Chapter – 2

THE STATE OF THE ART REVIEW

Methodologies used in Earlier User Studies
Need Based User Studies in General
Need Based User Studies in Scientific & Technological Institutions
User Studies on Information Seeking Behavior and Retrieval Models
User Studies in the context of Electronic Information
Research Gaps and Rationale for the Present Study
The problem of identifying user needs has been a subject of frequent discussion, "the first survey to have real impact in our field was J Bernal’s survey (as cited by Slater, M,1968:103) of the use of scientific information". Though it was carried out in 1948, results and conclusions still valid even today. "Bernal’s findings indicated that pure and applied scientist had different needs, and that work activity (i.e. title, status) was also a factor that could affect use of libraries and other sources of information. Other investigators have also corroborated conclusions. Menzel, H(1964:4-19) reports that "the end of 1963 seems to have been something of a take off point for empirical research on the information needs and uses of scientists and technologists".

It must be stressed here that most of these studies have been concerned with user demands rather than user needs and accordingly is lost without limitation This is certainly a defect, as there is a great deal of difference between a demand and a need. Demands made on libraries reflect not only the basic needs of users but also the nature, and sometimes the deficiencies of the system that is being used to satisfy these needs. The possible reason for the earlier studies being restricted to the study of ‘demand’ or ‘use’ is perhaps because it is difficult in practice to separate the two, and that it is easier in practice to study demand and deduce need.

2.1 Methodologies used in Earlier User Studies

Basing on the earlier study on information needs of library users, Wood, D. N. (1969:262-70) has discovered and enumerated the following five methods for the assessment of the information needs of library users.
i. Questionnaire;
ii. Interview;
iii. Diary method (systematic self observation by the user);
iv. Observation (by the person studying the user); and
v. Analysis of existing data.

**Questionnaire and Interview**, although not devoid of limitations, are the two well established and to a certain extent reliable methods. Among the direct studies questionnaire is found to be favorite method of study and belongs to first category while interview and observation are belongs to second and third categories. running second and observation a poor third.

**The Diary Method** involves the analysis of the user-records of information related activities. Inspite of being the most reliable source of information on the subject, its usefulness is limited by the difficulties in getting access to it. Hemer (1967:5) records the experiences of two investigators.

**The Citation analysis technique** and analysis of circulation and other statistics maintained by the library may be taken to be covered by the final category in Wood’s list. Each method of investigation has its own merits and demerits. Moreover, because of the variant nature of the information needs of the various types of users, no one method can be applicable in all the studies with the same accuracy of results.

The limitations of the individual techniques of study and the multidisciplinary trend in the development of subjects has made it imperative on the part of the investigator to use more than one technique to do away with the limitations of one technique with the help of another. Usually two and in some cases three techniques have been used for similar studies. Sharma, N. C (1977) has used three techniques, viz. citation analysis, observation and questionnaire. Clearly, very few studies with combination of techniques have been made and this thesis have made an attempt in that direction.
2.2 Need Based User Studies in General

Several studies have been conducted on need based user studies in general. The relevant studies pertaining to the areas and the conclusions that are of relevance to the librarians are reviewed and are as under:

Agrawal, S. P, Manchanda, Harinder K and Lal, Manohar (1984). discuss the scope of user education and the value, methodology and assessment of user education programmes, describing international and Indian developments in user education and proposing the formation of a national policy on user education and a national agency to administer its programmes. Allen, T. J. and others (1967:26) of MIT group have described about the communications stars that serve as “gatekeepers” and facilitate the flow of information from outside and transmit it to their colleagues. Bookes in looking at the scientific communication system commented on the importance of informal channels of communication.

Auster, E. and Choo, Chun Wei (1991:3-8) proposes a conceptual framework for studying the information-seeking behavior of executives when they scan the business environment and literature. The framework could be especially useful in designing research to investigate some basic questions about executive scanning behavior. The questions address issues such as what information do executives require, which sources are used by them to obtain the information, and how is environmental information used in decision making. Auster, E (1982:173-82) studied the area of organisational behavior and the areas of information seeking are separate fields that have produced literatures relevant to librarians. Neither of these fields, however, is concerned with librarians as their primary focus nor does the literature of librarianship generally take into account the findings from these disciplines.

The relevant studies pertaining to the areas and the conclusions that are of relevance to the librarians are reviewed and are as under.
Bates, M. J. (1997) develops an analytical framework to support the analysis of conversation in information seeking contexts. It brings together linguistic and sociolinguistic issues, which serve as viewpoints for exploring how information seeking conversations differ from casual conversations and conversations in restricted conversational domains (e.g. teacher-student, and physician-patient). A sample of 9 conversations from 2 information seeking contexts (i.e. school library media centre, and public library) is used to test the utility of the framework and explore possible characteristics of information seeking conversations. The findings support the utility of the framework for various purposes including: training of information specialists, feedback on their performance, design of human computer dialogues, eliciting of decision making processes during information seeking, and support for natural language processing.

Brown, M. E (1981) in his study brought together various aspects of information-seeking behavior, projected over an organisational and behavior framework, into a general survey of the literature. Three dimensions of information-seeking behavior were determined: the conditions, the context, and the process including the interaction among these dimensions. Selected barriers to information-seeking behavior are reviewed. Burdick, T. A. (1996) describes an exploratory study of the impact of gender on information seeking. The study took place during the fall trimester of 1994 at the laboratory school of a large university in the USA. The sample consisted of 47 females and 56 males enrolled in 4 English classes (one an honors class) in 10th, 11th, and 12th grades. Addresses the importance of investigating gender issues; presents a conceptual framework; reviews research questions methodology, and study site; presents a brief summary of findings; and outlines implications.

Chatman, E (1991:438-449) reports a study in which gratification theory (essentially, that certain populations live in an environment in which the emphasis is on immediate gratification and satisfaction of needs) was applied to an information-seeking behavior of a lower-working class population. Respondents were janitorial workers at a southern US university. Results show that, although members of this population expressed a number of
areas in which they needed information (e.g., employment, everyday coping advice, etc.),
they were not active seekers of information outside of their most familiar social milieu. 
Findings indicate that a possible explanation for this was the perception that outside sources 
were not capable of responding to their concern. Thus, there was little motivation in 
exploring the relevance of these sources. Moreover, items of most interest to them were 
those things that were accessible, had a firm footing in everyday reality, and responded to 
some immediate, practical concern.

