Chapter 1 Introduction

1.1 Organization of the Thesis

This research focuses on the empirical study of the challenges in management science research practices. Then it accumulates the opinions of the research scholars to explore the challenges faced during their research. Further the study analyses the views of the research scholars which then provides the ideas that can be the solutions for their research related problems. Through the analysis of the data, researcher investigates that whether there is a need of a KM for research community. Since the data analysis concluded that there is a significant need of the KM for research community, researcher further studied the various aspects of the Knowledge Management (KM) for research including existing KM - Models, Process, Systems, tools, etc. This study then focuses on proposing a conceptual KM Model and KM System for the research community. The organization of this thesis is as follows. Chapter 1 introduces and describes the journey to this research. How research problems have got investigated and then which research problems were most significant for this research were discussed in the section 1.2 that is Background of research study. The section 1.3 provides information about the significance of the research topic. The next section, 1.4, provides the concept of the Academic Research Community. Then section 1.5 gives information about the research knowledge and its resources. Furthermore, section 1.6 gives overview of the KM aspects for developing the research community. Section 1.7 is to elaborate the basic concept of the Research Knowledge Exchange Network for research community. In the last section 1.8, National Knowledge Network (NKN), give an introduction to the National Information Center’s NKN programme. How NKN is having relation with this research topic has been elaborated in the Chapter 5.

The Chapter 2 is focusing on the literature which provides basic idea and background of the research problem, supported by previous research literature. The chapter focuses on the detailed Literature Review for this research; this is elaborated in separate four sections. The first section is dedicated for the literature review of the Academic Research. Second section reviews the literatures related to the Knowledge Management and its usage in various Universities and R&D organisations. Third
section gives literature background of the Empirical research, to answer the questions - what is empirical research and how this research can be an empirical study? Finally the chapter ends with the last section, Essence of the Literature Review, which explains about the outcome of literature reviewed and the significance of the research problem.

Chapter 3 expressed the Research Methodology adopted for this research. This chapter starts with introduction and description of the research problem. Then it explains specifically objectives and hypotheses of this research. Further it gives exposure to the questions related to research methodology, like, what research methodologies are available, why the particular methodology has been selected, and how it is executed during the research. It also explains the research design, sample design strategies and constraints for selecting the specified strategies for the same. Further it explains the data analysis strategy and what & why of statistical tests used for the data analysis and hypotheses testing. Furthermore it gives over all idea about this research regarding year wise research plan and research model followed for this research. Finally it explains the ethical consideration, and scope and limitations of this research. This also provides the overlook on the research publications of the researcher during this study.

Chapter 4, Data Analysis and Interpretations, is the most important chapter of this thesis, which describes the data collection method followed for the research as well as administration of the web survey and manual survey. Data Coding and screening of data has been explained for this research. The highlight of this chapter is descriptive statistics, which analyses the data using IBM SPSS Version 21 and gives interpretations for the all-important parameters collected for this research through survey. This provides detailed idea about more than 50 questions or data variables of this research. This explains the specific challenges faced by research community, challenges faced at different stages of research, information resources and its usage, library resources, research publications of the research scholars, and verification of research topic. Finally it explains opinions of the research scholars about the features of the online system as a solution for the challenges faced by them. The chapter explains most important part of this thesis, that is, Hypotheses Testing. The major three hypotheses with total 12 sub hypotheses testing have been explained here
The Chapter 5 further discusses the major role of KM in academic research, which depends solely upon data analysis and interpretations. This chapter is dedicated to provide a conceptual solution for the research community challenges. This further explains the proposed conceptual KM Model for the research community in university or research institute. This KM Model is based on the idea of Higher Order Thinking Skills (HOTS), hence it can be more efficient for the research community. Then the chapter explains the KM process that should be implemented for the KM Model. The study is carried out further to provide the conceptual architecture for the KM System. This includes the layered structure of the KM System in detail. The chapter also provides the integration model for developing research community at national level. This chapter also proposed the use of NKN as a back bone for developing the national level research community.

