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**KNOWLEDGE MANAGEMENT SYSTEM  
ARCHITECTURE - A SPECIFIC STUDY  
FOR MANAGEMENT AND COMPUTER  
ACADEMICS**

A Thesis submitted in partial fulfillment of the requirements for  
the Degree of Doctor of Philosophy

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# ABSTRACT

## **Objectives of the Research:**

The objective of this research is to design a Web-based Knowledge Management System (KMS) architecture for academicians involved with Management and Computer Education and develop a prototype at Tezpur University, located in Eastern India. The objective can be further broken down as follows:

1. To classify the attributes of KMS, by a review of literature and also by observing KMS in practice.
2. To design architecture for a Web-based KMS through a user requirement study and using inputs from 1 above.
3. To implement the proposed design at Tezpur University and analyze effectiveness of the design via feedback.

## **Research Methodology:**

The research was based on primary as well as secondary data.

**For Objective 1:** The first objective of the research was to classify the attributes of KMS. In order to fulfill this objective, both primary and secondary data sources were utilized. Attributes of KMS architecture were gathered from literature review, which formed the secondary data source. Primary data on interface and processing information were obtained by observing seven corporate KMS in practice. They are:

- Alcatel Lucent
- BSNL
- ICICI
- Net Apps
- Oracle
- Sky Technologies
- Wipro Infotech

Considering both the primary and the secondary data, the attributes of KMS were classified.

**For Objective 2:** A user requirement survey was conducted among academicians teaching in Management and Computer Science institutions of Eastern India. Based on the information of structure and attributes of KMS derived from literature review, interface and processing information obtained by observing seven KMS in practice and the user requirement survey, the architecture was designed.

**For Objective 3:** The third objective of the research was to implement a prototype of a KMS for academics at Tezpur University based on the architecture design under objective 2. For fulfilling this objective, inputs regarding software and programming languages used for developing a KMS were gathered from literature review as well as from the seven KMS observed. The studies done by Tomassen (2008), Alani et al. (2003) and the websites of w3schools.com, Free PHP.net and Protege gave information on implementation details. All this helped in creating the prototype which was uploaded from December, 2010 onwards.

The effectiveness of the system was determined by analyzing the results of the feedback survey carried out through a questionnaire distributed via email and also self-administered. The questionnaire used for this survey was an adaptation of the ISO Consolidated Usability Model (Abran et al., 2003).

**Limitation of the Research:**

The research has the following limitations.

1. The primary data on observation of KMS in practice, required for fulfilling objective 1 and objective 2 considered only KMS of corporate sector as KMS of academic institutions could not be accessed.

2. Two questionnaire surveys conducted to gather the requirements of academicians and to collect the feedback of the implemented KMS for academics were restricted to academics of Management and Computer Science Institutions of Eastern India. A larger audience may have resulted in an improved KMS for academics.

**Findings:**

A summary of the findings from literature review and KMS observation is given below.

1. The attributes of a KMS architecture can be classified as follows.
  - a. Authorization
  - b. Document Management
  - c. Information Storage
    - a. File upload
    - b. Uploading chat script
  - d. Information Retrieval
    - a. Web Search
    - b. Site Search
    - c. Database Search
    - d. File download
  - e. Collaboration
    - a. Discussion forum
    - b. Email
    - c. Message Board
    - d. Web cast
  - f. Miscellaneous
    - a. News
    - b. Feedback
    - c. External Links
    - d. Awards
3. A summary of the user requirement survey findings and its relevance to designing of the KMS is presented in Table 1. It was seen that an academician was involved with different activities as mentioned in the first column of the table. To facilitate these activities, keeping in mind the respondent

requirements, list of items to be included in the main web page and the subsequent inner pages have been provided in the second and third column of the table. The links to the important items identified from the respondent requirements are placed in the main page because it serves as the index to the information content of the Knowledge portal. Moreover the main page must not look cluttered and have an aesthetic appeal. The details are therefore given in the inner pages. It has been found that the parameters presented in the table below, mostly fall under Document Manager, Search, Discussion Forum and Miscellaneous components of a KM portal. Therefore, these important components are needed to be kept in mind while designing the architecture of KMS for academics and also while developing the prototype.

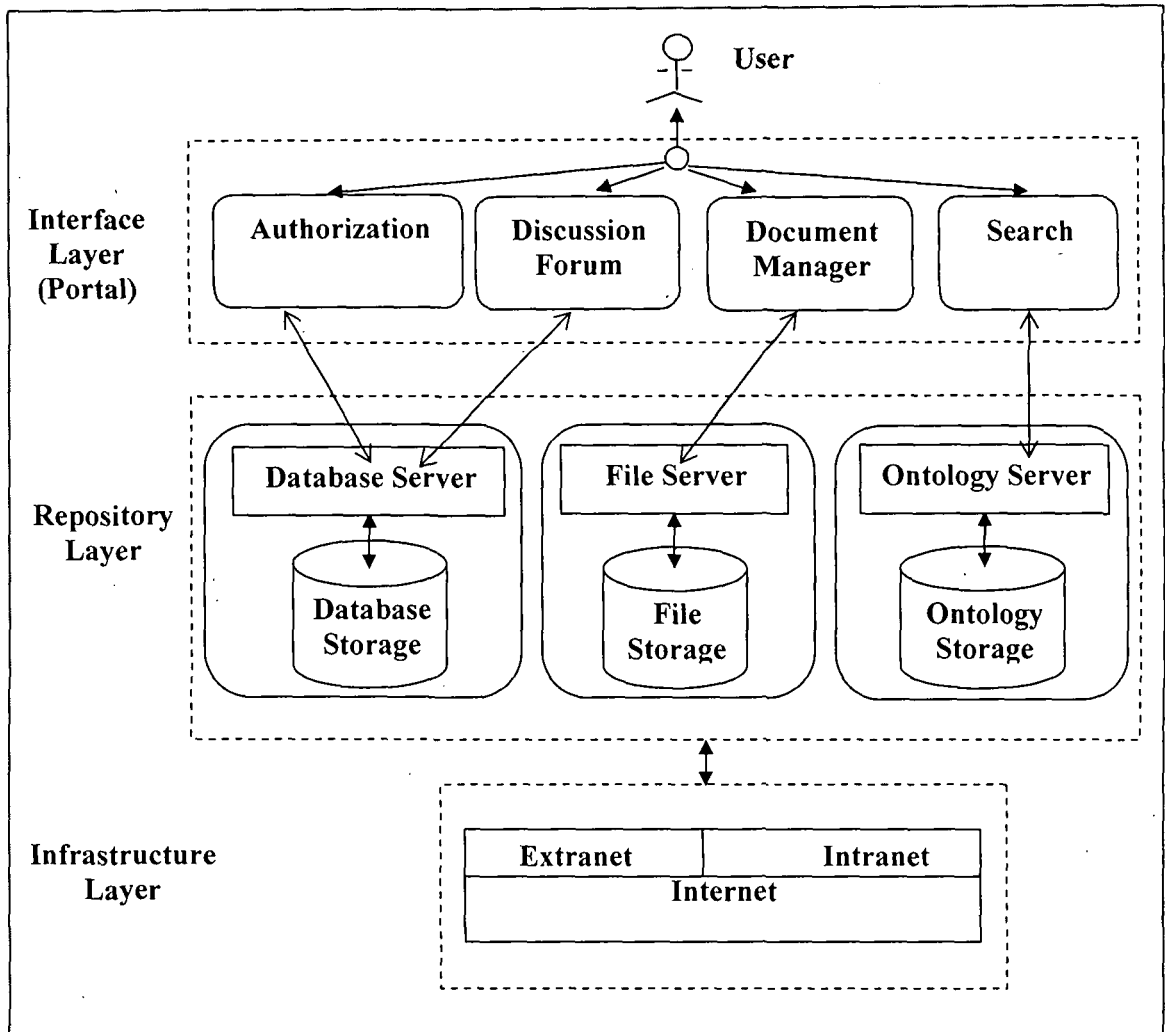
**Table 1: Summary of Survey Findings**

<b>Activities Identified for Academics</b>	<b>Items to be added in the Main Page of the Website</b>	<b>Items to be added in the Inner Pages of the Website</b>
Teaching & Research	<ul style="list-style-type: none"> <li>• Link to Online Journals</li> <li>• Link to Databanks</li> <li>• Link to Reference list of a particular topic</li> <li>• Link to Current trends of a particular topic</li> <li>• Link to Teaching Techniques</li> <li>• Link to software</li> <li>• Link to Library</li> <li>• List of new arrivals in the Library</li> </ul>	<ul style="list-style-type: none"> <li>• Research Details</li> <li>• Teaching Methodologies of a subject</li> <li>• Question Paper Setting Styles</li> <li>• Consultancy information</li> <li>• List of Experts of a subject</li> <li>• List of Funding Agencies</li> <li>• List of software available for a subject</li> <li>• List of Books and Journals available in the Library</li> <li>• Book searching facility</li> </ul>

**Table 1: Summary of Survey Findings**

<b>Activities Identified for Academics</b>	<b>Items to be added in the Main Page of the Website</b>	<b>Items to be added in the Inner Pages of the Website</b>
Curriculum Development	<ul style="list-style-type: none"> <li>• Link to list of other academic institutes</li> </ul>	<ul style="list-style-type: none"> <li>• List of other academic institutes</li> <li>• Model syllabus provided by regulatory bodies</li> <li>• Syllabus of other institutes</li> </ul>
Administrative Work	<ul style="list-style-type: none"> <li>• Link to list of Information System needed for administrative work</li> <li>• Link to Rules &amp; Regulations of the Institute</li> <li>• Link to list of Suppliers</li> </ul>	<ul style="list-style-type: none"> <li>• Rules &amp; Regulations of the Institute</li> <li>• List of available Information System</li> <li>• List of Suppliers</li> <li>• Recruiters</li> <li>• Alumni database</li> </ul>
Strategic Planning	<ul style="list-style-type: none"> <li>• Link to UGC guidelines</li> <li>• Link to AICTE guidelines</li> </ul>	<ul style="list-style-type: none"> <li>• UGC guidelines</li> <li>• AICTE guidelines</li> </ul>
News	<ul style="list-style-type: none"> <li>• News Headlines</li> </ul>	<ul style="list-style-type: none"> <li>• News Details</li> </ul>
Miscellaneous	<ul style="list-style-type: none"> <li>• Discussion Forum</li> <li>• Message Board</li> <li>• Link to Important Meetings</li> <li>• Link to official mail</li> <li>• General Search Facility</li> <li>• Feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Details of Important Meetings</li> <li>• Details of Important Documents</li> </ul>

From the findings of the user requirement study, observations of KMS in practice and review of the existing KMS architectures in academics, a three layer KMS architecture was designed as shown in Figure 1.



**Figure 1: Knowledge Management System Architecture for Academics**

4. A prototype based on the above architecture of the KMS for academics was developed. Considering the availability and popularity of the software Oracle 9i, it was selected to design the database for the KMS, Microsoft Frontpage was used to design the Interface and Protégé 3.1 to create the ontology used in the ontology driven search engine of the portal. The languages used for the interface design were HTML, Javascript and php script and for database connectivity php script was used. The server software used for the study was Zend which includes Apache Server and supports both php scripting and Oracle.



The portal was implemented in a Windows XP based PC, loaded with Oracle 9i Server and Zend server software. This PC was connected with internet via the gateway of Tezpur University internet connectivity.

Feedback survey indicated that on an average more than 50% of the respondents expressed satisfaction on the components of the portal. 100% of the respondents agreed that the portal would be useful for academicians. The overall score obtained was 3.92 on a five point scale. The respondents were satisfied with the KMS prototype for academics in terms of effectiveness, efficiency, security, satisfaction, and learnability attributes. It was also seen that though the respondents were satisfied with the prototype yet they felt that with the additions of the features suggested by them, the KMS for academics could be improved. Some of the suggestions like setting a limit to file size to be uploaded, controlling the type of files to be uploaded, adding presentations for different subjects in teaching aids and updating the income tax calculator have been already incorporated.