Chen, CC (1982) results of a study, supported by the Office of Libraries and Learning 
Technologies, US Department of Education, of the information needs and information 
seeking patterns of New England residents. 400 residents in six each of the New England 
States were interviewed over the telephone by researchers at Simmons College, Boston. The 
detailed questionnaire covered information searching both in work and in personal life 
during the previous month and the results are reported statistically in Tables, charts and 
graphs. Ellis, D. (1993) describes an approach to the design of an information retrieval 
system for academic social scientists and attempts to determine their information-seeking 
patterns conducted by the Department of Information studies at the University of Sheffield 
by means of informal, semi-structure, in-depth interviews. 6 characteristics appeared in the 
patterns and at the same time to provide a framework for a flexible model to underline 
recommendations for information system design and evaluation. These are: starting, 
chaining, browsing, differentiating, monitoring and extracting. Herner, S. and Herner, H. 
(1967) conducted a survey on the information requirements of the social scientists by the 
Bath University library group in England describes the different sources of information 
according to their use. Also the use of informal channels for locating relevant references and 
keeping up with the current research are described. The study reveals that older and more 
experienced researchers tend to use fewer libraries than others do.

Itoga, M (1992) presents an interdisciplinary study of research into the social aspects of 
information communication by bridging the existing gap between cognitive and 
phenomenological views of information needs and uses. Limberg, L (1995) intended to
understand the interaction between information seeking and learning outcome in education. The hypothesis of the study is that what students learning about the subject content of an assignment are affected by the way this student searches and uses information for the assignment. Studies have been carried out on upper secondary and college level. Lonnquist, H. (1990) reports a NORDINFO study designed to study the information-seeking behavior and information needs of scholars in the humanities from a holistic perspective. 64 people from Denmark, Finland, Iceland, Norway and Sweden were interviewed and result show that scholars in the humanities do not have a homogeneous information-seeking behavior or homogeneous information needs. Compared to other information channels research libraries turned out to be of greatest importance for scholars seeking information and printed materials for their research. The study also showed that scholars used bibliographies only to a small extent and their bibliographical awareness was rather low.

Maheswarappa, B. S. and Trivedi, S. K (1986) have made a study on the information needs of Indian Food Scientists a case study at CFTRI, Mysore studied the information requirements of food scientists through questionnaires and also evaluated the services provided to them. Results of this study are aimed at planners and designers of information systems to help them in designing effective information systems to help them in designing effective information services in the field of food science and technology. Nicholas, D. (1997) studied the potential impact of the introduction of the Internet into the workplace. It is proposed to do this through a case study of one of the first groups to feel this impact: journalists and information professionals working in the print media. Of particular interest will be the empowerment of end-users, the changes in work practice that the Internet may bring about, and the effect these changes will have on information professionals as intermediaries in the information-seeking process.

Ocholla, D. N. (1996) have analyzed information-seeking behavior by university academics at Moi University, Kenya. A pilot study was conducted and data collected through questionnaires and interviews among 27 academicians randomly sampled from: health sciences, information sciences, environmental studies and education faculties. Reports the
results which covered: departments and faculties where academics belong, rank and position in the academics, information resources frequently used by academics, gaining knowledge of the existence of information sources, generation of professional ideas, reasons for looking for, where the academics get the information resources they use, and dissemination of information. Make recommendations to support information provision capacity in a university. Oliver, R. and Oliver, H (1997) tests the hypothesis that information-seeking activities based on contextual and social purposes would lead to higher levels of knowledge acquisition and learning than those achieved through activities where the purpose and context was absent. Results provide tacit support for hypothesis. When students participated in information-seeking activities and tasks, the context and purpose of the activity influenced the amount of knowledge gained and retained.

Osiobe, S. A (1988) has reported a study undertaken at Port Harcourt University Library, Nigeria, which investigated student’s information seeking behavior. Results of the study show that browsing is the prevalent source of reference to the literature among undergraduates followed by faculty staff and the library card catalogue in 2nd position and the subject librarian in 3rd place. Abstracts and indexes are poorly used and ranked 6th in the study. Prentice, A. E. (1980) summarises the interview findings of the 5 papers in this special section. Each individual has his special information needs and each works in a field in which current information is both essential and often hard to locate. Co-workers are the most often consulted information sources, and libraries were rarely if ever used for on the job needs-perhaps there is little or no role for the library in this sphere for many workers. Library staff, too, consults co-workers when planning the libraries reference activities. Potential users know what they need. Librarians need to know the extent to which they can fill those needs.

Sasikala, C (1994) has reported results of a study of the information and library use behavior of 436 managers in 3 groups (senior, middle, and junior) from 20 industrial organizations in Andhra Pradesh. These show that: managers seldom visit libraries; that they try to satisfy their information needs from other sources as well as from libraries;
managers need data type information firstly and descriptive information on specific topics secondly; managers collect information to keep abreast of current knowledge, to solve immediate practical problems, and additional information relating to the job. There are some differences in search and use behavior among the 3 groups. Savolainen, R. (1995) offers a framework for the study of everyday life information seeking (ELIS) in the context of way of and mastery of life. Way of life is defined as 'order of things', manifesting itself, for example, in the relationship between work and leisure time and models of consumption, and nature of hobbies. Mastery of life is interpreted as 'keeping things in order'; 4 ideal types of mastery of life with their implications for ELIS are outlined, namely optimistic-cognitive, pessimistic-cognitive, defensive-affective and pessimistic-affective mastery of life. 2 major dimensions of ELIS are reviewed: seeking orienting information and seeking practical information. The research framework was tested in an empirical study based on interviews with 11 teachers and 11 industrial workers. Discusses the main features of seeking orienting and practical information and gives suggestions for refinement of the research framework.

