I know a person who has done some experiment for ten years and give this information and if I did not mention it in my thing it is not giving him or her the due respect … so I think … I try to always cite that – that person has this so in that way it is I am not overlooking or overlooking his thing – I am giving due respect to his finding
8	ORG2-SCT1-58 (**Scientific inquiry – continuity)**	Q: another related question – about activism in your area – people are not fond of this research; A; to convince them; Q: so does information – these kind of resource help in anyway when you prepare to convince them; A: when I say something about promoting this kind of research – I not only say my achievements – but I also give the supporting data from other scientists also who are very reputed and not necessarily from India from abroad – with that supporting evidence I enrich my presentation that way I
9	ORG2-SCT2-17 **(Scientist-driven-research); (Community-competition)**	but right now.. we have to be very thorough about our information ..so we find out in that particular area….while submitting a project or starting a project...make sure that there is no unnecessary overlap
10	ORG2-SCT2-18 **(Community-**	so that have an idea of the quality of research going on in that particular area.. whether I will get some enough publicity .. who will appreciate my work…and then keep on

Sr. No	Reference	Quotes
	competition); (Recognition)	connecting
11	ORG2-SCT2-21 (**Recognition)**	things that kind of make you popular...peer appreciation is the only thing that we look for...there is no other criteria...it is not like coming to the office, attend,...nothing matters.. only thing matters...is the peer appreciation ...if scientists come to know my paper then only I have something.. otherwise as an officer, I come to the office...I am actually an idle person...if somebody does not come to the office at all but he has peer appreciation.. that is important.. and of course student appreciation
12	ORG2-SCT2-39 (**Scientific inquiry – challenge**)	yes we have to give talks .. to audiences and you have to be very educated … when you are sending a paper, you do not see the person .. may be only three reviewers ..they may not have noticed a particular point in your paper .. but when you say it to a large audience of very knowledgeable people .... they are not bothered if your paper is published or not .. if you cannot answer...even if your data is published and accepted all over .. the audience can make a mess for you .. it will be very embarrassing .. unless you are totally informed ...if they suddenly say you have not studied this paper .. it becomes very embarrassing
13	ORG2-SCT2-47 **(Performance evaluation)**	when have to compile my CV or called for a promotion then I have to compile for what is my h-index .. but otherwise, once in two months I would like to review how much I have contributed to science
14	ORG2-SCT2-50 **(Performance evaluation)**	yes .. it was in abroad and then we also adopt whatever is coming ...so DST thought how to keep monitoring these ... it is not actually monitoring – no one monitors .. we are not producing anything ... they started asking citation index and ... looks at the standard of the journal .. and then they come to the conclusions
15	ORG2-SCT2-63 **(Community – competition and connection)**	A – for what is difficult to say.. for space you can say ..space in your peers .. you will not loose your job or anything ; Q – space means; A – intellectual space
16	ORG2-SCT3-09 (**Scientific inquiry – merit**)	whatever problem I am dealing or whatever experiment I am designing, I take the help of Internet to search if any work has already been done and how they tackled the problem .. whether I can do it in a better way or I have to follow the same .. or if there is none, I have to design completely on my own .. this is one way .. second all related work I have to read .. third in the context of this work, I get some new references .. that is why I say I am very highly involved in Internet
17	ORG2-SCT3-13 (**Scientific inquiry – challenge**)	Q: what I am saying .. if you do not get anything .. how inconvenient it would be for you; A: if you are working in a new line, it is very common to come across such problem .. you may not get anything .. so you have to read allied topics .. because you have to conclude something .. interpret something
18	ORG2-SCT3-14 (**Scientific inquiry – challenge**)	in the paper .. there are reviewers of the paper .. they may raise questions .. why you have written so .. then I have to give my explanation again to satisfy them
19	ORG2-SCT3-17 (**Scientific inquiry – challenge**)	I do not think here I could get any help [referring to her unique research concept] .. there is no such document, no such publications, no such reports.. so how can I get any help from the Internet.. under such circumstances, I never got any help from the Internet
20	ORG2-SCT3-25 **(Interaction – knowledge dissemination channel); (Community-reward)**	Q: how does it enrich .. after investing so much of your valuable time, what kind of return do you get; A: if you read more, then you learn more, if you learn more you can give a better explanation for your work .. and if you write the better explanation.. it shows that your judgment is correct .. so whatever offer I got from elsewhere also .. offer means editorial offer reviewing offer .. everyday I get at least 5 papers for review .. mostly I decline .. that depends on your eligibility .. I am part of it .. I am not fully responsible for it .. but in a journal I became an associate editor from January 2011 and from January 2011, the impact factor of the journal came to 3.09 which was earlier
21	ORG2-SCT3-35	that’s true but why we are arguing ... because now a days you cannot suppress any data ..