**Conclusion:**

Conclusively, it can be said that a KMS for academics will facilitate knowledge storing and dissemination and ultimately contribute to enhancement of capabilities of academicians, thus resulting in organizational effectiveness. A sample of comparative search results shows that the ontology driven search of the implemented KMS portal for academics gives more relevant results. [Please see Figure 7.1, Figure 7.2 & Figure 7.3 of Chapter 7] For designing a KMS for academics, the architecture design in this study can be used as a framework, based on which a need based KMS can be developed and implemented in an academic institution for meeting academic as well as administrative requirements.

## DECLARATION

I, **Ms. Heera Barpujary**, Research Scholar in the Department of Business Administration, School of Management Sciences, Tezpur University, Tezpur, Assam, hereby declare that the thesis entitled “**Knowledge Management System Architecture – A Specific Study for Management and Computer Academics**” is a bonafide research undertaken by me under the guidance of **Dr. (Mrs.) Chandana Goswami**, Professor, Department of Business Administration, Tezpur University, Tezpur, Assam. This thesis has not been submitted elsewhere for award of any other degree. The work embodies the result of my original research and reflects advancement in this area of research.

I also declare that to the best of my knowledge, any help received in preparing this thesis and all sources used have been acknowledged in this thesis.

**Dated:** 15.11.2011

**Place:** Tezpur University, Tezpur

  
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## CERTIFICATE

This is to certify that the thesis entitled '**Knowledge Management System Architecture – A Specific Study for Management and Computer Academics**' submitted to Tezpur University in the Department of **Business Administration** under the School of **Management Sciences** in partial fulfillment for the award of the degree of **Doctor of Philosophy in Business Administration** is a record of research work carried out by **Ms. Heera Barpujary** under my personal supervision and guidance.

All help received by her from various sources have been duly acknowledged.

No part of this thesis has been reproduced elsewhere for award of any other degree.

Date: 18/11/11

Place: Tezpur University, Tezpur

*Chandana Goswami*  
(CHANDANA GOSWAMI)

Principal Supervisor,

Professor,

Department of Business Administration,

School of Management Sciences.

# PREFACE

Knowledge has been a powerful intangible asset from time immemorial. Preserving this asset in tangible form had always benefited human beings. Since a few decades, people realized that the importance of management of knowledge. Corporate Sectors understood that if proper knowledge management was done in their organization, then they could compete with their competitors. Hence, corporate sector started deploying Knowledge Management Systems in their organizations that accelerated their performance. If Knowledge Management System can be beneficial for corporate sector then it can be beneficial to educational institutions, specifically to the academicians too. Though, few educational institutions started deploying Knowledge Management System but compared to corporate sector, educational institutions have a long way to go; moreover, Knowledge Management System catering to the needs of the academicians was not observed.

This research attempts to develop a Knowledge Management System for the academicians of Computer Science and Management. The study first designs architecture of the Knowledge Management System by taking inputs from the academicians, by observing Knowledge Management Systems of corporate sectors and by taking inputs from previous studies. A prototype based on this architecture was then developed and uploaded via the Tezpur University Internet gateway. Feedback of the prototype was also collected from the academicians in order to validate the architecture and the prototype developed based on this architecture.

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## Acknowledgement

During the course of my research, I have been receiving encouragement, support and help from innumerable personalities. At this juncture, I would like to acknowledge with appreciation the contribution of all these people who have, in some way or other, helped and encouraged me during my study. I would like to take an opportunity to thank all of them without whom; a work of this nature would not have been possible.

First of all, I would like to acknowledge my deepest gratitude to my guide **Dr. (Mrs.) Chandana Goswami**, Professor, Department of Business Administration, Tezpur University for her untiring support, help and valuable guidance, which helped me in the successful completion of this study. *Thank you Ma'am!*

I am immensely grateful to **Dr. S. M. Hazarika**, Professor, Department of Computer Science & Engineering, Tezpur University for his valuable advice and support and continuous encouragement.

It is great pleasure for me to record my deep sense of gratitude for continuous encouragement received from the colleagues of Department of Business Administration, Tezpur University.

This thesis could not have been done without the inputs from the academicians both in the user requirement as well as feedback survey. I take this opportunity to acknowledge their help and thank them for supporting the study. I would also like to thank **Nilanjana Deb** of Girijananda Chowdhury Institute of Management & Technology, Guwahati, **Rasida T. Noorain** and **Karabi Goswami** of Assam Institute Management, Guwahati, **Sinmoy Goswami** and **Manmmit Mahanta** of Gauhati Commerce College, Guwahati and **Samanoy Baruah** of North Eastern Regional Institute of Management, Guwahati, who helped me in getting the feedback from their colleagues.

I also like to thank the persons from corporate sectors for helping me to gather interface and processing information of their organisation's Knowledge Management portal.

My sincere thanks also go to **Mr. Rajib Goswami**, System Analyst, Department of Computer Science & Engineering, Tezpur University, **Mr. Dhiraj Sarma**, Computer Engineer, **Mr. Deepak C. Choudhury**, Junior Programmer & Webmaster and **Mr. Pritom Rajkhowa**, Junior Programmer, Computer Centre, Tezpur University for giving their valuable suggestions that helped me in developing and implementing the prototype of the Knowledge Management System for Academics, proposed in this study.

Finally, I owe the deepest gratitude to my father **Mr. Ramesh Barpujary**, my brother **Mr. Dhiraj Barpujary** and specifically my mother, **Mrs. Geeta Barpujary** without whose encouragement and constant support this research would not have been possible.

**Dated:** 15.11.2011

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Knowledge Management System Architecture

– A Specific Study for Management and Computer Academics

# Chapter 1

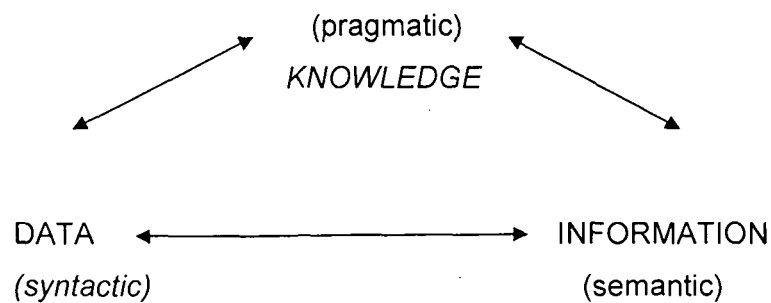
## Introduction and Overview

Knowledge Management System Architecture  
– A Specific Study for Management and Computer Academics

# Introduction and Overview

## 1.1 Knowledge – An Important Intellectual Asset

Ever since the dawn of civilization, it has been observed that knowledge has proved to be a powerful asset that led individuals and society to the path of success. The power of knowledge is a very important resource for preserving valuable heritage, learning new things, solving problems, creating core competences, and initiating new situations for both individual and organizations now and in the future (Liao, 2003). It is the only asset that increases when used. How to manage this knowledge has become an important issue in the past few decades. One major problem with knowledge management is the fact that despite intensive academic discourse on the terms data, information, and knowledge, in industrial practice they are used in an uncoordinated way. In the classical interpretation, data is associated with syntax, information corresponds to semantic and knowledge takes the pragmatic part. This interpretation is shown in the Figure 1.1.



**Figure 1.1: Relation between Data, Information and Knowledge**  
(Source: Muller & Schappert, 1999)

According to another definition, data is raw facts, which can be expressed in terms of numbers, symbols, text, images or voice, etc., representing quantities, actions and objects (Singh, 2007).

Again, Information is data which is processed into a form that is meaningful to the recipient (Davis & Olson, 1984). It is data endowed with relevance and purpose

(Drucker, 2001). According to Probst, Raub and Romhardt (1998), information is the flow of messages or meaning which may add to, restructure, or change knowledge.

On the other hand, knowledge is a “fluid mixture of experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information” (Davenport & Prusak, 1998). It originates and is applied in the minds of people. In organizations, it becomes embedded in documents and repositories, in organizational routines, in processes, practices, and norms. Knowledge can also be defined as “justified personal belief that increases an individual’s capacity to take action” (Alavi & Leidner, 1999).

The difference between information and knowledge is depicted in the table below.

**Table 1.1: The difference between Information and Knowledge**  
(Source: Abdullah et al., 2005)

<b>Information</b>	<b>Knowledge</b>
Processed data	Actionable information
Simply gives us facts	Allows making predictions, casual associations, or predictive decisions
Clear, crisp, structured and simplistic	Muddy, fuzzy, partly unstructured
Easily expressed in written form	Intuitive, hard to communicate, and difficult to express in words and illustration
Obtained by condensing, correcting, contextualizing, and calculating data	Lies in connections, conversations between people, experienced-based intuition, and people’s ability to compare situations, problems and solutions
Devoid of owner dependencies	Depends on the owner

Knowledge can be classified into two categories, namely tacit and explicit knowledge (Nonaka & Takeuchi, 1995).

Tacit knowledge is personal, embedded in the minds of people. It is obtained by internal individual process and stored in human beings. Such knowledge is sometimes described as Experience, Reflection, Internalization or Individual Talent. Such knowledge is difficult to identify, quantify and convert into real value, unless a structured approach is not adopted to manage such knowledge.

Explicit knowledge on the other hand can be easily expressed, articulated or encoded (codified), gathered, organized, transferred or shared with others through social interaction. It is stored in a mechanical or technological device such as documents or databases.

Knowledge can be converted from one form to another. Nonaka and Takeuchi (1995) defined four generic processes for converting between tacit and explicit knowledge that they describe as fundamental to creating value. This conversion between tacit and explicit is depicted in Figure 1.2.

	TACIT KNOWLEDGE	To	EXPLICIT KNOWLEDGE
TACIT KNOWLEDGE From	SOCIALIZATION		EXTERNALIZATION
EXPLICIT KNOWLEDGE	INTERNALIZATION		COMBINATION

**Figure 1.2: Knowledge Conversion**  
(Source: Nonaka & Takeuchi, 1995)

- Tacit-to-tacit (socialization) – Where individuals acquire new knowledge directly from others, through observation and dialogue.
- Tacit-to-explicit (externalization) – the articulation of knowledge into tangible form through discussion and documentation.

- Explicit-to-explicit (combination) – combining different forms of explicit knowledge, such as that in documents or databases.
- Explicit-to-tacit (internalization) – such as learning by doing, where individuals internalize knowledge from documents into their own experience.

## **1.2 Knowledge Management – What it means?**

“Knowledge is power” was rightly coined by Francis Bacon way back in the sixteenth century (Skyrme, 1999). In organizations, knowledge is embedded in documents, in organizational routines, in processes, practices, norms and in individuals. In today’s world, due to high competition and unstable market conditions, an organization’s competency is predominately determined by its intellectual asset rather than the market conditions. So, in order to compete in this emerging knowledge-centric economy, organizations around the world have undertaken various initiatives to manage their most important yet volatile asset – ‘knowledge’. Thus the term Knowledge Management came into existence.

Knowledge Management is a systematic process of retaining, organizing, sharing and updating knowledge that is critical to individual performance and organizational competitiveness (Wei et al., 2002). It is the strategy, the process, the tool and set of management principles that enable the identification, collection, retention and distribution of knowledge assets, the development of new and the sharing of existing knowledge as well as the establishment of a corporate culture to create value for all stakeholders (Liao & Yau, 2001).

Knowledge Management can be also described as a set of practices that help to improve the use and sharing of data and information in decision making. (Petrides & Nodine, 2003). It is the process of transforming information and intellectual assets into enduring value. It connects people with the knowledge that they need to take action, when they need it (Kidwell et al., 2000).

In organizations, management of knowledge is done by following the phases of the Knowledge Management Life Cycle. The Knowledge Management Life Cycle comprises of the following four phases.