Selden, L (1992:18-27) has described the research patterns of social science researchers and humanist scholars and assesses the state of business studies. Discusses Kuhlthau's model of information searching and presents a behavioural model for information system design based on information seeking activities. Examines the conditions for research and researchers' use of libraries. Discusses the research career and the information seeking career covering information socialization of the junior researcher, steps in the research career and information outcomes of the research career. Contrasts the structure of science and engineering information with that of business researchers and humanities scholars. Stam, D. C (1989:13-16) studies the information-gathering activities of art historians have been studied from 3 different perspectives: in terms of the books they use; through their own accounts of their working processes; and by informal, systematic observation, written up as 'user studies', by art librarians. While observation implies objectivity, a distance between observer and observed, in practice art librarians are very much involved with the art historian in the work of art history and in the development of its methodologies.
Wiberle, S. E. and Jones, William G (1989:638-645) has described how humanists in a small, interdisciplinary group seek information, confirming findings of previous research, although with significant variations. They ignore on-line databases and seldom consult reference librarians, but they do rely on archivists and special collection librarians. Their use of formal bibliography is limited to 1 or 2 sources and occurs only when exploring new topics, their preference being to find information by going to the person or location that can supply it.

2.3 Need Based User Studies in Scientific & Technological Institutions

The relevant studies pertaining to the user studies in scientific and technological institutions are reviewed as under:

Advisory council on Scientific Policy (1967:83-112) conducted a survey on the information needs of physicists and chemists, the various types of information sources are discussed and their importance has been ranked. A notable feature has been the general similarity of information seeking and use habits of physicists and chemists. The engineers may have psychological traits that predispose them in solving problems alone or with the help of colleagues rather than finding answers in the literature. They draw on past experiences, use the trial and error method, and ask colleagues known to be efficient and reliable instead of searching or someone search the literature for them.

Auster, E and Choo, C. W (1992:48-54) have reported the preliminary findings of a survey of the environmental scanning behavior of 207 chief executive officers (CEOs) in two Canadian industries: publishing and telecommunications. The CEOs indicated which sources they used to learn about trends and events in the business environment and their perceptions of the accessibility and quality of various information sources. Results show that they use a variety of internal and external sources with the most frequently used being: newspapers and periodicals; subordinate managers and staff; broadcast media; customers;
and internal documents. Analysis revealed that between perceived source accessibility and quality, source quality is the more important variable. This runs contrary to earlier user studies, particularly those of scientists and engineers, which concluded that perceived source accessibility was the overwhelming factor in source selection.

Barua, P. and Tripathi, Tridib (1988:93-98) have conducted a study at Burdwan University Library which aimed to investigate the information needs of scholars, information sources used by them, types of information consulted by scholars, various approaches to information, problems of access to information, and the various services provided by the University library and information/documentation centres. Outlines main reasons why the marketing strategy developed by the library has not been successful. Findings of the study are examined and suggestions made to ensure better information services to scholars.

Bervin, B and Nilan, M (1986:1-33) have observed in their survey on agricultural scientists in Netherlands that not only to scientists in different disciplines use information channels differently but different groups within a discipline also use channels differently.

Bichteler, J. and Ward, Dederick (1989:169-178) have investigated problems encountered by geoscientists retrieving and processing information. Through interviews and questionnaires, geologists judged the importance of information sources and described their continuous and on-demand modes of information seeking. Geologists show little interest in end user searching and need additional training in information services, sources, and procedures. Case D, Borgman, C. L and Meddow, C. T (1986:299-308) by interviewing 10 researchers and 23 search intermediaries in the energy field indicate a heavy reliance on databases as sources of information. These data, gathered for the Department of Energy Online Access to Knowledge (OAK), USA, project on improving access to energy data bases, suggest a migration of searchers toward commercial systems that offer the widest choice of data bases coverage. End-users of the data base information-energy researchers-still prefer that others do the searching for them. Librarians and technical information specialists, although recognizing the potential for researchers to use databases directly, doubt that such use will be common in the near future. While there is a modest trend
towards first-hand use of databases by end-users, printed and interpersonal sources are still the preferred channels for obtaining energy information and have discussed these findings in the light of previous research on the information habits of scientists and engineers.

Case, D and others (1985:331-336) have interviewed with 18 researchers and 34 search intermediaries in energy-related fields indicate a reliance on databases as sources of information. The interview data suggest a migration of searchers toward commercial systems that offer the widest choice of data base coverage. Cobbledick, S. (1996:343-72) has described and analyzed in depth interviews with four artists representing different media disciplines, a sculptor, painter, fibber artist and metalsmith. To aid future research in this area and to tap into larger, more reliable samples, these data have been used to design a survey instrument that is described in the appendix.

Curtis, K. L. Hurd, J. M. and Welle, A. C. (1993) have investigated information-seeking behavior, including use of major bibliographic tools by medical, pharmacy, nursing and science faculty at Illinois University at Chicago. The study assessed the impact of availability of locally mounted databases, determined needs for modification of instructional programmes, identified the need for promotional material, and established a baseline for subsequent studies. Results reflected a wide variation in the number and format of secondary services used by the faculty. Over 70 per cent of all faculties from the colleges of medicine, pharmacy, and nursing used Index Medicus or MEDLINE. There were statistically significant differences between colleges in their use of mediated and end user searching of MEDLINE. Colleges exhibited significant differences in use of Current Contents, PsycLIT, ERIC, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Chemical Abstracts, and Science Citation Index. Statistically significant differences also were found among several clinical departments. Concludes that, as new formats to bibliographic tools become available, traditional formats continue to be used; training sessions must be tailored to the audience; and the availability of local resources and their use by faculty needs to be understood.
Devarajan, G has surveyed on information needs and use habits of scientists: an assessment, the author has tried to examine the user approaches to information in different types of information sources. It also identifies the most favorite journals among pure scientists and awareness of users with regard to the various information services offered by the University Library System. A combination of questionnaire and Interview method has been adopted in the survey. Ellis, D and Haugan, M (1997) have explored the role of information and information seeking in the research and development department of an international oil and gas company. Analyzes the requirements for different types of information in an environment where the need for internal and external resources are intertwined; also compares features of the information seeking patterns of engineers and research scientists from this and previous studies. It was found that, although there were differences in the features of the information seeking patterns of the research scientists and engineers, the behavioral characteristics were similar; and the study identified identical or very similar categories of information seeking behavior to those of previous studies of academic researchers.