In Chapter 6, researcher has extensively explained the Conclusions and Recommendations of this research. The Researcher has elucidated the research conclusions relating it more specifically with each and every research objectives and hypotheses of the research. The researcher want to highlight the suggestions and recommendations for University, UGC and Ministry of HRD, Government of India based on this research, for the development of the research community at university and national level, in order to solve the problems of the research scholars, and promote good quality and high impact research. Finally research ends with the recommendations and future scope.

### 1.2 Background of the Research Study

The Researchers has completed his M. Phil. – IT degree. He has acquired good learning experience of research during his M. Phil. dissertation. During dissertation he experienced struggle in every stage of his Research. He was fatigued from his very first stage, which is, searching new research topic, to last point of research presentation. Researcher visited different Libraries for reading different thesis and getting proper idea of research topic. He discussed with his friends, research guide and research scholars regarding his issues. But there was not proper source for getting accurate and exact knowledge. He also tried to search on Internet but, Internet was also not sufficient at that time to learn about the research. Finally, research guide
channeled him to select the research topic, from his area of interest. It was an eye opening experience for the researchers himself. He thought that if he was struggling in every stage of research, then other researchers might face same problem in their research work. This thought made him curious to get an idea that whether other researchers are facing same problems in research and if yes, then how they are collecting the research related information. While attending different conferences, workshops and seminars, the researcher was trying to discuss with other research scholars about their issues related to research. In these discussions, he was trying to collect opinions about the challenges, issues and problems related to their research. Then he found that there is a scope of research in this academic research area.

Researcher has observed that, there is a lack of information regarding research topics of any particular research field from various universities. And this is one of the major issues for new researchers. The research scholars are unaware about the availability of the research repositories (Yunhong, X. U., Lin, J., Hao, J., Chang, Z., Ma, J., & Zhao, D. , 2010). Even if few researchers knew about the research information utilities they were not confirmed about any single unit. Researchers have to explore for information on search engine several times for the required data, resulting to wastage of time, energy and money. This means, there is no single utility available nationally which can provide proper information about the new research topic, like number of researchers working on the topic, status of the topic, amount of work done on the topic and so on. Putting all these points in mind, the researcher has worked out scope of the study and planned to do research on this topic (Carol Tenopir, Robert J. Sandusky, Suzie Allard and Ben Birch, 2014).

Academic programs like Ph.D., M. Phil. and Master Degrees provided by various universities, are research oriented programs for motivating students for research. The research scholars are doing work on their research as an academic requirement of their degree course. Now days, lot of students are attracted towards research, and competition for these courses has increased. This leads to increase in the number of research scholars in the research community (Chatterjea, A., & Moulik, S. P. , 2006). The academic research is a continuous process, which is going on for a long time. The research work creates a lot of research knowledge and information and is physically added to libraries. These resources should be easily available to new Researchers (Carol Tenopir & et. all, 2014).
In this Information Age, the Research information should be open to all for further use in research. Research means itself generating new knowledge. This knowledge is just kept in the form of thesis, dissertations, research papers, articles, etc. in libraries as a hard copy format. The researchers cannot search this huge amount of data because it is not centrally available and not easily accessible. Since the libraries belong to various universities and institutes located at different geographical locations, research scholars cannot reach to these resources effectively. Hence may be research scholars are ‘reinventing the wheel’ again and again (Rajasekhar, T. B., 2003, June). Researchers may not know that the topic selected by them has been already used by any researcher from other University. There is lack of appropriate tools for sharing of information and knowledge in academic research, which is the major problem faced by research scholars (Panda, A., & Gupta, R. K., 2014).