Sr. No	Reference	Quotes
	(**Scientific inquiry – challenge**)	if there is any controversial data from another lab .. you cannot suppress that .. if they find that paper they will ask you why you have not shown that data .. you have not explained your data .. so Internet does it
22	ORG2-SCT3-42 (**Recognition**)	in the area that I am working .. there are many researchers, but those who are working in your area is low .. and another advantage that my group has .. the fundamental problem (names specific species), I am the pioneer in that field and nobody claimed that .. because if somebody publishes, she or he has to refer to my work
23	ORG2-SCT3-46 (**Scientific inquiry – merit)**	actually in the beginning you have to do it largely, because you have to know the background, how you can justify that your work is essential .. to funding agency .. because why you will be given the money .. whether it is at all necessary .. so you have to do lots of Internet searching
24	ORG2-SCT3-48 **(Knowledge evaluation)**	you have to write a paper or write a report .. monitoring also goes on ..by those who are funding .. at that time you have to make a report ..and you have to read a lot .. because you have to justify
25	ORG2-SCT3-49 (**Scientific inquiry – challenge**)	they may say no you have not done enough work .. have you seen that work? .. so you have to interact that time also ..so that time (1:13:15) you have to be conversant with the current literature
26	ORG2-SCT3-51 (**Scientific inquiry – new knowledge)**	I am not talking of top of the information, I am saying I am not at the top of the information .. but the information searching was thorough .. but it was not found so we can now claim that whatever we developed is very unique, innovative
27	ORG2-SCT3-53 **(Interaction – knowledge dissemination channels)**	, when you get a paper for reviewing, I myself search the literature .. most of the reviewers they do not read even.. but it is my habit to read it thoroughly whatever publications are there .. may be the journal is not very high impact factor .. even though .. I search a lot .. if there is any information,.. why they are working .. whatever they are claiming
28	ORG2-SCT3-70 **(Identity-ego)**	you cannot say that I am ignorant ..about this work I do not know .. in the Internet era .. the risk is tremendous suppose I am a reviewer .. you have not seen my work .. and you have written a passage .. you will do this work .. I will review .. I am a human being .. I may be very angry .. can't you read the literature in the Internet days? If you put the keywords you will get the work .. so risk is tremendous
29	ORG2-SCT3-82 **(Load shifting)**	Q: under which situation you go for those information (impact factor, h-factor) .. how does that help; A: in promotional applications .. like I am reemployed now .. so I got this offer only after adjudicating these papers ..reviewing my papers .. when I applied I had to submit what are my achievements last year

APPENDIX 4: Codebook – External Entities

Following table contains list of themes on external entities that scientists come across and interact with.