Ellis, D, Hall, K and Cox, D (1993:356-369) have analyzed the information seeking patterns of a group of research physicists and research chemists and the key features of those identified. The aim was to use a similar methodology to that employed in a previous study of the information seeking activities of a group of social scientists and to effect a comparison between the information seeking pattern of the scientists and the social scientists. The methodology adopted for the interviews and analysis was qualitative and based on the grounded theory approach. Fundamental difference in behavior could not be determined. Considers the impact of developments in electronic communication have had on information or communication patterns of the scientists and social scientists. Folster, M. B. (1995:83-93) has reviewed some of the major studies that have been done in this area and discusses the implications of the findings for the development of services for this group of clientele.
Gruppen, L. D (1990:165-72) has reviewed recent research that identifies the context in which physicians seek information and advice from external sources, the information sources that physicians access, and the factors that influence which particular sources are sought. The results indicate that physicians vary in their information needs, preferences, motivations, and strategies for seeking information. Gupta, R.C (1988:52-58) has described information-seeking approaches of structural engineers. Highlights the value of user studies in formulating an efficient system. In order to provide an efficient service, information scientists should possess knowledge of library and information science, statistics, computer science, management and psychology and behavioural science. This knowledge should be incorporated in the programmes of training centres and education institutions so that library staff is trained to respond to users' needs as efficiently as possible. Hogg. H. and Smith, J. R. (1959:131-62) have surveyed on information and literature use in an R and D organization considers the information seeking habits of different levels of scientists and brings out the differences in their information seeking habits. The investigation aims to find out (a) the method by which scientists obtains their S and T information. (b) Different types of information sources consulted during fourteen consecutive days prior to the survey and (c) the means by which they obtained literature during that period.

Holl, M. P. and Powell, C. K (1995:7-15) have reported results of a follow up study, to assess the impact of the course, involving sending questionnaires to 60 students who had taken the course and 60 similar student who had not. Although both groups of former students were very similar in their use of information resources on the job, those who had taken the Technical Communications course identified more specific resources available to them. The latter also rated formal sources of information, such as college libraries and public libraries, more highly, and spent an average of 10 hours more per month searching for and reading information. Concludes that their is a relationship between the former students' use of information resources and their having taken TC 490. The study also revealed that many engineers have access to the tools needed for electronic information retrieval, and that while few receive formal training in their use, there is widespread interest in learning more.
Hurd, J. M., Curtis, K. L. and Weller, A. C (1992:136-43) have investigated the information seeking behavior of science and engineering faculty and explores their use of major abstracting and indexing tools such as Current Contents and Science Citation Index. Describes results of a survey of faculty in pure and applied sciences, at Illinois University at Urbana-Champaign, to establish a baseline for a subsequent survey to assess the impact of availability of locally mounted databases. King, D. W and others (1994:198) have studied behavior patterns of scientists and engineers in information seeking for problem solving. Lalitha, M (1995:65-74) describes a comparative study of the information-seeking behavior of medical and engineering personnel at five libraries in Thiruvananthapuram, India. Students, teachers, practitioners and research workers in both fields were surveyed. The findings of the survey are summarized and implications for libraries are discussed. Neither professional group seemed to have completely understood the complex nature of their information needs or their information sources. User education for medical and engineering personnel is clearly needed.

Leckie, G. J. and Pettigrew, K. E. (1996:99-110) many research projects have studied the use of information by professionals but their value has been reduced by the lack of connection to a larger framework or theoretical perspective. With this in mind a study was undertaken to review the literature on the information seeking behavior of three professional groups: engineers; health care professionals; and lawyers to determine whether there were common themes, findings, or theoretical perspectives among the various studies. The findings were used to develop a model of information seeking behavior. Reports results of a study to apply the model to analyze data from a pilot study of the role of visiting nurses in linking the elderly with community resources, and the role played by information seeking behavior in community information. The model has considerable potential for providing a conceptual framework for the understanding of information seeking behavior of professionals.
Leckie, G. J., Sylvain, C and Pettigre, K. E (1996:161-93) have studied on information seeking behavior of three groups (engineers, health care professionals and lawyers), posits an original model of information seeking that is applicable to all professionals. Presents in detail the general model and its six components, which are work roles; associated tasks; and characteristics of information needs; and three factors affecting information seeking: awareness; sources; and outcomes. Concludes with suggestions as to the potential usefulness of the model. Menzel, H. (1964:04-19) has reported that scientists use different channels of communication to keep themselves abreast of development in their primary fields. Pinelli. T. E (1991:5-25) has discussed the information seeking habits and practices of engineers as distinct from scientists. Evidence indicates that traditional information services and products may not be meeting the information needs of US engineers. The reasons for this deficiency are: the specific information needs of engineers are neither well known nor well understood; what is known about the information-seeking habits and practices of engineers has not been applied to existing engineering information services; information professionals continue to over emphasize technology instead of concentrating on the quality of the information itself and the ability of the information to meet the needs of the user.

Raitt, D. I (1985:319-23) has undertaken a recent research project to ascertain the communication, information seeking and use habits of scientists and engineers working in various multi-national, multi-cultural government organisations. Gives details of the research methodology, choice of organisations and survey technique. Reviews the major findings of the project as they relate to the library/information centre and its services; the information needs and sources of the scientists/engineers; the organisation and its communication flow; the reading habits of scientists/engineers; barriers to communicating; and the effect of time spent away on mission. Suggests improvements in communications and information flow within an organisation. Considers the rationale behind these recommendations and how they might be put into effect. Raitt, D. I (1984) have studied to discover the patterns of information usage of diverse groups of scientists and engineers in various international organisations and large aerospace R and D laboratories and the
methods and frequency of communication between them. A questionnaire has been developed and circulated for this purpose. Assuming that types of information users and their patterns of information use can be identified, recommendations will be made on how library and information services can be developed or adapted to meet their users' requirements. The study is not concerned with the work performance of personnel nor the actual information communicated.

Schroder M and Ginman, M (1991) have analysed the information-seeking behavior in the energy research field. The use of different types of information sources (formal information, external internal, primary secondary, traditional electronic) is explored. Both quantitative and qualitative research methods are used. A questionnaire was sent to over 150 researchers and 30 research workers and project managers were interviewed. Seggern, M. V (1995:95-104) has discussed these behaviours and some reasons for their use. Improvements in reference services to the scientific user community must be based on an understanding of scientific communication, information seeking behavior, and the information needs of the user. Gives examples of user oriented reference service. Soma Raju, P (1989:339-50) in his survey conducted at Andhra University the author has discussed the different types of services available to a research scholar such as: reference service, inter-library loan service, reprography service, translation service. The author recommends setting up of a documentation unit in the University to serve the research scholar community.