The researcher has seen an article in ‘Times on India’, published on March 11, 2011 regarding Research output of different countries, entitled ‘The Study of India’s Research output and Collaboration’, by Thomson Reuters. As we all know that India stand at 2nd position as World’s Largest Population Country. But contradictorily, our contribution in worlds research output is just 3.5% which is very less as compare to proportion of population and research output given by another country like Japan, Taiwan, UK, US and so on. This article motivated Researcher to think about the Indian Research Status and search for the different ways to improve the Research Quality and Quantity (Jonathan, A. J., King, C., & Singh, V., 2009). This was discussed with Research Scholars and seniors. Also Researcher has searched different online websites, research papers on Research quality and quantity improvement. After enormous discussions and going through various literatures, Researcher got an idea about the current situation of Indian Research and different research data management tools used in different Universities and Autonomous Institutions (Rajasekhar, T. B., 2003, June).

In the current era of Information & Communication Technology, research scholars have different tools like research repositories, research publication databases, open source solutions and free ware desktops software’s like Research Gate, Mendeley, Shodh-Ganga, IEEE Explore, Scopus, Google Scholar and many more, but these are not sufficient tools to meet the need of the research community. To design the proper tools there was need of studying the problems, challenges, issues and
requirements of research community (Prayuth, C., Kanokorn, S., & Pornpimon, C., 2014). Also the major shortcomings of the free ware/web solutions available were studied. As the implications of this study, researcher has tried to find about the required features or facilities for the research community (Shetty, P. K., Hiremath, M. B., Murugan, M., & Sreeja, K. G., 2010).

The rapid development in information technology and science has changed the paradigm of the university; nowadays universities are working on online systems. Universities have adopted online solutions for different processes like admission process, convocation process, exam applications, online exams, etc. The research projects and research work running in the university are the most important assets of the university (Sam Pitroda, 2010). The researchers contributing in their research work are the important knowledge resources. Researchers are holding subject expertise and set of knowledge in the respective subjects, because they have conducted various research projects and have good research work experience. The new researchers are getting added in the list by obtaining different degrees like M.Phil., Ph.D., Research Fellows, and Research Project Assistants. These all researchers, research supervisors and related all individuals forms a Research Community (RC) in the university. They need help and expert guidance in different tasks of research process (Altbach, P. G., 2013). They initially rely on resources available in university like library, Internet & expert consultation. But the expertise knowledge with individuals is not sharable, due to geographical distances. So the knowledge associated with the individuals should be managed properly in the university (Kidwell, J. J., Vander Linde, K., & Johnson, S. L., 2000). Problem is that, in the university, the knowledge of individuals is not documented and well organized, and even the university itself does not realize that the individuals have knowledge that can enhance competitive advantage among the researchers (Shetty, P. K. and et. all, 2010).

In India, University Grant Commission (UGC) has implemented a Research Repository, “Shodhganga”. After going through this repository, it has been observed that, there is no compulsion for any University to register or publish Research work on this Research Repository. Total 137+ Universities from all over India signed MOU with Shodhganga to publish research work under this Research Repository. But as compared to the number of universities in India, the number of universities those have
signed MOU with Shodhganga is quite less. The universities associated with Shodhganga, are not having any compulsion for researchers to publish their research work on this research repository. Due to this, it has been seen that, only about 10% Universities out of 137 have published their Research work in and around 100, while rest 90% Universities have less than 100 Research Publications in Shodhganga. It means that limited researchers are aware about the research repository and very few of them are using it. Hence through these facts, it can be observed that there is scope of study, to find researcher’s views, about The Research Repository. The Knowledge Management System (KM System) for University may be useful and beneficial for researchers, in different aspects such as, to store Research Publications centrally for easy access, to avoid duplication of Research work; to improve quality of Research, to increase no of Research Projects (Peer, L., & Green, A., 2012).

This Research focuses on the different aspects of Knowledge Management in Academic Research and proposes for building a Research Knowledge Exchange Network (RKEN). The Information and Communication Technology (ICT) can play important role in this. Due to the RKEN, researchers can get closer to each other irrespective of different geographical locations. They would get idea about their research expertise and individual knowledge set (Chugh, R., Wibowo, S., & Grandhi, S., 2015). They can share knowledge and information and can communicate with each other. They can share their views and experiences through RKEN. The proposed KM System can be an interface for the Research Community, to make these things happen. The researcher has proposed KM System architecture especially for research community in university.