Themes on entities	Description	Example
Entities supporting scientist-driven research	Agencies that financially support research formulated by individual scientist	"the GAP are my perception of the problem .. put up the proposal, if I can convince the board, reviewer .. they ask .. in that meeting if I can convince them .. because there more or less it is the basic understanding .. that is why DST sponsors a project .. what innovativeness you can do … it is not big amount of money … but we can do some work " (ORG1-SCT4-09)
Entities supporting industry-guided research	Agencies that financially and intellectually support research formulated by scientists and guided by industries	"one major networked project – networking was done not only within <group's name> but outside <group> with <names academic institutions> and of course industries and they are involved (insts) besides . .<name large industries> organizations and . . . . (plants) " (ORG1-SCT3-07)
Entities procuring in-house research outcome	Industries that purchase industrial solution from organizations	"…industry wants some sorts of testing … we are now flooded with testing type of activities .. particularly our division" (ORG1-SCT2-06)
Research collaborators	Industries/organizations that share the cost of research	"particularly for last two years, there is large deviation in the goal of xxx… we are emphasizing more on industry research where the industry is directly funding" (ORG1-SCT7-01)
Agencies monitoring research progress	Agencies that are authorized to monitor research progress	".. monitoring also goes on ..by those who are funding .. at that time you have to make a report ..and you have to read a lot .. because you have to justify" (ORG2-SCT3-48/49).
Institutionalized review system	Review system for journals/conferences - formal and indirect communication takes place	"because a journal will accept your work only when it is novel .. you may do a lot of research work .. unless something novel comes out, it is not going to be accepted" (ORG2-SCT2-38)
Knowledge reviewer (individual)	Reviewers - formal & indirect communication takes place	".. there are reviewers of the paper .. they may raise questions .. why you have written so .. then I have to give my explanation again to satisfy them" (ORG2-SCT3-14)
Knowledgeable individual	Individuals with domain knowledge with whom one-to-one interaction takes place	"but when you say it to a large audience of very knowledgeable people .... they are not bothered if your paper is published or not .. if you cannot answer...even if your data is published and accepted all over .. the audience can make a mess for you" (ORG2-SCT2-39)
Community	Scientific community of specific knowledge domain	" in the project meeting it was initially thought that they are with us .. but they were on the other side of the table .. they are also metallurgist .. at that time, convincing them, it was required that you should be on the top of information .. whatever

Themes on entities	Description	Example
		I said it should be last word in that particular area" (ORG1-SCT5-57)
Knowledge Dissemination Channel	Journals etc.	"if you read more, then you learn more, if you learn more you can give a better explanation for your work .. and if you write the better explanation.. it shows that your judgment is correct .. so whatever offer I got from elsewhere also .. offer means editorial offer reviewing offer .. everyday I get at least 5 papers for review .. that depends on your eligibility" (ORG2-SCT3-25)
Regulatory agencies	Patent granting and similar agencies	"but those who are in patent area have to be very up-to—date .. because in that case it becomes a question of buying and selling" (ORG2-SCT2-41)
Performance evaluation bodies	Agencies that are empowered to measure performance of scientists	" these days the impact factor of the journal is very important – so sometimes if I have to go somewhere and apply for some fellowship or something I have to mention in which journal I have published in last three years and how the impact of those journals so looking at impact factor quickly and enter and I find out the impact factor" (ORG2-SCT1-14)

APPENDIX 5: Codebook – Digital Library Use Meaning

The following table lists the themes on the meaning of digital library use as viewed by the informants.

Theme	Description	Example
Alliance formation	Refers to the value of DL use in the attempt to develop research collaboration with industries.	".. we need a partner .. we are going for a particular steel .. so if I give a proposal without proper knowledge .. they know what is going on across the globe .. will say already someone has done it or they themselves might have done that .. no point .. why do I fund your research" (ORG1-SCT5-79)
Community - acceptance	Refers to DL use' role of avoiding duplicate work and thus remain active within community.	"it is a major risk <proposing duplicate work> ... you are totally **out of business** ... only thing you will have your job and salary .. and you will be totally out of business .. because it is a government job, I will not loose it ... otherwise that is the end" -(ORG2-SCT2-33)
Community - connect	Refers to DL use' contribution in identifying scientists working in similar areas.	"Any one refers that paper – higher citation that paper – here is a group in India. . they know ORG1 is a place where somebody called xxx who are working in this field – through publication only you are known to the people so that is one . . likewise citation is very critical. . once a person cites your paper that paper has some meaning – other wise if none is citing" (ORG1-SCT3-23)
Community - Competition	DL use helps to be up to date and being competitive within community.	"you cannot describe how important it is … without that <information> you cannot do – you have to be up-to-date – one cannot stand in the market – that is – information is very critical nowadays" (ORG1-SCT3-16)
Compliance	Refers to DL use' role in meeting compliances.	"you develop a state of the art with reference to the technology of your proposal.. for any proposal you have to provide a literature search < "have to" indicates that it is unavoidable" >" (ORG1-SCT4-34)
Confidence building	DL use helps getting evidences resulting into confidence building.	"list of references .. I want to hypothesize some new formula or some new findings … so I have to give some support .. my thinking is not absurd … … supporting evidence – reference is our supporting evidence" (ORG2-SCT1-26 & 27)
Identity - collective	Up to date knowledge of scientists raises the prestige of organization.	"the risk < of not being able to present information> will be loss of face….as a representative of this laboratory, I am not aware of this … it will cause loss of face" (ORG1-SCT4-57)
Identity - credibility	DL use provides information that can be manipulated to show the novelty of a research.	" you do not want to duplicate what already has been done.. …... how you are adding… you have to show novelty in your research… that novelty has to be vis-à-vis other researchers' works .. <novelty is shown by backing up through literature>" (ORG1-SCT4-75 & 76)
Identity - ego	Up to date information awareness help to acknowledge other's work – such acknowledgement appeases the ego of senior researchers.	"you cannot say that I am ignorant ..about this work I do not know .. in the Internet era .. the risk is tremendous suppose I am a reviewer .. you have not seen my work .. and you have written a passage .. you will do this work .. I will review .. I am a human being .. I may be very angry .. can't you read the literature in the Internet days? If you put the keywords you will get the work .. so risk is tremendous" (ORG2-SCT3-70)
Identity - knowledgeable self	Up to date information helps to establish one as knowledgeable as others present in an interaction.	"these are the people who are in the state of the art…for example we have a project from X development fund and the monitoring committee is composed of many people who are <stressed> in the XX industry….top brasses in the XX industry.. some are academicians.. they are aware <academicians and top brasses of industry> of the state of the art… so I have to be in touch with the state of the art < way to match the knowledge of others>. And I have