1. **Create:** New knowledge is created from available knowledge and information via innovative and creative processes. The human processes that produce new knowledge can be individual efforts or collaborative sessions – brainstorming sessions, active research, serendipity during information retrieval, or day-to-day practice. System assisted knowledge discovery processes find new patterns in existing information during data or text mining, which could be stored as new knowledge back into the KM system.
2. **Capture:** Explicit knowledge can be captured as it is created and implicit knowledge can be elicited from the sources using questionnaire, interviews, or leveraging a collaborative environment. Knowledge thus gathered can be represented using schemas such as semantic networks, scripts, expert systems, etc. Tacit knowledge, on the other hand, cannot be captured at this stage of the knowledge management life cycle but can only be identified as existing in a particular expert's mind. The discovery and availability of such an expert can be codified as a knowledge source.
3. **Organize:** Information and knowledge captured during the knowledge synthesis processes need to be organized by an appropriate taxonomy for ease of retrieval. A knowledge map (semantic map, taxonomy, topic map, etc.) in addition to aiding the retrieval processes help in human comprehension of the scope and boundaries of available knowledge.
4. **Disseminate / Share:** Knowledge created, captured and organized is ready for distribution via multiple delivery channels. Dissemination includes “pushing” knowledge to its users and users “pulling” the knowledge they need. The ranges of push mechanisms include information and knowledge portals, intelligent agents, and recommendation systems. Search engines, knowledge map browsers, and adaptive / inferential information retrieval mechanisms aid users in knowledge pull activities.

### **1.3 Knowledge Management System – An Implementation of Knowledge Management Concept**

In order to implement the concept of Knowledge Management in an organization, Knowledge Management Systems (KMS) are designed, so that there can be proper utilization of this asset for improved organizational performance.

KMS is a complex aggregate of organizational infrastructure, information flow and supporting software for systematically dealing with the organization's knowledge. KMS can be implemented in business organization as well as in academics, where KMS are used as source of knowledge sharing among its stakeholders.

Literature reveals that Knowledge Management System has three common applications in the business organizations.

1. The coding and sharing of best practices,
2. The creation of corporate knowledge directories
3. The creation of knowledge networks.

#### **1.3.1 Knowledge Management System in Academics**

As in organizations, academics also have diverse areas where knowledge needs to be retained. A study identified five prominent areas of higher education viz. research, curriculum development, student and alumni services, administrative services, and strategic planning, where KM can be applied and the corresponding benefits can be observed (Kidwell et al., 2000). In academics, the Knowledge Resources identified are faculty, students, alumni, research, training and development, administration, admissions, placements, evaluation, assessments, performance and environment or governance (Ranjan & Khalil, 2007). Knowledge Management System connects individuals with a common interest to create a Community of Practice (CoP) where knowledge is created, sustained and transformed. A CoP is formed by people who engage in a process of collective learning in a shared area of interest and requires the following characteristics: the domain; the community; the practice. The domain is the area of interest; the community is formed by the relationships (conversations, discussions, etc.) between members; and the practice is what community members do with learning

derived from their interaction. Academics are already familiar with the idea of CoP as can be observed in their group practices, such as project teams, programme teams, special interest groups, and forums for discussions, sharing and developing practices. Therefore, KMS for academics can be also termed as the IT implementation of the CoP (Witt et al., 2007).

Though a full-fledged KMS is not observed in most of the academic institutions but some of the components of KMS are already implemented. The websites of the institutes has become the medium through which knowledge resources are shared. Practices like uploading study materials, class lectures and assignments in the faculty pages of the websites of the institutes, linking e-resources subscribed by the institutes to their websites, displaying office circulars and internal news in the websites, submitting assignments through emails, etc. are followed by most of the academic institutes. Though these practices can be termed as some form of knowledge sharing but they are not interactive.

Literature also revealed that studies made so far are intended to develop KMS that enhances the teaching-learning process. Studies on developing KMS to cater to the needs of academicians have not yet come to notice.

#### **1.4 Problem Definition**

KMS in corporate sectors improves team communication, reduces problem solving time, improves profitability, improves project management and reduces design cycle time. In academics, KMS reduces information searching time, improves community communication and collaboration, improves teaching-learning process, improves research activities and also improves performance of other administrative jobs.

From the foregoing discussion it is apparent that a formal KMS gives a competitive edge to both corporate sector and academics. Though, concept of formal KMS is widely practiced in the corporate sector but a formal KMS in academics is still at an initial stage in India and specifically in Eastern India. A formal KMS catering to the needs of an academician has not been observed, specifically in Eastern India.



An observation of selected management and computer science institutes located in Eastern India revealed that there was no KMS in place. This study is an attempt to develop a prototype KMS designed on the basis of users' requirements.

### **1.5 Problem Statement**

An architecture or blue print is the starting point for the development of any information system. So, before developing a KMS for academics, architecture of the system has to be developed. The requirements of the academicians can be best given by the academicians themselves. There are numerous areas of higher education and each of them have their specific requirements. Catering to the needs of all the areas is difficult; hence, the present study is concerned with the development of KMS architecture for Management and Computer Science academics of Eastern India.

### **1.6 Overview of the Thesis**

- Introduction to Knowledge Management is presented in Chapter 1.
- Review of literature on KMS is presented in Chapter 2. The research gap identified from this literature review is also included in this chapter.
- The objectives of the study, the research plan and the details of the data collection procedures are outlined in Chapter 3.
- Classification of KMS attribute, observations on interface and processing methods of KMS of few organizations and the findings of the user requirement survey are discussed in detail in Chapter 4.
- The proposed architecture of KMS for academics and its components is discussed in detail in Chapter 5.
- The development and implementation details of the proposed KMS for academics are discussed in Chapter 6. The findings from the feedback received from the target users of the system and the action taken on those feedback to improve the system are also discussed in this chapter.
- Summary of the study, specific contribution made through the study, limitation of the study and scope for future work has been presented in Chapter 7. Conclusions drawn from the study has also been presented in this chapter.

## **Chapter 2**

# **Literature Review**

# Literature Survey

## 2.1 Knowledge Management System

Knowledge Management (KM), also referred to as corporate memory, is an emerging area which is gaining interest in both corporate sectors and academics. It comprises of activities focused on a formalized, integrated approach to managing an organization's tangible and intangible assets or organization knowledge (Anbulagan & Kuswara, 2001). KM can be also reviewed as the process of transforming information and intellectual assets into enduring value. It connects people with the knowledge that they need to take action (Kidwell et al., 2000). According to Liao (2004), KM is the strategy, the process, the tool and set of management principles that enable the identification, collection, retention and distribution of knowledge assets , the development of new and the sharing of existing knowledge as well as the establishment of a corporate culture to create value for all stakeholders. KM is based on the common aspects of flexibility, integration, and adaptability; it addresses the three primary areas of acquisition, representation and reuse of knowledge. It includes issues related to developing, implementing and maintaining the appropriate technical and organizational infrastructures, which enable knowledge sharing and the selection of specific contributing technologies and vendors to leverage knowledge across the organization (Anbulagan & Kuswara, 2001). The IT implementation of the concept of Knowledge Management in organizations is termed as Knowledge Management System. The concept of Knowledge Management System and its application in education institutes and corporate sector is discussed in the following sections.

Knowledge Management System (KMS) is a phrase that is used to describe the creation of knowledge repositories, improvement of knowledge access and sharing, as well as communication through collaboration, enhancing the knowledge environment and managing knowledge as an asset for an organization (Abdullah et al., 2006). It is a complex aggregate of organizational infrastructure, information flow and supporting software for systematically dealing with organizational knowledge.

According to Liao (2004), a knowledge management system is a part of the overall management system that facilitates the management and development of knowledge assets to create value for an organization. As stated by him, the components of KMS are:

- A business and knowledge strategy and policies;
- The procedures and work instructions to optimize the creation, flow, learning and sharing of knowledge;
- The structure and roles for managing knowledge;
- The development, testing and evaluation of knowledge management process that explicitly link learning efforts to measures of performance;
- The knowledge-related audit;
- The technology architecture to facilitate knowledge management.

KMS is a rich area of research in terms of literature. The literature survey that encompasses the period 1991 to 2010 reveals that research on KMS has been carried out from different angles. Many researchers have examined the application of KMS, whereas few researchers tried to assess the factors responsible for the success or failure of a KMS implementation. Research has also been carried out in identifying the features of a Web-based KMS. Another significant area of research is the designing of the architecture of a KMS, which is the prime requirement in the implementation of a KMS.

The sources of this survey and the list of journals used for this survey are given in Table 2.1 and Table 2.2 respectively.

**Table 2.1: Source of Literatures**

<b>Sources of Literature</b>	<b>Nos.</b>	<b>In Percentage</b>
International Journals	37	30.83
International Conference Publications	59	49.17
Books	16	13.33
Webpage Publications	8	6.67
<b>Total</b>	<b>120</b>	<b>100</b>

**Table 2.2: List of Journals Referred for Literature Review**

<b>List of International Journals</b>	<b>No. of Articles</b>
Journal of Knowledge Management	2
IEEE Intelligent Systems	2
Computers in Industry	1
Organization Science	1
Progress in Artificial Intelligence	1
The Electronic Journal of Knowledge Management	1
Intelligent Agents and their Applications	1
ACM SIGMIS Database	1
Computational Science and its Application	1
International Journal of Information Management	1
Lecture Notes in Artificial Intelligence	1
Journal of Computer and Information Science	1
IBM Systems Journal	1
Knowledge-Based Systems	1
Education, Technology and Society	1
Internet Research: Electronic Networking Applications and Policy	1
Expert Systems with Applications	2
Singapore Management Review	1
Journal of Computers in Human Behavior	1
Teachers College Record	1
Journal of Theoretical and Applied Information Technology	1
Management Decision	1
Information Technology and Management	1
Human Resource Development	1
IEEE Transactions on Systems, Man, and Cybernetics—Part C: Applications and Reviews	1
VINE	1
Software Engineering Journal	1
Internet Computing	1
Emerging Technologies and Information Technologies for the Knowledge Society	1
Industrial Management and Data Systems	1
IEEE Software	1
Automation in Construction	1
Journal of Knowledge Management Practice	1
Educase Quaterly	1
<b>Total</b>	<b>37</b>

### 2.1.1 Applications of Knowledge Management Systems

Many researchers have examined the application of KMS, both in educational institution and corporate sectors. Some of the application of KMS in corporate sectors is discussed below.

Skuce (1995) applied a Knowledge Management tool called CODE, to capture knowledge about a *large commercial software system*. The advantage of using CODE is that knowledge can be captured faster than manual methods. Also, with the use of CODE, it is possible to refine the knowledge with a degree of clarity and economy of expression. In another study, a modeling technique based on Zachman framework for Information System Architecture was applied in *medical domain* (Kingston & Macintosh, 2000). A protocol assistant, Web-based Knowledge-based system capable of representing and reasoning with best practice guidelines (protocols) in the medical domain was developed. This system responded to all type of medical queries. KMS was designed for an *integrated circuit assembly and testing firm*, based on Codification Based Knowledge Repository building approach (Wei et al., 2002). Knowledge management was also applied in *Web-based business* (Wang, 2002). The study proposed a structure of Knowledge map for Knowledge Management in the Web-based business environment, based on theories of knowledge representations and semantic networks and applied it to *Online Auction*.

In another study, Wang et al. (2003) introduced knowledge management and team collaboration functions into the supporting systems for *enterprise modeling projects*. The development of an information and collaboration portal for modeling project team named e-modeling portal was depicted in detail in this paper. Compared to traditional enterprise modeling process, the new e-modeling portal can be easily disseminated, accessed, searched, and information and knowledge exchanged among all team members despite their far flung physical locations. Also, former and current projects can be safely maintained and reused. The strategic impact of Knowledge Management (KM) has also been observed in *biotechnology and pharmaceutical firms* (Salazar et al., 2003). The application resulted in internet applications like drug discovery, virtual

clinical trials, online patient recruitment, etc. Wimmer and Traunmuller (2003) introduced KM for *public administration*. They showed how a KMS can be helpful in administrative work. KMS is also applied in *Architecture, Engineering and Construction (AEC) industry* (Woo et al., 2004). A theoretical foundation for clarifying the contribution of experts in the *Architecture, Engineering and Construction (AEC) industry* was set. A prototype of a web-based software named Dynamic Knowledge Map, which could search for experts and facilitate communication with those experts, was also discussed by the authors. In yet another study, Trappey et al. (2005) proposed a new document classification methodology (an important R&D area in KM domain) based on neural network. This methodology was applied for *searching of correct patent documents and for classification of patent documents*. This searching method could determine the category of the target document by selecting the keywords of the target document and could also assist the user to narrow the searching ranges. Ginsbury and Kambil (1999) reviewed approaches to knowledge management support systems (KMSS) and proposed a KMSS named ANNOTATE, which was designed to support the Knowledge Management of *document collections in federated organizations*, which lack common vocabularies and central authority. An automated interface built in the Product Knowledge Management System (PKMS) to *retrieve product design requirements* from customers and other related information generated in the product development stage was proposed by Wu and Huang (2004). The system had the following functions.