Vittal Rao, D (1987:05-09) has analysed information-seeking behavior of scientists (heterogeneous users) of the National Institute of Nutrition, Hyderabad by a questionnaire method. Information was sought with regard to their information-seeking behavior with reference to current information sources, documentary and non-documentary. Emphasis was laid on non-documentary channels: formal and informal, such as mass media, flow of communication among scientific groups and gatekeeper scientists. Concludes that non-scientists' information seeking behavior is mostly non-documentary and non-formal in character.
Vij, R. and Mehta, S. N (1989:339-350) conducted at DESIDOC on the formal and informal needs of scientists with an attempt to assess the information awareness among various categories of scientists and explore the possibility of applying evaluation measures in the area of Defense Science. The survey has revealed that the discussion should be focused on the ways in which library patron can be taught to exploit the existing information services in the library. Voight, M. J (1961:81) in his interesting paper on Scientists Approaches to Information’ has described three major approaches which the scientist uses to obtain information depending upon his requirement. These are – i. Everyday Approach, ii. Current Approach, and iii. Exhaustive Approach. Welborn, V (1991:51-60) has contributed to a thematic issue on the information seeking and communicating behavior of scientists and engineers. A research team from the University of Utah announced at a press conference on 23rd March 1989 that they had achieved cold fusion in the laboratory. The events that ensued offer an opportunity to re-examine the information seeking and communicating process of scientists, with particular reference to peer review and the role of the scientific journal.

Wilkins, J. L. H. and Leckie, G. J (1997:561-74) have reported the results of a questionnaire survey of professional and managerial staff on the very large campus of the Western Ontario University to examine their work related information needs. The 3 objectives of the study were to: examine, in general, the information seeking habits of the staff; explore what role (if any) the campus library played in meeting the information needs of this group; and test the critical incident technique as a methodology for gaining a more detailed understanding of the interrelationships between the nature of professional and administrative work within the university setting and the information needs that arise from such work. Through personal contacts, the Internet, and departmental sources, professional staff is able to readily satisfy readily many of their daily and short-term work related information needs with minimal use of the library. However, because their jobs are multifaceted and complex, these staff members frequently are engaged in longer term activities (such as project development, report writing) requiring more intensive library use,
which often is perceived to be frustrating and time consuming. Discusses the implications of these findings for academic libraries generally.

2.4 User Studies on Information Seeking Behavior and Retrieval Models

The relevant studies pertaining to the user studies on information seeking behavior and retrieval models are reviewed and are as under:

Akeroyd, J (1990:33-52) studies three different interfaces for on-line public access catalogues were evaluated using transaction logging as a methodology. In two cases exercises were set and run against each interface so that results could be critically evaluated to indicate areas of weakness. In all cases a random transaction log was derived and this was used to diagnose system problems and identify patterns of behavior. Results showed that searches were often difficult to categorize, users employing different approaches to the same end. Users were also prepared to undertake sustained searching until something was retrieved; however they then frequently stopped. Search input problems are also identified and possible areas for further research suggested.

Albrechtsen, H and Hjorland, B (1997:136-144) presents an interview with Birger Hjorland, Danish author of a new book on knowledge organization entitled 'Information Seeking and Subject Representation: An Activity-Theoretical Approach to Information Science'. The book presents a new general theory for information science and knowledge organization, based on a theory of information seeking. Gives the author's views on knowledge organization and subject representation. Bystrom, K. and Jarvelin, K (1995:191-213) have studied the relationships of broad job types and information seeking characteristics have been analyzed both conceptually and empirically, mostly through questionnaires after task performance rather than during task performance. Analyzes at the task level on the basis of a qualitative investigation of the relationships of task complexity, necessary information types, information channels, and sources. Tasks were categorized in 5 complexity classes and information into problem information, domain information, and problem solving.
information. Moreover, several classifications of information channels and sources were utilized. The data were collected in a public administration setting through diaries, which were written during task performance, and questionnaires. The findings were structured into work charts for each task and summarized in qualitative process description Tables for each task complexity category. Quantitative indices further summarizing the results were also computed. The findings indicate systematic and logical relationships among task complexity, types of information, information channels, and sources.

Chamis, A. Y., Saracevic, T and Trivison, Donna (1986:67-72) have reported on a project on the cognitive aspects of information seeking and retrieving. Analyses the variations in search results obtained by nine searches on a series of questions. The objectives of the 1st phase of this project were: to analyse the degree of agreement in search results and search strategy among intermediary searchers searching the same question; and to test the cognitive characteristics of the searchers and correlate these with the effectiveness and efficiency of the search results obtained. Indicates wide variations in the number of citations retrieved by the nine searches. Analyses the number of unique citations in the set of nine searches for each question.

Derr, R. L. (1984:124-28) in his study has identified five types of information seeking expressions of users has by an analysis of a sample of such expressions and of analogous expressions in another social context. The treatment of these expressions in the literature of information retrieval is reviewed. Two recommendations are offered: information specialists should call questions 'questions', requests 'requests', statements 'statements', commands 'commands', and truncated expressions 'truncated expressions' and both the search interview and the search itself should focus upon user questions. Hjorland, B (1993:80-86) has provided a summary of a dissertation which presents a theory of information seeking behavior based on the theory of knowledge, thus uniting the two areas in which this subject is usually studied: user studies and information retrieval. Chapters deal with the following areas: definition of subject retrieval; an overview of the field of subject representation data; subject analysis; theories of subject, interpreted, characterized and criticized from the
viewpoints of objective idealism, subjective idealism and realism; methodological problems in information science; analysis of information seeking from a methodological collectivistic methodology; the concept of information needs; and the relationship between the proposed concept of subject and tendencies in philosophy and psychology.

Hyldegaard, J (1997:79-89) has aimed to study the potentials, if any, of using a Virtual Reality (VR) user interface for visualizing, retrieving and manipulating information. A VR user interface represents the next generation of user interfaces by allowing for a high degree of transparency and non-command based interaction. Discusses the different factors affecting transparency and considers information retrieval through browsing. Kuhlthau, C. C (1991:361-71) has discussed the users' perspective of information seeking. Presents a model of the information search process derived from a series of five studies investigating common experiences of users in information seeking situations. The cognitive aspects of the process of information seeking suggest a gap between the users' natural process of information use and the information system and intermediaries' traditional patterns of information provision.