Theme	Description	Example
		to respond to their question.<forced to do this>." (ORG1-SCT4-55)
Load shifting	DLs help in providing data that are required by others.	"in promotional applications .. like I am reemployed now .. so I got this offer only after adjudicating these papers ..reviewing my papers .. when I applied I had to submit what are my achievements last year" (ORG2-SCT3-82)
Performance evaluation	DLs are used to establish performance.	"sometimes we -- these days the impact factor of the journal is very important – so sometimes if I have to go somewhere and apply for some fellowship or something I have to mention in which journal I have published in last three years and how the impact of those journals so looking at impact factor quickly and enter and I find out the impact factor" (ORG2-SCT1-14)
Recognition	DLs are a media through which other's contributions can be recognized.	"my publications are archived in electronic resources… look at my publications… read them…know about the areas that I am researching…it is both ways… I know about other people and they also know about me…. So recognition wise it is very important" (ORG1-SCT4-80)
Scientific inquiry - challenge	DL is used to establish the claim made and thus meet the challenge of research	"suppose I am writing a paper and I am giving a hypothesis . . . one of the reviewers raised a point -- no that cannot happen … so I have to check whether he or she is right or I am right – so I have to go thru all the other references related to this topic what are others are thinking -- so they have got this data – I have done this experiment and so I have got this data – so can it be linked? so or somewhat – so I consult with – it always happens" (ORG2-SCT1-15)
Scientific inquiry - continuity	DL provides the information base that can be used to establish that the current research has a continuity from the past.	"for the sponsors they know that <through the tech report> what I am doing is incremental… additional to what is available..,. in the market or in the literature …that gives the accountability … they can judge with regards to that < he provides a yardstick, through lit search, to the sponsors for judgment>" (ORG1-SCT4-40)
Scientific inquiry - merit	DL is used to provide background and establish merit of a proposal.	"actually in the beginning you have to do it largely <literature search> because you have to know the background, how you can justify that your work is essential .. to funding agency .. because why you will be given the money .. whether it is at all necessary .. so you have to do lots of Internet searching " (ORG2-SCT3-46)
Scientific inquiry - new knowledge	DL provides the information base that is used to create new meta knowledge.	"– I have been invited to write the reviews. . I have written four scientific reviews. . and I took lot of knowledge. . for review in a particular research field you have to know what others have done. . so that information has gone directly to the. . now it is published and rated as one of the highest downloaded " (ORG1-SCT6-13)
Scientific inquiry - successful participation	DL use helps framing projects successfully	"they submitted their projects .. they have not gone thoroughly through the literature .. so they could not frame the proposal properly" (ORG2-SCT3-69)

APPENDIX 6: Codebook –factors contributing to DL use/non-use

Factors contributing/inhibiting the use of digital libraries could be viewed across four dimensions, namely environmental, technological, organizational and personal. Themes as emerged are listed under each dimension.