The researcher proposed a conceptual Knowledge Management Model specifically for research community for the knowledge representation, acquisition, dissemination in the RKEN. This Knowledge Management Model is based on the Higher Order Thinking Skills (HOTS) concept especially for the research scholars. This means the important concept of HOTS must be followed by every researcher.

This research is focused on the challenges (Baptista, A. V., 2011) faced by management science research practices, and analysis of the solutions discussed by research scholars and the need of the Knowledge Management in the Research Community. Then finally it proposes the Knowledge Management Model based on
HOTS concept, specifically for Research Community. This research also proposes the conceptual architecture of the KM System for developing the Research Community Network.

1.3 Significance of the Problem


The academic research plays very important role in progress of country. The Article published in Times of India, based on Thomson Reuters’ International Survey (Jonathan, A. J., & et. all. 2009), regarding, Research Contribution of different countries in the world, has been already mentioned in the previous section. The findings of the study on ‘India’s research output and collaboration’, has clearly mentioned that the country has just 3.5% of global research output in 2010. The report was recently submitted to the Department of Science and Technology and it was abysmally showing India’s low research output. In this report they have mentioned about the Research percentage of India, discipline wise, in global research contribution. In this report it has been declared that only 2.4% of global research on computer sciences was from India in 2010 while the world’s share moved to three emerging research economies - China 15%, Korea 6.3% and Taiwan 5.7%. India's global share of research in economics stood at 0.7% in 2010 while in social sciences it was worse, 0.6%. Indian higher education is facing powerful dilemmas and difficult choices - public/private, access/equity, uncertain regulation, different teaching standards and contested research quality as per the report. But in this report it was also mentioned that, India has a long and distinguished history as a country of knowledge, learning and innovation. In the recent past, however, it has failed to realize its undoubted potential as a home for world class research (Baptista, A. V., 2011).

Here the report concluded that India needs to Motivate higher educated students towards research and focus to speed up the research activities, for progress and all versed development of the nation. Doing research work is not sufficient but high quality research work should be done. The contribution of the Indian research should be increased and hence it should Motivate the students for the research. Needs
to think about, the problems, challenges & issues faced by researchers, the different source of information and knowledge, the facilities they have and their actual needs. This is the requirement of the current age in the knowledge base economy (Marginson, S., 2010). These all challenges and problems of research should be studied in Knowledge Management aspects, in order to know the solutions, tools, techniques and systems, to help research community (Paghaleh, M. J., 2011).

The research has main objective to analysis the challenges and problems faced by the management research scholars and what are the possible solutions for the same. In the KM perspectives, it is important to understand how it can get the proper solution. The KM’s solutions can be like what can be proposed, how it can help to improve the research quality and quantity, etc.

In India, it is a need of increase in good quality research and high impact research publications to represent India globally (Bhanoji Rao, Nov. 2011). Hence this research focuses on the study of challenges, problems & issues faced by management science research scholars. The study further relates its significance with the need of the Knowledge Management principles in academic research. Hence researcher has finalised the research topic entitled with, “An empirical study of challenges in Management Science research practices with special significance to the need of Knowledge Management”.

1.4 Academic Research Community

A societal, religious, professional, or other groups sharing mutual characteristics or interests perceived or perceiving itself as distinct in some respect from the larger society within which it exists is called as community. For example, the business community, the community of scholars. A community is an open unit of any size that shares collective values. Although embodied or face-to-face communities are usually small, they can be larger or more extended, like national community, international community and virtual community (Dagnino, G. B., & Longo, M. C., 2012). According to the concept of community, the university and its related institutions, colleges and students, teachers and other staff, these are named as academic community. In academic community, the special and important community
in higher education, at university level, is Research Community (Peer, L., & Green, A., 2012). The Research Community is a community of research scholars, research facilitators and research staff, as shown in the Figure 1.1. Research Community at university level, includes the different research institutions, research centers, university departments which are the supervisory bodies of the research. As shown in Figure 1.1, Research Community members can have two different types of members i.e. direct members and indirect members. Direct member are those directly working on research under research organization as an individual like Research Students, Research Fellows, Research Assistants, Research Guides / Supervisors. Indirect member are those who are not directly working on research but they are working as employee in the university departments, institutions and libraries. Also the other indirect members are the research experts and research scholars from other universities.