- a. Automatic search of incoming order information,
- b. Message issued to notify reviewers,
- c. Browse product parts,
- d. Display the product structure,
- e. Review historical product information, and
- f. Review messages.

Again, Li et al. (2002) presented an intelligent *Web-based project management system*, called VH Build.com, which integrated project management, knowledge management, and artificial intelligence. The system is easy to use and allows multiple access. In another study, Salisbury and Plass (2001) describes the design and development of a Web-based KMS. The design was initiated by developing a theoretical foundation called "Collaborative Cognition Model". A KMS based on this model was developed that supported the process of creating new knowledge, making it explicit and translating the knowledge into different forms for effective dissemination across the organization. This model was applied to develop the *Process Realization Online Website* through which the Technical Best Practices could be used by United States Department of Energy (DOE) and its eight affiliates, for guiding their operations.

From the review, few studies related to application of KMS in academic institutes were also identified. They are discussed below.

A study identified five *prominent areas of higher education* viz. research, curriculum development, student and alumni services, administrative services, and strategic planning, where KM can be applied and the corresponding benefits can be observed (Kidwell et al., 2000). On the other hand, Liao (2004) explored the application of KM techniques to *educational institutions*, specifically in *administration*. Stover (2004) described the process of knowledge transformation (from tacit to explicit to codified knowledge) in an organization. The *Web-based Ready Reference Database* at San Diego State University was analyzed as an example of the process of knowledge conversion in *library reference services*. A KM framework for *teaching Database Normalization* was designed by Zhang et al. (2005). The findings are based on the educational Knowledge Management (KM) system analysis, design, prototype implementation and evaluation. In yet another study, made by Numprasertchai and Poovarawan (2006), the Information and Communication Technology (ICT) based KMS framework of Kasetsart University, Thailand, was discussed. A ICT based KM framework had been implemented to *support university mandates* such as teaching and



learning, research activities, community services and cultural preservation, for enhancing its competitiveness.

Ranjan and Khalil (2007), proposed a conceptual framework of Knowledge Resources in *Business Schools*. The Knowledge Resources identified were faculty, students, alumni, research, training and development, administration, admissions, placements, evaluation, assessments, performance and environment or governance. Another study by Basu and Sengupta (2007), studied the factors influencing the success of knowledge management initiatives in a *business school* to distinguish itself in the academic market place. A generalized model has been constructed highlighting possible antecedents and consequences of a business school in its quest for becoming a learning organization. This model was then applied in ICFAI Business School, as a test case. In yet another study, Witt et al. (2007), states that education sector has started exploring the usefulness of connecting individuals with a common interest to create a *Community of Practice* (CoP) where knowledge is created, sustained and transformed. A CoP is formed by people who engage in a process of collective learning in a shared area of interest and requires the following characteristics: the domain; the community; the practice. The domain is the area of interest; the community is formed by the relationships (conversations, discussions, etc.) between members; and the practice is what community members do with learning derived from their interaction. Academics are already familiar to the idea of CoP that can be observed in their group practices, such as project teams, programme teams, special interest groups, forums for discussions, sharing and developing best practices. Therefore, KMS for academics can be also termed as the IT implementation of the CoP.

### **2.1.2 Assessment of Knowledge Management System Implementation**

Research has been conducted to assess the success or failure of Knowledge Management Systems implementation by detecting the causes of failure or success of the system. Homburg and Meijer (2001) discussed the questions regarding information and knowledge sharing. The authors presented a theory driven framework *to find out*

*the incentives that should be given to individuals, so that they share information and knowledge.* From the study, it has been found that human beings and organizations in alliances share information and knowledge when it is in their best interest. Also sharing of information and knowledge is determined by the ownership structure. In another study, *the behavior of users of KMS* was studied and the *measures to be adopted for motivating the users*, so that the KMS can be implemented fully, were suggested (Milijic, 2002). A theoretical framework for *understanding the knowledge workers' commitment and motivation affect on the use of KMS* was proposed by Malhotra and Galletta (2003). The study performed an empirical validation of the measures of KMS User Motivation and it found that it supports prior theoretical discussion about the presence or absence of user motivation in using, sharing, renewal, or creation of knowledge. It also suggests that the linkage between the information-based model and knowledge-based view of organizations needs to be informed by understanding KMS user motivation in terms of the KMS user's degree of self-determination of behavior pertinent to use, sharing, renewal, or creation of knowledge. On the other hand, Kim and Tatar (2004) analyzed the *prospects of knowledge management systems with respect to the social and technical issues* discussed and illustrated in Ackerman's nine general findings of Computer Supported Co-operative Work (CSCW). Based on the examination, the authors developed several hypothetical KM scenarios to illustrate the CSCW concern. Finally, the authors discussed the nature of social technical gap for KM systems and gave the following suggestions on how to reduce this gap.

- a. KM systems should aim for some level of symmetry.
- b. The visibility of participants' contributions should be increased.
- c. KM system should be designed in such a way that it benefits even when the user population is small.
- d. Stakeholders of the KMS have to be identified and the developer should see that the goals of the people are not in conflict.

In yet another study, Pumareja and Sikkil (2005) *detected dissonance, as a cause for failure of KMS*, after examining the causes of failure of a Knowledge Sharing system called KennisNet, used by non-life insurance division of Active Insurance Group (AIG). Clay et al. (2005) investigated the *factors affecting the Loyal Use of KMS*. The authors developed a model of the factors affecting the Loyal Use of a KMS and used data gathered from 1013 users of a well-established codification-based KMS in a multinational pharmaceutical firm to test the model using LISREL. The results showed that Loyal Use is a function of Perceived Usefulness, Perceived Ease of Use, Extrinsic Motivation, and Voluntariness.

An exploratory study about Knowledge Management in practice at ICICI (India) was done by Goswami (2009). The study tried to identify the critical success factors of a Knowledge Management System from a small survey conducted among 31 employees of ICICI. Based on the responses of the survey, a factor analysis was done and the critical success factors were identified as Cooperation, Motivation Level, Top Management Support and Work Culture.

Studies were also conducted to define the parameters for assessing a KMS. Abran et al. (2003) addressed the limitations of the various ISO models that measured software usability by proposing a consolidated and normative model for the evaluation of software usability. The software usability measurement parameters of this model are effectiveness, efficiency, satisfaction, security and learnability. Hashim and Sultan (2009) validated the Consolidated ISO Usability Model proposed by Abran et al. (2003) by preparing a questionnaire that measured the parameters set by this model and then conducting a questionnaire survey among the fourteen users of Universiti Putra Malaysia KMS. In another study, Tseng (2008) explored the KMS performance indicators that are useful to assess the KMS performance of firms. Both financial and non-financial measures were adopted to evaluate KMS performance that was identified from an interview followed by a survey. The critical factors that would improve the quality of KMS were identified as internal and external analysis in formulating KM strategy; goal setting, employee orientation, and KMS infrastructure

in designing the plan for knowledge management; and employee commitment and measurement in the implementation of Knowledge Management. Jennex et al. (2007) tried to define KM and KMS success by an expert panel approach followed by two exploratory surveys. The definition of KM and KMS success inferred from the survey is as follows: KM and KMS success are a multidimensional concept. Each includes capturing the right knowledge, getting the right knowledge to the right user, and using this knowledge to improve organizational and / or individual performance. KM success is measured using the dimensions of impact on business processes, strategy, leadership, efficiency and effectiveness of the KM system, organizational culture and knowledge content. In yet another study, Ong and Lai (2007) developed a validated instrument to measure user satisfaction as surrogate measure of KMS effectiveness. Based on a survey of 147 respondents mostly from semiconductor manufacturing companies, a 16-item instrument was suggested that measured the four dimensions of user satisfaction with knowledge management viz. content, ease of use, personalization, and community, was well validated.

### **2.1.3 Features of a Web-based Knowledge Management Systems**

Few studies have also identified the features of a Web-based KMS. A study reviewed the different approaches to the organization of knowledge in Web-based environments (Rowley, 2001). Four key approaches that are frequently made available to provide *access to information in Web-based environments are addresses, hyperlinks, menus, and keyword searching*. From the review, he concluded that Web addresses are useful when the user knows which site they wish to search, but within a large site the user may still need recourse to menus or a search engine. Hyperlinks can provide useful associations between sites, but it is difficult for the user to know in advance whether the linked site will provide the kind of information or service that they are seeking. Menus are a type of controlled indexing language, with the information architecture being defined by indexers or other knowledge workers during the design of the Web site. The menu-based approach to knowledge organization shares common characteristics with traditional knowledge classification. The language control and menu structure helps searchers to locate information and services, provided that

searchers understand and relate to the terms and information structure designed into the system. The other alternative is for the searcher to specify the topic of their search through the use of keywords. These keywords are in the natural language of the searcher, which may or may not be coincident with the natural language of the Web sites being searched by the search engine. In order to negotiate variability of natural language the searcher needs to learn to use more advanced search features such as Boolean searching, nesting and truncation. In another study, Caldwell et al. (2000) discussed the design and development of a *Web-based decision support tool named Webcadet, to assist designers in conceptual-design evaluation*. A user evaluation exercise was conducted to determine the strength and weakness of Webcadet software. From this exercise, the key need identified is interruptibility. Other observations included a preference for more hyperlinks for faster transitions between Webcadet modes rather than using a BACK button. In yet another study, Tiwana and Ramesh (2001), *identified the attributes of a KMS and described how Web-centric approaches can support these requirements*. The desirable attributes of KMS identified in the study are:

- Platform independence and portability
- Robust access
- Integration with legacy and existing systems
- Security
- Scalability
- Distributed connectivity, flexibility and customizability
- Ubiquitous, consistent, intuitive client interface.

All these attributes can be facilitating in a KMS, if it is integrated with a Web-based environment.

## **2.2 Architectures of Knowledge Management System**

The design of a robust architecture is the first step towards the implementation of a KMS. Researchers have also designed numerous architectures, out of which few are general and the rest are mostly application based. According to Chua (2004), general frameworks include the seven layer KMS architecture (as cited by Tiwana, 2000) which mirrors the OSI Model used in data communication. This mode is not easily understandable by non-technical persons. The KM reference model (as cited by Abou-Zeid, 2002) which is a conceptual framework for developing technology solutions, addresses the concerns of the technologists rather than those of the non-technical people. The KM spectrum (as cited by Binney, 2001) and the Ovum KM tools architectural model (as cited by Woods, 1998) are comprehensive in scope but lack actual deployment examples. To overcome the drawbacks of these general architectures, the author designed a three-tier KMS architecture which was understandable to technical as well as non-technical persons. This architecture identifies three distinct services supported by KM technologists. They are infrastructure services, knowledge services, and presentation services. The two main infrastructure services provided by technology are storage and communication. Knowledge services are supported by technology solutions intended to help achieve the goals of KM directly. The three primary goals are to promote the process of generating new knowledge, encourage the flow of knowledge among organization members, and ensure the ease of access to knowledge repositories (as cited by Martin, 2000). The underlying knowledge processes of these three KM goals are knowledge creation, knowledge sharing, and knowledge reuse. Technologies that provide presentation services are primarily concerned with enhancing the interface between the user and the information/knowledge sources. Two common features of presentation services are personalization and visualization.

From the literature survey, it has also been observed that KMS architectures are based on different technologies. The technologies generally used in KMS architecture are agent technology, ontology, object oriented design, client-server technology, and case

based reasoning. These technologies and the architecture based on these technologies are discussed below.

### **2.2.1 Agent Technology**

An agent can be seen as a software and/or hardware component of system capable of acting exactly in order to accomplish tasks on behalf of its user in some environment (Nonaka & Takeuchi, 1995). Its characterization includes (1) reactivity; (2) autonomy; (3) co-operation; (4) reasoning ability; and, (5) knowledge base (Zhang et al., 2008).

Agent technology is one of the most promising technologies for dealing with distributed collaborative environment and social interaction in knowledge management. They can monitor and coordinate events, meetings, and disseminate information (Balasubramanian et al., 2001). Furthermore, agents are proactive in the sense that they can take initiative and achieve their own goals. The autonomous behavior of the agents reduces the amount of work that people have to perform when using a KM system. Another important issue is that agents can learn from their own experience (Soto et al., 2006).