Dimension	Factor	Description	Example
Environmental	Information environment	Availability of information in digital media	"no earlier ..there were some CDs but only abstracts" (ORG1-SCT5-66)
	Awareness	Awareness of others having access to this rich resource	"if you write a paper reviewers are reviewing for sciencedirect .. they give free 60 days access, ..put some keywords and then you can check whether the author has cited all these papers .. so immediately my publication will be checked .. if I do not cite .. they will say oh you cited some old journals" (ORG1-SCT4-70)
	Non-availability	Non-availability of specific information in digital media	"so it will be tremendous work .. but we do not have a supporting data from which we can derive something .. nothing is available .. in that case you do not get any help" (ORG2-SCT3-20)
Technological	Access mechanism	Simple way to reach a resource	"previously we had to spend more time in library. . from home only we used to think that in the first half we will work and in the second half we will work in the library. . now because of the facility of Internet . . we do not have to bother. . we can do simultaneously . . we can put some work and then do lit search" (ORG1-SCT6-15)
	Interfacing ICT tools	ICT tools that interface with DLs	"one is that these days you get what is called citation libraries .. previously we had to type out the references .. in a format .. now with reference manager, as soon as you click on that particular reference and give journal name .. it immediately puts it in the right format .. that is a major advantage" (ORG2-SCT2-37)
	Learning load	Technological complications that demands learning efforts	"I am not sure but if it is very user friendly, of course I will go for it .. but if it is too complicated system, I do not know if at this age whether my energy will allow that" (ORG2-SCT3-60)
Organizational	Organizational policy	Organizational policy leading to the use of certain type of resource	"no.. I am going for a project .. … now BDM division has to do that .. whether it is at all available in the world or not … if it is available in the world who are the companies .. there are many companies in <mentions areas> … so they do that

Dimension	Factor	Description	Example
			research … for the last two years we are doing that research .. and if it is coming up then they are saying .. how I am differing" (ORG1-SCT4-41)
	Internal ICT infrastructure	ICT infrastructure's contribution to current state of DL use	"accessibility was a problem .<explains the problem> .. like we had 3-4 scientists sitting in that room and there were only two computers … we had to share .. it was slow also .. now I think everybody has computer .. wifi is there" (ORG1-SCT4-69)
	Workload	Workloads of scientists deters them from using DL extensively	"not really <keeping tab on information regularly>.. regular practice would have been the best.. but it does not happen.. I have certain other commitments..<does not keep tab regularly himself>" (ORG1-SCT3-51
	Support system	Organization provides support system for DL use	"for example this patent search, it is beyond my … they have the software and they know the tricks .. so there my job is to give only the keywords .. and it is refined .. again give some keyword … if I am not happy I give another set of keywords .. I say please do this way" (ORG1-SCT4-49)
Personal	Habit	DL use as personal habit	"what I practice. . whatever area I am working on, I keep searching on regular basis. . twice or thrice a week. . may be sometime daily also." (ORG1-SCT5-27)
	Perception	DL selection based on perception	"the sources that our laboratory subscribes, I use those… those are always available on our library website… I use all of them…. ScienceDirect happens to be the one which has largest collection.." (ORG1-SCT3-65)
	Desire	Achievement desire leading to DL use	". there are some literatures some reports – I just want to take advantage of that and get my knowledge more and . . whatever I doing on my own I want to take the benefit of that also and I want to improve my doings and my science and my experiment" (ORG2-SCT1-17)
	Labor saving	DL use is encouraging as it saves physical stress compared to print age	"compared to now means there were Biological Abstracts, Chemical Abstracts .. and since I was in Calcutta University, ... I used to visit this library very often and there was a floor .. you have to climb stairs .. there is advantage and disadvantage .. tremendous time taken .. very laborious work .. every week you can get one Biological abstract and one Chemical Abstract and our Professor used to say that you have to go back at least 10 years .. so from that dust you have to search all these journals .. it was a herculean task .. .. so now it is a pleasure" (ORG2-SCT3-66)