Kuhlthau, C. C. (1993:339-55) has proposed an uncertainty principle for information seeking. The principle is based on the results of a series of studies conducted into the user's perspective of the information search process. A basic principle of uncertainty is elaborated by six corollaries. Proposes the principle to explain the constructive process of information seeking and use bringing affective considerations to what has usually been regarded as a cognitive process. Liddy, E. D. and Jorgensen, C (1993:185-90) has attempted a study which aimed to empirically investigate book-index usage, behaviors, and the extent to which specific print index features affect a user's search for information; and to examine these features in an electronic environment and to determine the optimum specifications for indexes in electronic texts by gathering evidence from a controlled user study. Provides an overview of the research project, focusing on a subset of the results from the study of hard-copy book indexes. Describes observable behaviours of a sample of user s when consulting
different variations of a hard copy book index. Suggests a preliminary model at three levels of abstraction repressing users' behaviours when using a book index.

Malmsjo, A (1997:222-35) has reviewed the factors related to the environment and situation influencing users' information seeking behavior and the various models and equations reported in the literature to describe this activity in a quantitative manner. The aim is to examine the degree to which these models of information seeking behavior can be of use in designing practical information systems.

Marchionini, G (1989:54-66) has conducted this exploratory study on elementary school children searching a full-text electronic encyclopedia on CD-ROM. 28 third and fourth graders and 24 sixth graders conducted two assigned searches, one open-ended, the other closed, after two demonstration sessions. Keystrokes captured by the computer and observer notes were used to examine user information-seeking strategies from a mental model perspective. Older searchers were more successful in finding required information, and took less time than younger searchers. No differences in total number of moves were found. Analysis of search patterns showed that novices used a heuristic, highly interactive search strategy. Searchers used sentence and phrase queries, indicating unique mental models for this search system. Most searchers accepted system defaults and used the AND connective in formulating queries. Transition matrix analyses showed that younger searchers generally favored query-refining moves and older searchers favored examining title and text moves. Suggestions for system designers were made and future research questions were identified.

Reneker, M. H (1993:487-507) has studied the information seeking activities of 31 members of the Stanford University academic community were examined over two week periods, the 2,050 information seeking incidents being tape recorded and supplemented by interviews. Qualitative and quantitative analysis was used to examine the information needs in relation to perceived environment, source use, personal characteristics, and satisfaction with the result of information seeking. Results revealed information seeking to be embedded in day to day tasks and relationships and triggered both by articulation of need and
availability of information. Describes the methodological approach adopted and the use of
the ETHNOGRAPH and SPSS/PC Plus software to facilitate data analysis. Saracevic, T.,
Kantor, P., Chamis, Alice Y. and Trivison, Donna (1988: 161-76) have conducted a series
of observations and experiments under as real-life a situation as possible related to: user
context of questions in information retrieval; the structure and classification of questions;
cognitive traits and decision making of searchers; and different searches of the same
question. The study is presented in 3 parts: Part 1 presents the background of the study and
describes the models, measures, methods, procedures, and statistical analyses used.

Savolainen, R. (1993:13:28) has developed the sense-making theory, which is based on
constructivist assumptions on human information seeking and use. Focuses on the epistemic
and practical interests of the theory, discussing them in relation to the interests of the
traditional intermediary-centered approach. Sense-making theory is a programmatic research
effort suggesting user-centered ideas for the conceptualization of the information seeking
and use. Its contribution to LIS researches its critique to the limitations of the traditional
intermediary-centered approach. Sitter, S. and Stein, A (1992:165-80) have presented a
dialogue model that incorporates the illocutionary aspects of information-seeking dialogues.
Directives, commissive, and assertive types of dialogue acts (asking, offering, rejecting,
answering, and evaluating) are represented by a complex transition network. The model
determines all legitimate types and sequences of dialogue acts and regulates the role
assignments (when the information seeker and the information provider temporarily
exchange their roles). Such an integrated model can serve as a basis for the design of
human-computer dialogue systems. The model was worked out in the COGITO (Cognitive
Interaction Tools) at the Integrated Publication and Information Systems Institute, Germany.

Spink, A (1996:10-15) has reported the results of an exploratory study to investigate the
ability of novice searchers to recognise stages in a user's information seeking process. The
study follows a research project, which investigated the ability of experienced search
intermediaries to recognise and assess the stage of a user's information seeking process.
Two aspects were examined in the study: problem definition level; and the work stage that
the user was experiencing at the time of the online search. The study aimed to investigate whether the ability of searchers is limited to skilled and experienced intermediaries or is a more fundamental human cognitive activity. Results suggest that novice searchers were able to judge the user's problem definition level more successfully than the users work stage. Implications of the results are discussed in terms of a general process model of information seeking behavior. He further goes on to argue that information science is beginning to explore feedback as a key concept within information seeking and retrieving models. Feedback has been a fundamental element in many cybernetic and social models. Gives an overview of feedback within the cybernetics and social frameworks. Compares these feedback concepts with the interactive feedback concept evolving within the framework of information seeking and retrieving, based on their conceptualization of the feedback loop and notion of information.

Summers, E. G. Matheson, Joyce and Conry, Robert (1983:75-85) Current research on information retrieval suggests that greater attention be given to the study of information habits and needs of users of information. It has also been suggested that the user be viewed more broadly as existing within interacting cognitive, emotional, and social systems. The findings of the study offer support for the notion that information source use by educators is the result of a complex set of interactions among variables and examination of the interaction of personal, professional, and psychological attributes of users provides a useful beginning in understanding the dimensions influencing the use of information sources. Talja, S. (1995) discusses the theoretical foundations of information seeking research, theories of the nature of information and its users are metatheories which guide the information of concrete research programmes in IS research. The basic ontological and epistemological assumptions of these metatheories are analyzed in that project, and their implications for the development of research strategies are discussed. Trivison, D., ChamisA. Y., Saracevic, Tefko, Kantor, P. B. and Paul Kantor (1987:341-349) have studied made to validate a model of information seeking and retrieving and to observe the effects of a selected set of cognitive variables involved in on-line searching. Professional searchers
were observed searching prepared questions in their subjects on DIALOG. The degree of agreement in search strategies was low.