Agent paradigm is a promising technology for information retrieval. They can collect information from the web by taking the advantage of semantic annotations in a document, i.e. additional information provided by the document creator (Aldea et al., 2003). Agents can also alert users about new relevant information by filtering out the less relevant information (Garcia & Cobos, 2006).

### **2.2.2 Ontology**

An ontology is a formal, explicit specification of a shared conceptualization. It is a vocabulary of entities, classes, properties, functions and their relationships. Ontologies are meant to provide an understanding of the static domain knowledge that facilitates knowledge sharing and reuse. Fensel (2001) identifies five different types of ontologies:

- i) *Domain ontologies*, representing a target domain, as engineering, medicine, etc.
- ii) *Generic or Common Sense ontologies*, capturing general knowledge about time, space, events, etc.
- iii) *Method ontologies*, describing specific task, as diagnosis.
- iv) *Metadata ontologies*, describing the content of on-line information sources.
- v) *Representational ontologies*, provides representational entities without stating what should be represented and without committing themselves to any particular domain.

According to Aldea et al. (2003), Ontologies have been found to be useful for:

- a) Retrieving the appropriate information from documents by providing a structure to annotate the contents of a document with semantic information (as cited by Alani et al., 2003; Gibbins et al., 2003).
- b) Integrating the information from various sources by providing a structure for its organisation and facilitating the exchange of data, knowledge, and models.
- c) Ensuring consistency and correctness by formulating constraints on the content of information.
- d) Creating libraries of interchangeable and reusable models.
- e) Supporting inference to derive additional knowledge from a set of facts (as cited by Gomez et al., 2001).

The use of ontologies implies the study of the following topics:

- *Design and implementation*. An ontology is a representation of a domain. Thus, there could be many points of view for the same concept.
- *Validation*. The ontologies must be evaluated and changes made iteratively until an expert in the area thinks that the representation is accurate and complete.
- *Representation*. A representation language is required to save ontologies. Gomez and Corcho (2002) analyzed some available languages like Ontology Exchange Language (XOL), Simple HTML Ontology Extension (SHOE), Ontology Markup Language (OML), Ontology Interchange Language (OIL), DARPA Agent Markup Language + Ontology Interchange Language (DAML + OIL) and RDF (Resource



Description Framework) and showed their advantages and disadvantages. The order of lightweight to heavyweight ontology languages as determined by the study is: XOL, RDF, SHOE, OML, OIL and DAML+OIL. On the other hand, XML (Extensive Markup Language), UML (Uniform Mark Language) and RDF are identified to be the most widely used ontology representation languages that are used mainly to physically code some ontology (Todorovo & Stefanov , 2006)

- *Storage*. It is a representation to maintain a repository. The ontologies are used to reason about a domain; therefore a query language is required.

### **2.2.3 Object Oriented Paradigm**

Object oriented paradigm uses objects which are data structures consisting of data fields and methods together with their interactions, to design applications. Programming techniques such as information hiding, data abstraction, encapsulation, modularity, polymorphism, and inheritance or reuse are used by this paradigm.

A KMS is based on real world objects, requires revisions on individual components and gives importance to the concept of reuse. These features are basis of any object – oriented design. So, an architecture based on object – oriented design, can result in an effective KMS.

Moreover, the most powerful and dynamic web language Java, which forms an important language for designing a KMS also uses object oriented concepts. Apart from programming language, Relational Database Management System (such as Oracle 8 and its higher version) is required for designing the data store of a KMS and it also uses object oriented concepts.

### **2.2.4 Client – Server Technology**

Client-server technology or networking is a distributed application architecture that partitions tasks or work loads between service providers (servers) and service requesters, called clients. Often clients and servers operate over a computer network on separate hardware. A server machine is a high-performance host that is running one

or more server programs and which shares its resources with clients. A client does not share any of its resources, but requests a server's content or service function. Clients therefore initiate communication sessions with servers which await (*listen* to) incoming requests.

Client-server architecture enables the roles and responsibilities of a computing system to be distributed among several independent computers that are known to each other only through a network. This creates an additional advantage to this architecture in terms of greater ease of maintenance. Client-server technologies were designed to ensure security, friendliness of the user interface, and ease of use.

Specific types of clients include web browsers, email clients, and online chat clients. Specific types of servers include web servers, ftp servers, application servers, database servers, name servers, mail servers, file servers, print servers, and terminal servers. Most web services are also types of servers.

A KMS is uploaded in a server and it can be viewed through individual browsers, which acts as the clients. So, it can be concluded that the client-server technology forms the base on which a KMS stands. KMS can be deployed by integrating client-server technology with other technologies.

### **2.2.5 Case-based Reasoning**

Case-based reasoning (CBR) is a reasoning methodology inspired by the human process of remembering a previous similar episode to solve a new problem. The act of being reminded of a previous episode is modeled in case-based reasoners by comparing a new problem with a collection of stored cases (the case base), often based on indexes describing the contents of the stored cases. The most similar cases are then retrieved, and can be used as references to classify the new case or the solutions from the retrieved similar case(s) can be adapted to fit the new problem. If the adaptation result is successful, a new case has been created and is retained in the case base.

According Li et al. (2002), humans often use this technique for decision making therefore attempts have been made to address CBR as a scientific cognitive model (as cited by Kolodner, 1998).

There are two important operators in a case-based reasoning system: select and adapt (Li. et al., 2002).

Select is the means of retrieving the most similar case from the case base, according to the features of the new problem. In adaptation, decisions have to be made about what stays the same and what changes. The two alternatives for reusing a previous construction situation are to replay the operators that produced the solution and to reuse the construction situation itself. These are identified as derivational analogies and transformational (as cited by Carbonell, 1986). The second alternative transfers the solution of an old case so that it satisfies the criteria of a new problem; whereas a derivational analogy modifies the problem-solving processes or techniques of an old case to construct paths that result in solutions to the new problem.

The concept of case-based reasoning can be utilized in designing the knowledge base of organizations. In these organizations, generally the same type of solutions with some refinements has to be applied in solving problems occurring at different instance of time.

Considering one or a combination of more than one technology, KMS architectures are designed both for corporate sectors and education institutes. Some of these architectures related to corporate sector and education institutes are discussed in the next two sections.

### **2.3 Knowledge Management System Architecture in Corporate Sector**

Yan et al. (2004) designed an *agent-based B2B trading system* that has both the dynamic negotiation ability and knowledge management functionality. The study focused on knowledge content of agent negotiation process in electronic marketplace,

discussed how knowledge can be formulated and managed and further be utilized to assist in the competent negotiation process. The study reveals that agents can communicate as if they are using a common market-specific language built on a Knowledge Base, which gives buyers and sellers the freedom to interrelate automatically. Agents also provide a high level of flexibility and interplay on a fully automated level, which allows for broad based, simultaneous activity. Also, since agents have self learning ability, during the negotiation process, when the agents encounters some new “ways” of business deals, it will learn about it and be able to apply them in the future. In another study, Abar et al. (2004) proposed a generic Knowledge Management system architecture based on Agent – based Distributed Information Processing System (ADIPS) framework. *Ontologies* which stand out as a keystone of new generation of multi-agent information systems are used for the purpose of structuring the resources. The framework provides personalized information delivery, identifies items of interest to user proactively and enables unwavering management of distributed intellectual assets. The architecture was proposed to be implemented using IDEA 4.2 – an Interactive Design Environment for Agent designing framework ADIPS/DASH-1.9h and Java 2 SDK-1.4. For the development of interactive user interface, the technology employed is Microsoft ASP-based IIS-PHP. The knowledge specification is written using RDF/XML. The agent architecture discussed in the study aims to support KM activity in the *domain of network management system*. The concept is to specialize agent interactions for autonomously and flexibly managing the operational knowledge of network devices, thereby reducing the workload of a network administrator. In yet another study, Hlupic et al. (2002) investigated the potentiality of an intelligent agent-based software, for more effective KM in the context of e-commerce, from the perspective of a *Small and Medium Size Enterprise (SME)* involved in multi-agent software development. The main recommendation is for considering the future of technology within the context in which it will be applied. In another study, Chiu et al. (2002), described the design and implementation of a *smart office task framework to automate system integration and to enable user centric application*. To achieve the goal of implicit knowledge accumulation and inheritance, they developed a service framework at the

backend for integrating diverse systems seamlessly and an interface agent at the front for hiding complex efforts on manually binding different systems. Advanced e-Commerce Technology (ACT) laboratory adapted Web services to wrap various existing systems into a general RMI format, utilized *ontology* to define and to integrate new functionalities semantically, and took advantage of *agents* to enable a user-centric office environment. In the study, task agents (which is a kind of interface agents) are used to assist workers in daily tasks by detecting regularities in workers' behavior. The main contribution of this study is to offer a substantial test bed on exploring what is the practical approach to shift the design paradigm of developing software from application-centric to user-centric.

Studies have also been done on few multi-agent architectures for KMS, some of which are applied in a specific context. The type of agents used in these studies varied from study to study, depending upon the context. Zhang et al. (2008), used Domain Knowledge Agent, Organization Knowledge Agent, Process Knowledge Agent, Distributed Knowledge Base Agent, Ontology Agent, User Interface Agent, Workflow Agent and Toolset Agent, in its *multi-agent KMS*. These agents are very important for project teams in *cooperative design and development*. In order to achieve effective interaction, each agent must have a mechanism to ensure that it reaches an agreement. This study uses knowledge *ontology* to define a common vocabulary for agents to communicate with one another, and explicitly formalize the domain knowledge about primitive concepts, relations, rules and their instances. *Multi-agent model* is also used to describe the various *activities of the Knowledge Management Life Cycle* (Vizcaino et al., 2007). It consists of the Constructor Agent, the Captor Agent, the Searcher Agent, the Disseminator Agent and the Maintenance Agent. The multi-agent model designed in this study will be helpful to KMS developers to implement KMS. Tacla and Barthes (2002), designed a *multi-agent* architecture for Knowledge Management systems in *research and development (R & D) projects*. The agents used in this architecture are project agent, organizer agent, and repository agent. A KMS based on this architecture is developed, using which a collaborative project between two groups in different countries is done. Soto et al. (2006) utilized two *methodologies for the*

*construction of multi-agent system*, namely MAS-CommonKADS and INGENIAS. MAS-CommonKADS, which extends CommonKADS, is a methodology designed for the development of knowledge base system. On the other hand, INGENIAS is an agent oriented software engineering methodology for multi-agent system development. The study concludes that INGENIAS is one of the most complete methodologies for the development of MAS.