A Research Community shares a common interest and common goal of research. The university research is an important knowledge asset of the nation. The government is always motivating the scholars for the research activities through offering different student scholarships and research project grants. The Research Community can be a special kind of community which always needs interaction, communication, and sharing of knowledge from various streams and disciplines in order to generate innovative research (Chugh, R., Wibowo, S., & Grandhi, S., 2015). The community members regularly tries to contact and interact with each other for knowledge and information sharing through different conferences, seminars, workshops, development programs, etc.

The Research Community is the most important community and its individual member is a knowledge set for the university. But now there is need of formation of such a kind of community in the universities by using ICT and providing technology, tools, and various platforms for the development of Research Community, to make healthy research environment. It would be helpful to inculcate the importance of research knowledge in students, to improve the quality research and provide a global exposure to the research scholars and to advance the image of country in global research.
1.5 Research Knowledge Resources

Research Knowledge means the information collected, created, generated through analysis and stored in minds of researchers in the form of research experiences, stories, conclusions and suggestions. Research Knowledge is conclusive information that forms the basis for thoughts, actions, and beliefs. It includes the theories and experiments of scientists, who collaborate to establish our knowledge of the external world. Research knowledge is a scientific knowledge which is generated by proper scientific Research methods. Research Knowledge is having its own value in the research field and interdisciplinary research too (Levin, B., 2013).

The knowledge which can be represented by the means of text, images, charts, process flows etc. is known as an explicit knowledge. Hence this knowledge can be managed in the different forms of data like text, images, charts, etc. The tacit knowledge is very different from this, it cannot be easily represented. Tacit
knowledge can be shared using few formats, like videos, audios, images and storytelling about the exact research experiences (Chugh, R., Wibowo, S., & Grandhi, S., 2015). This way data can be managed in data server, which can be made available to the research scholars, to share the knowledge (Chugh, R., Wibowo, S., & Grandhi, S., 2015). This would help the research scholars to improve their research experiences and plan more innovatively.

The research knowledge resources must be identified for creation of research knowledge. As shown in the figure 1.2, it can be seen that the basic research knowledge resources include research projects by the research scholars, different conferences, workshops, seminars, research journals, research magazines, thesis, dissertations and books. These resources provide a different kind of research oriented outputs like research project reports, conference proceedings, research papers, research articles and research review reports. These research documents contain research knowledge which includes explicit knowledge and tacit knowledge, and can be processed to convert and store in to knowledge base (Chugh, R., Wibowo, S., & Grandhi, S., 2015).

1.2 Research Knowledge Resources
1.6 The Knowledge Management aspects for the Research Community

1.6.1 Knowledge Management

Knowledge Management has the most important capacity in each and every field. Information is useful when it is applied in particular event and its nothing but knowledge. Here some definitions of Knowledge Management are given below:

“Knowledge management is not about data, but about getting the right information to the right people at the right time for them to impact the bottom line”, IBM.

“Knowledge management is a process that emphasizes generating, capturing and sharing information know how and integrating these into business practices and decision making for greater organizational benefit”, Maggie Haines, NHS Acting Director of KM.

Hence through this definition of the Knowledge Management from well-known authors and organizations, it gives an idea about Knowledge Management – The data and information collected is applied or used in particular event as per the environment, situation, organization and its purpose, is nothing but simply knowledge and it should be created, shared, learnt, enhanced, organized and utilized for the benefits of organization (Bouthillier, F., & Shearer, K., 2002).