CURRICULUM VITAE

NAME OF THE AUTHOR: Swati Bhattacharyya

PLACE OF BIRTH: Kolkata, India

DATE OF BIRTH: September 30, 1956

GRADUATE AND UNDERGRADUATE SCHOOL ATTENDED:

Syracuse University

Indira Gandhi National Open University, India

Documentation Research and Training Center, Indian Statistical Institute, India

Jadavpur University, India

University of Calcutta, India

Degrees awarded:

1. M. Phil in Information Science & Technology, 2008, Syracuse University, USA.
2. Masters of Computer Applications (2000), Indira Gandhi National Open University, New Delhi, India.
3. Associateship in Documentation & Information Science (equivalent to M.Lib.Inf.Sc) (1981), Indian Statistical Institute, Bangalore, India.
4. Bachelors of Library Science, 1978, Jadavpur University.
5. Bachelors of Science, 1975, University of Calcutta.

Professional Experiences

1. Librarian, Indian Institute of Management Calcutta, 1994-continuing
2. Scientist – Information, National Metallurgical Laboratory, Jamshedpur, India, 1988-1994
3. Documentation Officer, National Institute for Entrepreneurship & Small Business Development, New Delhi, India, 1986-1988
4. Jr. Information Supervisor, Steel Authority of Indian Ltd, Ranchi, India, 1982-1986
5. Library Assistant, British Council Library, Calcutta, 1978-1979

Award/Scholarship/Recognition

1. Received *Student of Promise Fund* Scholarship from the School of Information Studies, Syracuse University, 2013.
2. Secured 3rd position in the international paper contest conducted by American Society for Information Science & Technology, 2011.
3. Received Emerald Research Fund – Indian LIS Category award for 2009 for the research proposal "Social context of Electronic Library Use – an Exploratory Study of Indian Academic and Research Organization"
4. Syracuse University Future Professoriate Program Teaching Associate, 2007-2008.
5. Represented India in the Indo-US Workshop on Open Digital Libraries and Interoperability, Ballston, VA, USA, June 22-25, 2003
6. British Council Visitorship, for studying Information Services in UK, 1992.
7. Fulbright Fellowship, for an internship in Information Technology, in School of Information Science and Policy, State University of New York at Albany, 1991-1992
8. Certificate of Merit under National Scholarship Scheme, Ministry of Education and Social Welfare, Govt. of India, in recognition of the high position secured in the list of meritorious candidates in 1972 (Higher Secondary Examination)

Teaching experiences:

IST 613: Library Systems and Processes (teaching in asynchronous mode using WebCT for the MLS program at SU), Summer 2006, Fall 2006, Spring 2007, Summer 2007.

I served as Counselor/Teacher for the course Information Technology in Library and Information Science, under the program of Masters of Library & Information Science, a distant education program under Indira Gandhi National Open University, New Delhi, India (1997-2005).

Member, Board of Studies, MLISc program, Netaji Subhas Open University, Kolkata, India.

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18. Bhattacharyya, S. (2010). Planning and Management of Digital Libraries. Invited lecture delivered at 3rd Refreshers Course in Library and Information Science, Academic Staff College, Banaras Hindu University, August 31 – September 20, 2010.
19. Bhattacharyya, S. (2010). ICT Environment of Resource Sharing Activities. Invited lecture delivered at the UGC-Calcutta University Refresher Course in Library Science, on ICT Applications in Academic Library Management, for College and University teachers, Feb. 19 – March 12, 2010
20. Bhattacharyya, S. (2010). ICT and Library Services: A Futuristic Vision. Invited lecture delivered in the INDEST-AICTE Workshop & Seventh Annual Meet. IIT Kharagpur. January, 2010
21. Bhattacharyya, S. (2009). New role of librarians in twenty-first century. Invited lecture delivered at UGC sponsored Refreshers Course in Library and Information Science, Academic Staff College, Calcutta University, March, 2009, Calcutta, India
22. Bhattacharyya, S. (2008). Change in LIS: different perspectives. Invited lecture delivered at UGC sponsored Refreshers Course in Library and Information Science, Academic Staff College, Burdwan University, November 8, 2008, Burdwan, India