Few ontology based KMS architectures have also been attempted. Alani et al. (2003), presented the developments in the Artequakt project, which sought to *automatically extract knowledge about artists from the Web*, based on an *ontology* describing the domain, populate a knowledge base, and use it to generate personalized narrative biographies. Three key areas of the architecture were identified. The first concerns the knowledge extraction tools used to extract factual information items together with sentences and paragraphs from Web documents that might be manually selected or obtained automatically using appropriate search engine technology. The fragments of information are passed to the ontology server along with *metadata* derived from the vocabulary of the ontology in an XML representation. The second key area is the information management and storage. The information (in XML format) is stored by the ontology server and consolidated into a KB (a relational database) which can be queried (using SQL) via a inference engine. The final key area is the narrative generation. The Artequakt server takes requests from a reader via a simple Web interface. The reader request will include an artist of whom a biography is to be generated in a particular style (chronology, summary, etc.) and also any user interest. The server uses story templates to render a narrative from the information stored in the KB. GATE and WordNet is used for entity identification and WordNet is also used to expand the terms in the ontology and Web documents. The ontology server was based on Java sockets and connected to the Artequakt KB through the Protégé API. In another study, Antunes et al. (2007), describes the Semantic Reuse System (SRS), which takes advantage of *ontologies*, represented using the knowledge representation languages of the Semantic Web like RDF, OWL, etc., for *software development knowledge reuse*. The Knowledge Base of SRS comprises of the Representation

Ontology, the Domain Ontology, the SDKE Repository and User's data. The system is managed by the Jena Semantic Framework, which is an open source Java framework for building Semantic Web applications, providing an API for manipulating RDF graphs, including support for RDF and OWL. The SDKE Repository is managed using Apache Lucene, which provides an open source high-performance engine for full-featured text search and document storage written in Java. The system and user data is managed through a relational database. The core modules of the system are: Indexing Module, Context Module, Search Module, and Browse Module. The study concludes that Ontologies and the Semantic Web technologies enable the association of semantics to software artifacts, which can be used by inference engines to provide new functionalities such as semantic retrieval, or suggestion of relevant knowledge. The SRS provides easy integration with client applications through the semantic web service. Thus, tools for Software Engineering and Model Driven Architecture (MDA) that use metadata can be integrated in SRS. In yet another study, Li et al. (2003) introduced a three-stage life cycle for ontology design and applied it to a real case with Taiwan's *metal industry*. The resulting ontology was represented as information ontology and domain ontology. To facilitate the knowledge management in the industry, an *ontology-based knowledge management system* with the KAON API environment was developed. The proposed system was built upon the Java J2EE distributed component environment and provided the capability of semantic match, and assisted engineers in the activities of knowledge management. The system is composed of three layers: Presentation Layer, Business Layer, and Data Layer. The presentation layer contains several JSP pages and Java servlets (lightweight Java applications in the server side). The major components are News, Forum, System Manager, Personal Knowledge Manager, and Knowledge Search Engine. The J2EE server is deployed in Business Logic Layer. It contains three major components: basic components, knowledge management components, and ontology management components. All knowledge objects are stored in Data Layer. It contains several databases: system database, user database, personal knowledge base, common knowledge base, information ontology base, and domain ontology base. The system not only facilitates users to share individual knowledge objects with each other, but

also enables the KO search engine to have the capability of semantic match due to the ontology. Liu et al. (2007) proposed an *ontology-based* KMS for *expertise matching* within an academic research environment. The system can be used to browse and search experts efficiently and effectively. *Ontology* is also applied to develop a Knowledge Management System for the *industry cluster* to achieve their goal (Sureephong et al., 2008). The architecture of this system consists of three parts, knowledge system, ontology, and knowledge engineering. To test and validate the approach and architecture, *the handicraft cluster* in Thailand is taken as a case study. Literature Review revealed two more KMS architectures which are based on object oriented technology. Carlson and Ram (1991) presented architecture for Distributive Knowledge Base Management System (DKBMS) which manages the meta-knowledge necessary to co-ordinate multiple Knowledge-Based Systems (KBSs). They proposed an *object-oriented design* for implementing the DKBMS structure and the communication protocol which connects the DKBMS with each of the KBSs. A prototype of DKBMS, which *assists managers when developing and controlling strategic plans*, was developed to demonstrate the feasibility and functionality of the DKBMS architecture and to resolve or refine the research issues described above. Through this prototype, the communication protocol and the partial global plan development to minimize network communications overhead was defined. In another study, Frank (1999) designed a KMS architecture based on the *object-oriented* concept. The architecture consisted of three layers. The meta level layer serves to describe and manage terminologies or languages as well as editors used to manipulate models written in object-oriented modeling languages. The conceptual level layer serves to create and manage models. On the other hand, the interface layer is to provide concepts on such a level of abstraction. The study revealed that the pivotal challenge of knowledge management is not to capture existing knowledge, but to create knowledge – through the creation of languages and the construction of realities which are *acceptable to a wide range of companies*. The success of KMS which feature languages and reference models of (future) reality depends on social, economic and political processes – hence it is more a cultural than a technological or scientific challenge.



Review also revealed an open architecture knowledge management tool operating through web (which exhibits *client server technology*) to support knowledge acquisition, representation, and inference through semantic networks and repertory grids (Gaines & Shaw, 1996). It illustrated how web technology provided a new knowledge medium in which knowledge-based system methodologies and tools could be integrated with hypermedia technologies to provide a new generation of knowledge management facilities. The results of this study demonstrated that the World Wide Web client server model operating through the Internet can effectively support the porting of existing knowledge acquisition, modeling and representation tools to operate in a distributed, open architecture environment. This opens up new possibilities for collaborative research in which the methodologies and tools developed by one group are made available on the network for use by other research groups world-wide. It enables past studies of the integration of hypermedia, knowledge acquisition, and interface tools within a local environment to be generalized to integration on a distributed basis across wide area networks. A major advantage of this approach is that tools can be operated at the site of the originators responsible for them, and their maintenance, upgrading and monitoring can be done very much more effectively than when the software is distributed to other sites.

Few KMS architectures based on CBR has also been identified in the review.

Wang and Chen (2004) studied the issues of collection and evaluation of knowledge in a collaborative team of a complex engineering domain. They provided a collaborative knowledge production model for it by combining *case based knowledge management* and *workflow management technique*. A reference model was developed and based on this a collaborative KMS was developed, which was used in a *craft design academy and an automobile manufacture factory of China*. Another study provided a case representation method and corresponding system architecture of CBR (*Case Base Reasoning*), which could be used for developing trend of knowledge sharing , knowledge management tools, and knowledge application (Liu et al., 2004). Based on Semantic Web and Ontology technology, a new case representation method and

corresponding system architecture of *CBR (which can support the agent solving problems automatically)* was designed in this study. The study identified the following advantages of this system.

- **Flexibility:** The Semantic Web divides the knowledge representation into two layers: one is the frame of the knowledge, the ontology; the other is detail knowledge such as cases. The Semantic Web uses the extended markup language (XML) to implement the knowledge representation and uses document as the storage form of the ontology and cases, which is more natural in the representation form and clearer in the organization structure than the database or other case base organization forms. This gives flexibility to the process of knowledge representation.
- **Independence of data and algorithm:** The Semantic Web based CBR used DAML + OIL language to label the cases and used the agent to wrap the reasoning algorithm to realize the independence of data and algorithm. Thus the same case can be reused by different reasoning algorithms for different phases of the system's development. The different applications based on the same ontology can exchange knowledge via the ontology to realize the co-operation and the communication of heterogeneity knowledge.

The Semantic Web CBR approach depends on the ontology and calls for high quality ontology.

Case Based Reasoning also addressed the issue of integrating knowledge access into the user's problem-solving process. The user's task relevant information is collected automatically from multiple sources. Leake et al. (1999), applied this feature in the Stamping Advisor, a system that aids in the *design of stamped automotive parts*. The system automatically presented the designer with needed information in a natural way, uses *CBR and task-focused information retrieval* to access useful information, and automatically captures relevant information to support downstream task processes and build its memory of cases. The system

illustrates five principles for integrating CBR into design support tools and generally for using CBR in task-based knowledge management.

- **Seamless Interaction:** Interaction with the combined system must parallel the user's own problem-solving process, to make the information available without leaving the problem-solving context.
- **Proactive support:** The system must automatically provide the right information when it is needed, rather than placing the burden on the user to formulate requests.
- **Integration with other knowledge sources:** The system must provide a task-based facility to gather relevant information across all available information resources, supplementing case information with other types of information as appropriate to the task.
- **Integration across tasks:** The system must support not only the immediate reasoning task but also the downstream tasks it serves. The system should automatically access information about the previous tasks to provide a context for its reasoning.
- **Experience capture:** Each processing episode must generate new cases or update old ones to capture information for future reasoning and downstream processing.

In yet another study, Zhang et al. (2006) established a *case base of repair experiences* to manage the tacit knowledge by case-based reasoning. The system was developed on ASP platform. The repair stations all over China access the system by logging in the ASP server. The system is used by three large domestic appliance manufacturers. KMS for domestic appliance repair is a learning platform of repair knowledge, a communication platform for repairers to share their experience and technology, a working support platform of repair working process, and a training platform for new repairers. Weber and Wu (2004) utilized the learning from previous experience feature of CBR to design a KM framework, which was incorporated in a *Computational Intelligence System*. This system was used for software testing at National Institute for System Test and Productivity. The main advantage of adopting this KM strategy relate to giving CIS the ability to learn from its own executions and to adapt and

evolve. The KM framework presented here uses two well validated methods: monitored distribution (MD) and *case-based reasoning* (CBR). MD has been demonstrated to improve the quality of the final result produced by the system it targets. CBR on the other hand, contributes to the framework with a solid array of techniques developed and implemented in real world applications. An approach for the automatic acquisition and cross-linking of cases from heterogeneous knowledge sources is also reviewed. In yet another study, Li et al. (2002) presented *an intelligent Web-based project management system, called VH Build.com*, which integrated project management, knowledge management and artificial intelligence. One unique feature of the system is that it utilizes a number of intelligent decision support systems; including *genetic algorithms based time-cost optimization, rule-based drawing interpretation, and case-based reasoning*. By storing and indexing previous cases of critical issues into a case base, the CBR mechanism transfers past problem solving experiences into a process of knowledge management. The system has been implemented in a Web-based environment with a main server containing project databases.

Besides these technologies, there are other tools used in designing the architecture of a KMS. One such KMS architecture named as Knowledge Support (K-Support) system is based on *adaptive task based profiling approach and fuzzy analytical method* (Wu et al., 2004). This system provides a collaborative task-based workplace to facilitate knowledge retrieval and sharing among peer-groups. The adaptive task based profiling approach is proposed to model workers' information needs (profiles), while the fuzzy analytical method is proposed to *identify peer groups with similar task interests based on workers' profiles*. The system is grounded in a research institute to effectively stimulate task based knowledge retrieval and sharing. It is a Web based application that allows workers to retrieve, organize and share task relevant knowledge. The system can recommend task relevant information based on the worker's profiles. A tree like structure is employed to organize the task relevant information. Once the worker selects a document or a task topic to read, the detailed information will be displayed. The worker can download the document or store it to

the My Favorite folder. The user behavior tracker in the profile modeling server will track the worker's feedback or assess behavior to adapt the task and work profiles. The system expands the ontology of a worker with the peer group member's personalized ontology for knowledge sharing. The system facilitates knowledge sharing by displaying the shared information such as tasks and documents from task based peer groups. Another study employed *Churchman's Singerian inquiring system* as a kernel theory on which KMS design is based. The Churchmanian Knowledge Management Systems (CKMS) defined a purposeful and ethical information system that creates exoteric knowledge and provides a link between knowledge and action in an organization. The design principles involve a strong emphasis on ethical behavior, the development of success measures for CKMS, the need to ensure that the CKMS enhances the dignity of mankind, a highly participatory design process, the desire to unify the designers, the decision makers and clients, the need to shape CKMS components in relation to the system as a whole, and the need for a guarantor to validate knowledge residing in the CKMS. The study concludes that the nine conditions of the Singerian inquiring system can form the foundation on which the design principles for KMS can be based. The design principles stated in this study must be refined and tested to be used in *action research projects*. In yet another study, *Bosch's architectural design method and simulation techniques* were used in the development of a KMS (Perez, et al., 2002). In this study, the quality attributes defined by the Bosch's architectural design method was applied to the KMS case study, in the *domain of collaborative systems*. A number candidate architectures of the system were proposed, and then simulation technique was applied to select the most suitable architecture. The architectural quality attributes that must be used in the development of collaborative system are identified as: Maintainability, Reliability and Efficiency. For evaluating the architecture, Bosch method was used. Profile technique, proposed in the Bosch's method was modified in order to adapt it to simulation technique. *System analysis* is another tool used in the designing of KMS architecture (Tuzovsky & Yampolsky, 2003). This study considers the main stages of knowledge processing such as defining Company's new knowledge requirements, exposure knowledge of organization, building conceptual model for Company's subject area,

knowledge description, educational courses elaboration for new knowledge mastering, and sharing knowledge of *Company*. On the basis of these, a KMS is built which can be used over Internet / Intranet. Another study analyzed the different models of KMS and considered the *Service model as the basic model in the Service- Oriented Architecture* (Deng & Hu, 2007). This model is divided into four layers. They are knowledge units, knowledge processing, knowledge storage and knowledge sharing. A Complex Organic Distributed Architecture (CODA) is described in a study to model a distributed knowledge management system applied in *business intelligence* (Megaache et al., 2000). This study also proposes a security system architecture that can be integrated with CODA. The foundation of the *security system is a Role-Based Access Control (RBAC) model*, which provides all the functionality required by a security system, including authentication and auditing. From the study it has been found that the support of evolution is requirement in the development of enterprise knowledge management system and data warehousing system. Thus, the success of such systems should be measured by its ability to operate in frequently changing environment. Also, RBAC security techniques can be considered as an important enterprise access control technique. It is characterized by its management efficiency and its support for a wide range of policies. The *design principles proposed by Boland, et al. (1994)* are modified with the addition of *Habermas's theory of communicative action* and the resulting design principles are proposed as a framework for the design of *information technology that supports distributed cognition and knowledge management in organizations* (Richardson, 2005).