There are many definitions of Knowledge Management; here we have combined the Knowledge Management and Organization Management literature to define Knowledge Management as the process of selectively applying knowledge from previous experiences of decision-making to current and future decision making activities with the sole purpose of improving the organization’s effectiveness. This definition allows us to define the goals of Knowledge Management as:

1. Identify Critical Knowledge
2. Acquire Critical Knowledge in a Knowledge Base
3. Share the stored Knowledge
4. Apply the Knowledge to appropriate situations
5. Determine the effectiveness of using the applied knowledge
6. Adjust Knowledge usage to improve effectiveness.
1.6.2 Why do we need knowledge management for Research Community?

The idea that an organization’s most valuable resource is the knowledge of its people and basically Knowledge management is based on this idea. This idea is not new – organizations have been managing “human resources” for years. What is new, it is the focus on knowledge. This focus is being driven by the accelerated rate of change in today’s organizations and in society as a whole. Knowledge management recognizes that today nearly all jobs involve “knowledge work” and so all staff means “knowledge workers” to some degree, or another meaning is that their job depends more on their knowledge than their manual skills (Bouthillier, F., & et. all., 2002).

In the same manner here, in this study, research knowledge community is most important part of the organisation that is University. Research output and Research scholars are main knowledge resources in the university. The individual's set of research knowledge in the university is major and important asset of the university. This knowledge set of researchers should be managed, means that in real sense the Research Knowledge Management of the university should be formed (Scholl, W., König, C., Meyer, B., & Heisig, P., 2004). The Research Knowledge Management means that creating, sharing and using the research knowledge. These activities are the most important activities and every person in an institution under the constituent of university should know about these (Ondari-Okemwa, E., 2006). Do we know everything we need to know or there are gaps in our knowledge? Of course there are gaps in research knowledge. The current modernization programs require us to let go of what we know and to learn and apply new knowledge in research (Firestone, J. M., & McElroy, M. W., 2003). In this concern the following questions should be asked to RC's individual members

1. Do we share what we know?
2. Is the knowledge of individual researchers available to the university?
3. Is the research knowledge of organizations available to all?
4. How many times have we lost valuable knowledge and expertise when a staff member moves on?
5. How many times have we “reinvented the wheel” when we could have learned from someone else’s experience?
6. Do we use what we know to the optimum?
7. Is our knowledge not always been applied to best effect due to lack of
time or resources?
8. How many times have we implemented a new initiative, only to find we
reverted back to the “old way” a few months later?

The answers for these questions would be the basic reasons for forming RKEN
(Toral, S. L., Bessis, N., Martinez-Torres, M. R., Franc, F., Barrero, F., & Xhafa, F.,
2011, November), using KM System as a medium of communication for RC
(Tijerino, Y., Masaki, H., & Igaki, N., 2006, December). In terms of how that can be
done, the processes of knowledge management are many and varied. As knowledge
management is a relatively new concept, organizations are still finding their way and
so there is still no single agreed way or any best practice (Joseph, B. K., 2009). This is
still a time of trial and error. Similarly, to simply copy the practices of another
organization would probably not work because each organization faces a different set
of knowledge management problems and challenges. Knowledge management is
essentially about people – how they create, share and use knowledge, and so no
knowledge management tool will work if it is not applied in a manner that is sensitive
to the ways people think and behave (Joseph, B. K., 2009).

Knowledge Management and few definitions: “The creation and subsequent
management of an environment, which encourages knowledge to be created, shared,
learned, enhanced, organized and utilized for the benefit of the organization and its
customers” (Abell and Oxbrow, 2001). “The capabilities by which communities
within an organization capture the knowledge that is critical to them, constantly
improve it, and make it available in the most effective manner to those people who
need it, so that they can exploit it creatively to add value as a normal part of their
work” (BSI’s A Guide to Good Practice in KM).
1.7 Research Knowledge Exchange Network for Research Community