Vakkari, P and Kuokkanen, M (1997:497-519) have described a study whose aim was to analyse theory growth in information science by using a case from information seeking studies. Scientific growth is identified with the growth of theories. Differentiates three contexts of theoretical work: unit theories, theoretical research programmes and metatheories. States that for analysis of theory growth, tools based on the current theory of science are needed. Introduces tools for the analysis of theory growth and theory reconstruction and applies them to analysis of a theory on information seeking. Vakkari, P in an independently published article analysed some theoretically most advanced studies of information seeking will to reconstruct the theoretical structure of unit theories presented in the studies. The structure of a unit theory includes a set of concepts and assertions relating those concepts in an account of some information behavior phenomena. With the help of the reconstruction linkages between unit theories are analyzed in order to reveal possible theory relations. Theory relations might refer to the fact that theoretical research programmes exist, i.e. family of interrelated unit theories. Finally on the basis of interrelated unit theories, conclusions are drawn from the nature of growth of theories of information seeking.

Wilson, T.D (1981: 03-15) has reviewed work on information-seeking behavior and information needs in a number of disciplines, other than information science. The aim is to identify models and methods that may be transferable to information science. Wilson, T. D (1995) further explores the information-searching behavior with the framework of a model of information-seeking behavior based on the concept of uncertainty-reduction. A number of models will be tested, and the role of individual psychological factors will be investigated. A sample drawn from the staff of the University will be used, and qualitative data relating to their information behaviour will be gathered using semi-structured interviews, observation of searches, and transaction logs. Psychometric data will be measured using Riding's cognitive style analysis. Data analysis will seek to establish both statistical and qualitative evidence of relationships between different elements of
information-seeking. While the project is seen essentially as a contribution to the basic understanding of information behavior, a number of practical lessons should arise from it, both for the design of information retrieval systems and for the training of information intermediaries. Information provided by the British Library (RIC).

Yoon, K (1997) has studied for his doctoral thesis about the use of certainty in information seeking in an interpersonal context. Certainty is what users know or think they know in relation to their information need whereby they describe their need using what they already know. That is, users employ certainty in order to point to what they do not know and need to find out. The uncertainty has been widely accepted as the information need in many information retrieval and user studies. The certainty, however, has not been explicitly addressed. The purpose of the study is to explore the extent to which the user's communication for information seeking relies on certainty, and what characteristics are in relation to uncertainty.

2.5 User Studies in the context of Electronic Information

The relevant studies pertaining to the user studies in the context of electronic information are reviewed and are as under:

Barry, C. A. (1997:236-56) has reported the results of the Information Access project, funded by King's College London and the British Library, Research and Development Department, set up to examine the effects of information technology, the electronic library and the Internet on the information seeking behavior and research behavior of academics in higher education. The project studied a team of theoretical physicists over two years using a qualitative, context situation, and user-centered methodology. Electronic resources, primarily electronic bulletin boards and electronic mail, were used to access information in 80 per cent of the 48 research projects, usually in conjunction with traditional methods. Discusses the changes in information activity, changed boundaries and speeding up of the work of the research community; increased visibility for researchers; formalization of the
preprint process; replacement of formal with informal peer review; improved access to more current information; and the demise in the use of libraries. Drawbacks reported include: limitations of electronic mail communication; information overload; limitations of reliance on single information sources in terms of their focus; and the reduction in creative active information seeking. The main electronic information source for the high energy physicists, used in the study, was the High Energy Physics Theory (HEPHT) pre-print bulletin board: a service designed to provide rapid access to written research information available before it is published in periodical form.

Burke, M (1990:169-189) examines the extent to which microcomputer availability has affected the level and nature of use of traditional information sources. Discusses the results of 2 field surveys, which were carried out in order to examine the current and potential use of microcomputers for information handling activities. The survey populations include electronic bulletin board users in the USA and university staff in Eire. There appears to be extensive use of microcomputers for online-library oriented information retrieval activities, but less use for traditional bibliographic applications. The library can continue to have a positive role in an electronic environment, if it accepts the responsibility of catering for two types of users, the information technology rich and the information technology poor.

Chapman, J. L (1981:325-33) has focused on statistical analyses of on-line searching patterns compared the usage of a query language by various groups of searchers. Data were gathered by an experimental project, Individualized Instruction for Data Access (IIDA), concerned with developing and testing a system which serves as a teacher and assistant to users of Lockheed's DIALOG system. Sequential listings of user commands were classified by corresponding state codes to represent phases of searching. Zero- through 4th-order Markovian analyses of individual commands and strings of like commands were performed to compare searching procedures used by 3 classes of users. Estabrook, L (1983:68-75) has studied the social and psychological effects on users of the introduction of on-line catalogues in libraries. Within this framework, the argument is put forward that users' access
to information is inextricably bound up with the social context within which it is made available.

Hallmark, J. (1995:51-56) has examined the process of scientific communication in all disciplines with an emphasis on the Internet. A review of the wide variety of information resources offered on the Internet for one particular discipline, chemistry, is followed by descriptions of general applications, including collaborators, electronic publications, online conferences, document delivery, and data and image access and retrieval. Specific Internet resources include: listservs, newsgroups, preprints, periodical articles and abstracts, text databases, numeric and other data, newsletters, conferences, indexes and Tables of contents, and reference and document delivery. Suggests some problems and issues which have arisen in connection with scientists' use of technology and proposes factors which may encourage (or discourage) the use of new technological options. These include differences among disciplines; specific individuals in the organization who lead the way. the commitment of the organization to new technology, cost and ease of use, geographical location, and corporate policy.

He, P. W. and Jacobson, T. E (1996: 31-51) have reported the results of a survey, conducted by the State University of New York at Albany Library, to investigate the effects of gender, college status and prior Internet experience on the use of Internet resources. The subjects were 96 randomly selected users using the Library's Internet terminals during the first two months of 1995. Respondents felt strongly that the Internet is useful, and has been an important resource for their research and assignments. Users have high expectations of searching capabilities, while they feel neutral or disappointed with browsing. Results indicate that libraries should provide access to the Internet and suggest that libraries should take the lead in developing searchable indexes and making databases better organized for the ease and effectiveness of browsing. Hendry, D. G. and Harper, D. J (1997:1036-48) have studied the effective information seeking in an electronic library, offering a large multi use information space of materials and services, requires searchers to coordinate their reading, information seeking, and writing activities. Most interactive displays, however, do
not help people monitor their problem solving. Describes a display, called SketchTrieve, which stresses the 'ease of expression' above all other design options and gives prominence to information seeking material, rather than 'retrieval controls'. Jandt, F. E. and Nemnich, M. B (1997:108) have studied the use of Internet and the World Wide Web in job search and career information.