## **2.4 Knowledge Management System Architecture in Academics**

Review of literature also revealed that few KMS architecture for academics was designed using the technologies discussed in the previous sections (Section 2.2.1 to Section 2.2.5). Abdullah et al. (2005) proposed a framework of KMS implementation in collaborative environment for *Higher Learning Institutions (HLI)*, by analyzing KM concept, system and architecture. The architecture utilized both *client-server and agent technology*. The framework development started with the framing of a questionnaire that was used to interview members of the HLI's Communities of

Practice, like system analysts, chief knowledge officers (CKOs), programmers, and active users, who are involved in the KMS development. The results of the interview showed that the respondents agreed that KMS should be focusing on issues in terms of KM architecture and its functionality, KM infrastructure and technology, KM process as a model of acquisition and dissemination, and KM culture. As far as architecture is concerned, the study put forward a four layer architecture, namely repositories, infrastructure, technology and application. The functionalities included in the application layer are the portal, Electronic Document Management System (EDMS), Workflow, and Online Analytical Processing (OLAP). In the technology layer, functionalities like agent, email, video conferencing and chat were focused. In another study, Anbulagan and Kuswara (2001), discuss the implementation of Knowledge Management in a *leading Indonesian IT school (Bina Nusantara University or BINUS)*. They followed the knowledge management development process such as need detection, construction of corporate memory, diffusion of knowledge, use of knowledge, evaluation of corporate memory, maintenance and evolution of corporate memory. A four layer architecture was used in the KMS. The knowledge repositories (Storage Layer) could be accessed using browser (user interface layer) through communication and transport layer. The architecture was based on both *client server and agent technology* and the implementation done by using Lotus Notes. A *multi agent* architecture ESMAP used user agents, expert agents, node agents, information agents and a broker agent for their study (Gracia & Cobos, 2006). This architecture enhanced the potential of KnowCat (Knowledge Catalyser), a distributed non-supervised system that supports collaborative Knowledge Management for knowledge communities. It provides a highly structured and organized framework to find relevant and good quality knowledge that may be of interest for knowledge communities. KnowCat comprises a set of topic-specific knowledge centres called KnowCat knowledge nodes. An expert recommender module is devised in order to facilitate the location of expertise knowledge. The *expert recommender* module which consists of a main agent and the expert agent interacts with other agents such as user and information agent, to prepare the recommendation list.

Aldea et al. (2003) described the development of knowledge management platform for web-based enabled environments featuring intelligence and insight capabilities. It was the result of an *IST project involving three universities, a technology provider and five user companies*. The main objective of the platform was to analyze, search and present information retrieved from the web or any other document. This was achieved by the use of *Multi-Agent system and ontologies*. The three layer architecture implemented in this study comprised of:

*The user interface:* This consisted of a Graphical User Interface and a User Agent.

*The search module:* This was a multi-agent system comprising of two agents, namely Coordinator Agent and Internet Agent.

*The Knowledge Generation Module:* In this module, the domain ontology was described.

In another study, Minor and Biermann (2005) employed this strategy for a sample Knowledge Management System, namely a *case-based online dictionary* for the RoboCup simulation league community. Users can query the selected parts of the case base in natural language as well as navigate along the cross-references. In comparison with other similar studies, this study requires less effort to prepare the knowledge sources.

## **2.5 Summary of Literature Review**

The summary of the studies on Applications of KMS as discussed in Sections 2.1.1, 2.3 and 2.4 are described in Table 2.3 and Table 2.4.



**Table 2.3: Summary of Studies on Applications of KMS**

<b>Researcher &amp; Year</b>	<b>Education Institute / Corporate Sectors</b>	<b>Applied Area</b>
Carlson & Ram, 1991	Corporate Sector	Assist managers when developing and controlling strategic plans.
Skuce, 1995	Corporate Sector	Large commercial software systems.
Gaines & Shaw, 1996	Education Institute	Collaborative Research
Ginsbury & Kambil, 1999	Corporate Sector	Document Collection in federated organizations.
Frank, 1999	Corporate Sector	Wide range of companies.
Leake, 1999	Corporate Sector	Design of stamped automotive parts.
Kidwell et al., 2000	Education Institute	Identified prominent areas of Higher Education where KM can be applied.
Kingston & Machintosh, 2000	Corporate Sector	Medical Domain.
Megaache et al., 2000	Corporate Sector	Business Intelligence.
Anbulgan & Kuswara, 2001	Education Institute	Leading IT school of Indonesia.
Salisbury & Plass, 2001	Corporate Sector	Process Realization Online Website through which the Technical Best Practices are shared.
Chiu et al., 2002	Corporate Sector	Smart office task to automate, integrate and enable user centric application.
Hlupic et al., 2002	Corporate Sector	Small and Medium Size Enterprise (SME).
Li et al., 2002	Corporate Sector	Web-based Project Management System.
Tacla & Barthes, 2002	Corporate Sector	Research and Development (R&D) projects.
Wei et al., 2002	Corporate Sector	Integrated circuit assembly and testing firm.
Wang, 2002	Corporate Sector	Online Auction

**Table 2.3: Summary of Studies on Applications of KMS**

<b>Researcher &amp; Year</b>	<b>Education Institute / Corporate Sectors</b>	<b>Applied Area</b>
Alani et al., 2003	Corporate Sector	Automatically extract knowledge about artists from the Web.
Aldea et al., 2003	Education Institute	IST project involving three universities, a technology provider and five user companies.
Li et al., 2003	Corporate Sector	Metal Industry
Salazar et al., 2003	Corporate Sector	Biotechnology and Pharmaceutical firms.
Wang et al., 2003	Corporate Sector	Supporting systems for enterprise modeling projects.
Wimmer & Traunmiller, 2003	Corporate Sector	Public Administration
Abar et al., 2004	Corporate Sector	Network management system
Liao, 2004	Education Institute	Administration
Stover, 2004	Education Institute	Library References Services
Wang & Chen , 2004	Corporate Sector	Craft design academy and automobile manufacture factory.
Weber & Wu, 2004	Corporate Sector	Computational Intelligence System.
Woo et al., 2004	Corporate Sector	Architecture Engineering and Construction (AEC) industry.
Wu & Huang, 2004	Corporate Sector	To retrieve Product Design Requirements.
Wu et al., 2004	Corporate Sector	Identify peer groups with similar task interests.
Yan et al., 2004	Corporate Sector	B2B trading system
Abdullah et al., 2005	Education Institute	Public Higher Learning Institution.
Minor & Biermann, 2005	Education Institute	Online Dictionary.

**Table 2.3: Summary of Studies on Applications of KMS**

<b>Researcher &amp; Year</b>	<b>Education Institute / Corporate Sectors</b>	<b>Applied Area</b>
Trappey et al., 2005	Corporate Sector	Searching of correct Patent Documents and its Classification.
Zhang et al., 2005	Education Institute	Teaching Database Normalization.
Gracia & Cobos, 2006	Education Institute	Expert Recommender.
Numprasertchai & Poovarawan, 2006	Education Institute	To support University Mandates.
Soto et al., 2006	Corporate Sector	Software Maintenance companies
Zhang et al., 2006	Corporate Sector	Domestic appliance manufacturers.
Antunes et al., 2007	Corporate Sector	Software Development Knowledge Reuse.
Basu & Sengupta, 2007	Education Institute	Business School.
Ranjan & Khalil, 2007	Education Institute	Business School.
Vizcaino et al., 2007	Corporate Sector	Activities of KM Life Cycle
Witt et al., 2007	Education Institute	Community of Practice.
Sureephong et al., 2008	Corporate Sector	Handicraft cluster.
Zhang et al., 2008	Corporate Sector	Cooperative design and development.

The summary of the studies on Architectures of KMS as discussed in Section 2.3 & Section 2.4 and the technologies used in these architectures are illustrated in Table 2.4.

**Table 2.4: Summary of Studies on Architecture of KMS and the Technologies Used**

<b>Researcher &amp; Year</b>	<b>Education Institute / Corporate Sector</b>	<b>Technology Used</b>
Carlson & Ram, 1991	Corporate Sector	Object Oriented Paradigm
Gaines & Shaw, 1996	Corporate Sector	Client Server Technology
Frank, 1999	Corporate Sector	Object Oriented Paradigm
Leake, 1999	Corporate Sector	Case-based Reasoning and task-focused information retrieval.
Anbulgan & Kuswara, 2001	Education Institute	Agent and Client-Server technology
Chiu et al., 2002	Corporate Sector	Agent & Ontology
Hlupic et al., 2002	Corporate Sector	Agent
Li et al., 2002	Corporate Sector	Genetic Algorithm, Rule-based drawing interpretation and Case-based Reasoning
Tacla & Barthes, 2002	Corporate Sector	Agent and Ontology
Aldea et al., 2003	Education Institute	Agent and Ontology
Alani et al., 2003	Corporate Sector	Ontology
Li et al., 2003	Corporate Sector	Ontology
Abar et al., 2004	Corporate Sector	Agent & Ontology
Liu et al., 2004	Corporate Sector	Case-based Reasoning, Agent & Ontology
Wang & Chen , 2004	Corporate Sector	Case-based Reasoning
Weber & Wu, 2004	Corporate Sector	Case-based Reasoning & Monitored Distribution
Yan et al., 2004	Corporate Sector	Agent
Abdullah et al., 2005	Education Institute	Agent and Client-Server technology
Minor & Biermann, 2005	Education Institute	Case-based Reasoning
Gracia & Cobos, 2006	Education Institute	Agent
Soto et al., 2006	Corporate Sector	Agent
Zhang et al., 2006	Corporate Sector	Case-based Reasoning
Antunes et al., 2007	Corporate Sector	Ontology.
Liu et al.	Education Institute	Ontology

**Table 2.4: Summary of Studies on Architecture of KMS and the Technologies Used**

<b>Researcher &amp; Year</b>	<b>Education Institute / Corporate Sector</b>	<b>Technology Used</b>
Vizcaino et al., 2007	Corporate Sector	Agent
Sureephong et al., 2008	Corporate Sector	Ontology
Zhang et al., 2008	Corporate Sector	Agent & Ontology

## **2.6 Research Gap**

From the summary of studies on applications of KMS, illustrated in Table 2.3, it can be observed that out of the forty seven studies on applications of KMS, only fourteen studies relate to academics. Also, from Table 2.4, it can be observed that out of twenty seven KMS architectures, only six are for academics. Therefore, it can be concluded that research on KMS architectures for educational institutions are limited in number. Moreover, from the studies discussed in Table 2.4, it can be inferred that most of the KMS architectures for academics are either *addressing a specific component of academics like teaching-learning process, administrative issues etc.*

The KMS architectures for academics discussed in Table 2.4, was designed considering selective user requirement from one institute only. No studies took inputs from corporate sector KMS probably because it is difficult to get access to corporate knowledge portals or may be it did not fall under the scope of their study.

KMS focusing on facilitating an academician, in academic and administrative activities, was not found in the course of literature review. Moreover, the available KMS architectures to academics were specific for an institute and could not be generalized.

# Chapter 3

## Research Methodology

# Research Methodology

## 3.1 Objectives of the Study

The objective of this research is to design a Web-based Knowledge Management System (KMS) architecture for academicians involved with Management and Computer Education and develop a prototype at Tezpur University, located in Eastern India. The objective can be further broken down as follows:

1. To classify the attributes of KMS, by a review of literature and also by observing KMS in practice.
2. To design architecture for a Web-based KMS through a user requirement study and using inputs from 1 above.
3. To implement the proposed design at Tezpur University and analyze effectiveness of the design via feedback.

## 3.2 Study Plan as per Objective

In order to achieve the stated objectives the following research plan was adopted.