During this study, after discussion with researchers, views come out, RC would be an effective community. RC formation, organization, implementation is important task for the universities. The main purpose of RC formation is to provide common platform and tools to the research scholars for the exchange of Set of Research Knowledge (SRK). SRK is related to different research tools and techniques, Statistical Analysis tools, various research disciplines, research methodologies, research streams, etc. The shortcomings of SRK in RC would be fulfilled within itself as community. Researchers will get idea about the SRK of individual research scholars and related problems would be solved easily. RC would arrange different activities for the sharing of knowledge and ideas related to their research, which will help them for further development (Owoc, M., & Marciniak, K., 2013, September). Hence for communication, sharing, exchange of ideas, learning new tools, university research environment, would require the proper network. The network, in the sense of Person to Person P2P, Person to Application P2A, Application to Application A2A interaction for the closeness of RC. This network, basically exchanging Research Knowledge among RC, is nothing but Research Knowledge Exchange Network (RKEN) (Yunhong, X. U., Lin, J., Hao, J., Chang, Z., Ma, J., & Zhao, D., 2010).

The RKEN is amalgam of each individual research scholar, Colleges, Institutes, Research Centres, set of infrastructure, hardware, networks, Knowledge Management System (KM System) for Research (Dagnino, G. B., & Longo, M. C., 2012), and various required tools and techniques. Higher hierarchy level, UGC (University Grant Commission), University and Other Universities, will be treated as a controlling body for the Research Activities. These bodies will control the protocols, activities & procedure of the RKEN (Yunhong, X. U., Lin, J., Hao, J., Chang, Z., Ma, J., & Zhao, D., 2010). The next level is University Departments, Research Institutes / Colleges / Centres; these will be working as facilitators for individual research scholars (Marjan Laal, 2010). Individual Members of RC will be the end users of this RKEN, who will get benefited by this network. The detailed Knowledge Management Model and KM System for RC are described in chapter 5.
Developing merely university or institute level RKEN would not be a solution for the research scholars. The RKEN should be expanded at national level to build the national Research Community using the KM System. (Armbrecht, F. M., Chapas, R. B., Chappelow, C. C., Farris, G. F., Friga, P. N., Hartz, C. A., ... & Whitwell, G. E., 2001) So, research scholar can avail the research expertise and knowledge at national level on a unique authorised online system platform. The researcher was also curious to know how to integrate this KM System at national level. He got an idea about the Indian government’s ambitious programme – National Knowledge Network (NKN). This network can be used for integration of the individual RC at institute level to form national level RC. He contacted with National Informatics Centre (NIC), Pune and NKN team to get the idea about the purpose, functionality, applications and benefits.

Figure 1.3: Research Knowledge Exchange Network
of the NKN Programme. The NKN team was very co-operative and informative about the NKN Programme. Researcher also tried to collect information regarding any project that has been launched for the Research data management of university research at national level. But the NKN team informed us that there is no such kind of project currently in development stage or in future plans. The information about the NKN programme collected by NKN team and from NKN authorised website is elaborated in next point. By the information it was understood by the researcher that the integrated KM System can be launched through this NKN programme easily for national level integration of the KM System for research community (Ermine, J. L., 2010). The integration model has been explained in chapter 5.

1.8 National Knowledge Network (NKN)

1.8.1 Introduction to NKN

The NKN is the Government of India’s prestigious programme and it’s developed and implemented by National Informatics Centre (NIC) (Information collected from official website of NKN- www.nkn.in, 2015). The NKN is a high-tech multi-gigabit pan-India network for providing an integrated high speed network mainstay 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.

Globally, research and development activities and innovations are increasingly multidisciplinary, collaborative, and require substantial computational power. The key to successful research today demands live consultations, data sharing and resource sharing. Therefore in order to optimally utilise the potential of institutions engaged in generation and dissemination of knowledge in various areas, it is important to connect them through a high speed broadband network. The idea of setting up a National Knowledge Network first emerged through deliberations between the office of Principal Scientific Advisor to the Government of India and the National Knowledge Commission. This was followed by extensive discussions with key stakeholders
including experts, potential users, telecom service providers, educational and research institutions, which resulted in the design of the National Knowledge Network.