Klobas, J. E (1991:379-91) has compared librarians' strategies for finding out about developments in information technology with those of computer professionals. Compares the importance placed by each group of professionals on different sources of information about information technology, and the extent to which each group is satisfied with their information-seeking strategies for securities analysts, institutional and retail investors, schools of library and information science, and practising information professionals. Kuntz, L (1968) has investigated the role of online/electronic resources in the information-seeking behavior of university students doing a research assignment. This work is based on interviews that were conducted at UC Berkeley during the 1996-97 academic year. Marchionini, G (1992:156-73) has discussed and illustrated the essential features of user-system interfaces designed to support end user searching. Presents examples of interfaces to support the following basic information-seeking functions are presented: problem definition, source selection, problem articulation, examination of results, and information extraction. Argues that present interfaces focus on problem articulation and examination of result functions, and research and development are needed to support the problem definition and information extraction functions.

Marchionini, G. and Dwiggins, Sandra (1990:129-42) have studied as part of ongoing investigation of information seeking behavior of end users in electronic environments, a comparison was made of those users having expertise in a topic area and those with expertise in on-line searching. Computer scientists and on-line search specialists conducted assigned searches in a HyperCard data base on the topic of hypertext. Both groups of experts were able to conduct successful searches and outperformed a novice control group. Search specialists took slightly less time than the domain experts, modified queries by
adding terms found in the text, and tended to focus on query formulation. Domain experts focused on the text and used their domain knowledge for further question answering. Marchionini, G., Lin, X., Katz, A. and S. Dwiggins! 993:35-69) have undertaken a study to identify and examine the roles that information-seeking expertise and domain expertise play in information seeking in full text, end user search systems. This forms part of an investigation to characterise information seeking and to determine how it is affected by interactive electronic access to primary information. Distinguishes between the approaches of search experts and domain experts. Make recommendations for systems design.

Milligan, G. A (1986:34-37) has conducted a survey at the Institute for Medical Literature (IML) created by the South African Medical Research Council in 1976 for the purpose of providing research workers in biomedicine with access to computerised information services using the MEDLINE data base of the National Library of Medicine in the USA. The information-seeking behavior, work activity, and age of users and non-users of this computerised bibliographic retrieval service were investigated by means of a questionnaire administered to a sample of user and non-user groups. Results indicate that workers in the biomedical field who use computerised search services such as those offered by IML are more likely to be involved in research rather than patient care. This finding was also evident when the work activity was investigated. Age variations are recorded. Further, Morehead, D. R. and Rouse, William B (1982:205-06) have investigated the user-system interface with a totally computer-based information system. Focuses on the effects of the computer on the user's information seeking behavior and, more specifically, how the characteristics of the database and the nature of the search question affect the users search strategy. Considers also the effects of on-line aids whereby the computer can help the user to utilise the structure of the database more effectively. The experiment employed DBASE (Data Base Access and Search Environment) designed for the project.

Rouse, W. B. Rouse, Sandra H. and Morehead, David R (1982:141-49) have indicated that the strategies, heuristics and tradeoffs involved in on-line searching of bibliographic citation networks. Results from the field of citation analysis are used to describe the mathematical...
structure of citation networks. An experimental environment called DBASE (Data Base Access and Search Environment) is discussed and its use in two studies of human information seeking behavior have been considered. Variables examined in these studies included the nature of the search question and the interconnectivity of the database. Schwartz, D. G (1995:360-62) examined how physicians and biomedical scientists in India learn information-seeking skills have indicated that these were learnt through their mentors. None reported having received instructions from a librarian. Training is needed to enable librarians to use computerized information technology. CD-ROM technology has the potential for enabling important breakthroughs. Wang, H. and Liebscher, Peter (1988) have focused on the effects of a system's interface on fact retrieval in a hypertext environment. Results from two experiments are presented. One looked at the effect on user performance of searching electronic versus paper versions of a full text database. The other examined the effect of two distinct search strategies, index use and browsing, in the electronic version of the same database.

2.6 Research Gaps and Rationale for the Present Study

User studies are necessary not only for planning and designing information system but also for their efficient and effective operation. There are likely to be many surprises to even an experienced librarian about his own clientele as he would not have heard them all in a systematically planned set up in his day to day work. The obvious drawback in relying on experience is a bias towards outspoken and intensive users, which is, at times, either too pleasant or too bitter. User studies helps to improve the relation of he library with users in an objective way provided it is done with the organisation concerned. Accurate and objective knowledge about users and their information behaviour are the essential ingredients for designing an information system. The effectiveness of library and information system depends on the extent to which the system characteristics correspond with the user and on how much the potential user is willing and able to make use of it. In fact research in library and information science is more meaningful if the findings increase the efficiency and effectiveness of information flow to suit the interest of the users.
A lot of works have been done in the western countries, especially UK and USA but very little work has been done on the information needs of library users in India particularly in the field of engineering science. Further, no comprehensive study has so far been pursued. The present study is the first successful attempt in that direction. Most of the studies conducted earlier have adopted individuals as the unit of analysis taking the similarities and differences among the users in terms of their backgrounds like status, age, experience, education, discipline and specialisation into account. However very few studies have been conducted taking an organisation as the unit of analysis treating organisation as the composite entity with sample individual respondents as the typical representative.

Typical Indian user studies represent an over emphasis on bibliometric studies in general and citation studies in particular. But the utility of such studies in understanding the user dynamics is limited. No single comprehensive user study has been reported in the country relating to scientific and technological institutions in general and scientific and industrial research institutions in particular. Hence this study is focused on the information needs and seeking behaviour of the engineering scientists with specific reference to engineering research group of laboratories of CSIR and the issue pertaining to the networking of these laboratories. The study also suggests a model for need based information system among these laboratories.