The NKN comprises of an ultra-high speed CORE (multiples of 10 Gbps), complimented with a distribution layer at appropriate speeds. Participating institutions at the Edge will connect to the National Knowledge Network seamlessly at speeds of 1 Gbps or higher. The network is designed to support Overlay Networks, Dedicated Networks, and Virtual Networks. Advanced applications in areas such as Health, Education, Science & Technology, Grid Computing, Bio informatics, Agriculture, and Governance will be an integral part of NKN. The entire network will seamlessly integrate with the global scientific community at multiple gigabits per second speed.

The purpose of such a knowledge network goes to the very core of the country's quest to build quality institutions with requisite research facilities and create a pool of highly trained persons. The NKN while impacting the existing academic and student community will also alter the R and D landscape for future generations as shown in Figure 1.3. NKN is designed as a Smart Ultra High Bandwidth network that seamlessly interconnects the leading Scientific and Technological institutions which are pursuing world-class research and development. NKN design is inherently proactive; it takes into account the requirements that may occur in the near term and long term. Some of the salient features of the NKN are:

- Establishing Connectivity for Knowledge and information sharing.
- Enabling Collaborative Research in emerging areas such as Climate Modelling.
- Facilitating distance education in specialized fields such as medicine, emerging high tech areas covering info-bio-nano technology.
- Facilitating an ultra-high speed e-governance backbone for information sharing.

NKN will also act as a test bed for research in the area of network, security and delivery models for various services. As NKN is a new initiative, it will leverage existing initiatives, to ensure faster roll out with modest investment.
1.8.2 Applications

Country wide Virtual Classroom: The NKN is a platform for delivering effective distance education where teachers and students can interact in real time. This is especially significant in a country like India where access to education is limited by factors such as geography, lack of infrastructure facilities etc. The network enables co-sharing of information such as classroom lectures, presentations and handouts among different institutions. A portal (http://virtualclassroom.nic.in) for Virtual Classroom services has been created and is running successfully. This website is extensively used by IITs/NITs and other institutions for Virtual Classroom teaching activities over NKN.

Collaborative Research: The NKN enables collaboration among researchers from different educational networks like GLORIAD, TEIN3, GARUDA, CERN etc. NKN also enables sharing of scientific databases and remote access to advanced research facilities.

Grid Computing: The NKN has the capability to handle high bandwidth with low latency with a provision overlay grid computing. Some of the grid based applications are climate change/global warming, science projects like Large Hadron Collider (LHC) and ITER. The NKN can be the platform to realize many such innovative applications. The Garuda Grid has enhanced its power and stability by
migrating to NKN.

**Virtual Library:** The Virtual Library will enable sharing of journals, books and research papers across different institutions.

**Sharing Computing Resources:**

High-performance computing is critical for national security, industrial productivity, and advances in science and engineering. The network enables a large number of institutions to access high-performance computing to conduct advanced research in areas such as weather monitoring, earthquake engineering and other computationally intensive fields.

**Network Technology Test-bed:** NKN provides a test-bed for testing and validation of services before they are made available to the production network. NKN also provides an opportunity to test new hardware & software, vendor interoperability etc.

**E-Governance:** The NKN will provide high speed backbone connectivity for e-governance infrastructure such as data centers at the national and state levels, and networks (SWANs). The NKN will also provide massive data transfer capabilities required for e-governance applications.

This research specially introduces here the NKN as an important future resource for the proposed concept of national level integration of the KM System. Also the researcher has visited the NKN Cell, Pune, to gather information about the running projects under this NKN programme. The NIC and NKN employees was very cooperative during visit and they have explained the vision, mission, purpose and application of this programme. Also researcher was curious about to know that is there any project is under development or in future plan of NIC or NKN related to research community. But NKN team have shown live website and function of the programme shortly and got idea than no any such kind of project is executing now or in the future plan too. The NKN and NIC scientist have also given very positive reply about the proposed KM Model and KM System. They were interested to know about this research.