1. Attributes of a KMS were gathered from literature survey (objective 1).
2. Interface and processing requirements for a KMS was obtained by observing KMS in practice (objective 1).
3. Geographical scope was defined and a database of emails of academicians teaching graduate and post graduate courses in Computer Science (Annexure II A) and Management (Annexure II B) and websites of academic institute also (Annexure III) was created.
4. Focus group discussions were held among academics from Management Science and Computer Science of Tezpur University, to find out their requirements from a KMS. The inputs gathered have been used for designing the questionnaire, which was used for collecting user requirements (objective 2).

5. User requirements were obtained via email survey conducted among faculty of Management and Computer Science of those institutes mentioned in Annexure III (objective 2).
6. A Web-based KMS architecture was designed based on inputs from literature survey, observations of KMS in practice and user requirements (objective 2).
7. A prototype was developed based on this architecture and the same implemented at Tezpur University (objective 3).
8. The ISO Consolidated Usability Model (Abran et al., 2003) questionnaire was adopted partly to elicit feedback on effectiveness of the KMS. (Refer to Annexure VIII)
9. Feedback of the implemented system was obtained by conducting an email survey (for academicians who are geographically at a distance) and also by conducting a physical survey among the academicians in Tezpur University and those within a radius of 200 kms from the university (objective 3).
10. The feedback was analyzed in order to validate the system (objective 3).

### **3.3 Sources of Data**

For the study both secondary and primary data was used which is described below.

#### **3.3.1 Secondary Data**

Secondary data used in the research were obtained from books, journals and websites. The data obtained from these sources were used to identify the attributes of a KMS, to gather the email addresses of academicians and to design the architecture of the KMS for academics. This helped in creation of the prototype.

#### **3.3.2 Primary Data**

Primary data used in research were obtained from observations of KMS in practice and also from a survey done among academicians teaching graduate and postgraduates courses in Management and Computer Science in Eastern India. KMS of various organizations were observed either by personally visiting the organization or by observing and querying about the portal through internet. Interface and processing



information were the parameters that were observed in these KMS in practice. These inputs went into the prototype creation.

A user requirement survey was conducted to gather the specific requirements of academics of management and computer science that should be incorporated in the architecture of the KMS for academics. This user requirement obtained also helped in prototype creation. Details regarding the process of questionnaire design, the survey and the questionnaire details are discussed in the next sections.

Primary data was also obtained from feedback of the implemented system.

### **3.4 User Requirement Survey**

In order to design the questionnaire for the user requirement survey focus group discussion technique was adopted. Two focus group discussions were held among academics from Management Science and Computer Science & Engineering of Tezpur University. The reason for confining this discussion to Tezpur University is that these groups of academics have strong knowledge of computer operations and browsing, and are high users of the Intranet and Internet. The discussion took place in the month of May, 2007 in the premises of the Department of Business Administration, Tezpur University.

The first group comprised of five participants' viz. four academicians from Computer Science & Engineering and one from Management Science and two moderators. The participants in this group comprised of senior academicians. The second group comprised of six participants' viz. three academicians from Computer Science & Engineering and three from Management Science and two moderators. The participants in this group comprised of junior academicians.

The discussions revolved around Research, Curriculum Development, Dealing with students and alumni, Administrative services and Strategic Planning; these are areas

identified by Kidwell et al. (2000). This discussion provided clues about the unique needs of this community.

The outcomes of the first focus group discussion were:

- Suggestion to develop a Knowledge Management portal for Research first, and then to add the other components one by one.
- Contents of Research suggested were:
  - Access to research publications
  - Experimental details of previous research work
  - Research publication index
  - Student projects

The outcomes of the second focus group discussion were:

1. In the context of Teaching and Research Activity, the following specifications were put forward.
  - Bibliographies of various research topics
  - Authentic databanks
  - APA guidelines for referencing
  - List of subject experts
  - Collaborations with other institutes
  - Funding agencies
  - Future trends of research activities (unpublished work)
  - New arrivals in the Library
  - Reader's comments
  - Evaluation rules
  - Question paper setting style
2. For Curriculum Development, the following specifications were put forward.
  - Links to Curriculum
  - Feedback from alumni

3. Administrative Services sought by the academicians were:

- Leave Rules
- Procedure of applying for attending a conference
- IT calculator

4. For Strategic Planning the aid sought by the academicians was:

- UGC and AICTE guidelines.

5. Miscellaneous requirements included

- Holiday List
- Bus timings
- Canteen information
- Event calendar

The inputs gathered were used for designing the questionnaire that was used for collecting user requirements. [See Annexure I]

#### **3.4.1 Questionnaire for User Requirement Survey**

The data collection instrument employed for the user requirement survey was a questionnaire distributed through email. The questionnaire was designed based on inputs of the Focus group discussions. The questions formulated, tried to find out the requirements of academicians teaching in graduate and postgraduate programs in Management and Computer Science institutions in Eastern India.

The questionnaire contained eleven questions [See Annexure I]. All the questions were in nominal scale except Q.No.7, which was an open-ended question. The first question tried to find out research and teaching related requirements of the respondents. Thirteen options were provided for this question along with one open option. The second question, tried to find out respondent's expectations from a library. In this question, five options were provided which included one open option. The information required by the respondents to design a new curriculum or revise an old curriculum was found from the third question. For this question also five options were provided, including the open option. Question four tried to find out the additional

administrative position held by the respondent and question five tried to identify the aids the respondents required for performing additional administrative jobs. Including the open option, four options were listed for both question four and five. Question 6(a) was a question with a yes/no response format. It tried to find out if the respondent was involved in strategic planning of the institute and question 6(b) tried to find out the requirements of those respondents who were involved in strategic planning. Four options including one open option was provided for this question. Question no. 7 was an open ended question, which tried to find out frequently required information other than those already listed. Sources from which the respondents search for information was identified from Question 8. In this question, three options, including one open option was provided. Question no. 9, tried to find the average time spent by a respondent per week in searching for information required by them for their work. The reading habit of the respondent was sought in Question no. 10. In this question also, six options were provided including one open question. The questionnaire ended with a request for information regarding name, designation, department and the organization of the respondent.

### **3.4.2 Sample Survey - 1**

Primary data was obtained from prospective users through email survey. Details regarding primary data collection including study population, sampling procedure, sampling frame, sample size and area covered have been provided in the following sections.

**3.4.2.1 Study Population – 1:** The population for the survey, from which the sample was drawn, was academicians from Computer Science or Management disciplines, and who worked in an academic institute in Eastern India.

Element: For the purpose of this research, elements are individuals who fulfill the following criteria:

- (a) An academician working in a Computer Science or Management Institute in Eastern India.
- (b) Eastern India comprises of Assam, Arunachal Pradesh, Bihar, Jharkand, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Sikkim, Tripura and West Bengal.

Sampling Unit: The sampling unit for this study is defined as the individual academician.

Extent: The survey was conducted in Eastern India.

Survey period: The data was collected during the period December 2007 through October 2008.

**3.4.2.2 Sampling Procedure -1:** Judgement sampling procedure was used for the study.

The basis of judgement in selecting the academic institutes was that the institution be located in Eastern India and have Intranet and Internet connections.

The basis of judgement in selecting the respondent was that the respondent should be an academician, teaching higher-level Management and Computer courses in Eastern India, and should have computer operating and browsing knowledge. The websites of the academic institutes of eastern India offering Computer Science and Management education were searched and the email address of the permanent faculty member of those institutes were collected from those websites. The questionnaire was sent to only those academicians who had email accounts.

The reason behind selecting these two disciplines for this particular study is that both are very popular, industry oriented and the people in these two disciplines are Internet savvy. There is also a large number of institutions (both public and private) offering these courses. [See Annexure III]

The respondents were selected from Eastern India due to convenience in accessibility and with the intention of confining it geographically.

The Internet connectivity of Tezpur University, where the proposed prototype of KMS was implemented, is provided via a 2Mbps Leased Line Link and a VSAT link of 512 Kbps. While accessing the KMS, the user may be connected either through the VSAT link or through the Leased Line Link. If access is via the VSAT link, then an outside user may not be able to open the site or even if it opens then the efficiency of the KMS will be very poor. Due to this problem, getting feedback from online users is likely to be difficult. So, if the survey is restricted to Eastern India then a self administered offline feedback survey can also be carried out.

Sample selection was restricted to academic institutions offering Management and / or Computer Science courses in Eastern India. The reason for restricting it is as follows. Elaborating on implementing of KMS in educational institutions, Thorn (2001) had stated that a wide open area of study makes it difficult to understand the implication of KM for an educational setting. From the above statement it can be concluded that a common KMS for all branches of education becomes difficult. Hence the study focused on only two disciplines.

**3.4.2.3 Sampling Frame – 1:** The sampling frame in this research comprised of the websites address of Management and Computer Science institutes obtained from the following websites.

- <http://www.indianmba.com/>
- <http://www.techeduindia.com/computer-science-engineering-in-india/>

- <http://www.assameducation.net/management/>
- <http://www.aicte-india.org/einp.htm>

**3.4.2.4 Sample Size – 1:** To determine the sample size for the user requirement survey, similar studies were taken into consideration. The literature review showed that very few studies used survey method for identifying the requirements of the users. However, none of the studies mentioned about the sample size. Only one study was identified that used interview method to determine the user requirement in KMS architecture. This study interviewed fourteen respondents to gather their requirements for designing the KMS architecture (Abdullah et. al., 2005).

For this study, a total of 120 questionnaires were sent to different academicians. Out of this, 72 usable questionnaires were obtained at the end of the survey period. Details about the profiles of the respondents are provided in Chapter 4.

**3.4.2.5 Area Covered – 1:** User requirement was collected from different management and computer science institutes of Eastern India. They are:

**Assam**

Assam Institute of Management, Guwahati

Centre for Management Studies, Dibrugarh University, Dibrugarh

Department of Business Administration, Assam University, Silchar

Department of Business Administration, Gauhati University, Guwahati

Department of Computer Science & Engineering, Indian Institute of Technology (IIT), Guwahati

Department of Electronics and Telecommunication, National Institute of Technology (NIT), Silchar

Department of Business Administration, Tezpur University, Tezpur

Department of Computer Science & Engineering, Tezpur University, Tezpur

North Eastern Regional Institute of Management (NERIM), Guwahati

**Arunchal Pradesh**

Department of Computer Science, NERIST, Nirjuli

**Jharkhand**

Department of Management Studies, Indian School of Mines, Dhanbad

Department of Computer Science Engineering, Birla Institute of Technology, Mesra, Ranchi

Department of Management, Birla Institute of Technology, Mesra, Ranchi

School of Management, Xavier Labour Relation Institute (XLRI), Jamshedpur

**Meghalaya**

Rajiv Gandhi Indian Institute of Management, Shillong

**Orissa**

Academy of Management Studies, Bhubaneswar

Department of Computer Science Engineering, NIT Rourkela, Orissa

Department of Computer Science Engineering, Silicon School of Information Technology, Bhubaneswar

Department of Computer Science & Engineering, National Institute of Science & Technology, Berhampur, Orissa

Department of Computer Science & IT, Synergy Institute of Engineering & Technology, Orissa

Institute of Business Administration and Training (IBAT), Bhubaneswar

Institute of Management and Information Science, Bhubaneswar

Regional College of Management, Bhubaneswar

Xavier Institute of Management (XIM), Bhubaneswar

**Sikkim**

Department of Computer Science & Engineering, Sikkim Manipal Institute of Technology, Majitar, Rangpo



## **West Bengal**

Department of Computer Science Engineering, Birbhum Institute of Engineering & Technology, Birbhum, West Bengal

Department of Computer Science, Bengal Engineering and Science University, Shibpur, West Bengal

Department of Computer Science & Engineering, Indian Institute of Technology (IIT), Kharagpur

Indian Institute of Management Calcutta (IIM Calcutta), Kolkotta

Vinod Gupta School of Management - Indian Institute of Technology (IIT), Kharagpur

### **3.5 Architecture Design of KMS for Academics**

Attributes of KMS and technologies used in KMS architectures were gathered from the literature survey; primary data on Interface and Processing requirement were obtained by observing KMS in practice and primary data on user requirements were gathered through an email survey (details discussed in Chapter 4). Based on these inputs the architecture of the proposed KMS for academics was designed (details discussed in Chapter 5).

### **3.6 Implementation of KMS for academics**

Software and programming languages used for developing a KMS were gathered from literature review as well as by discussing with the KMS experts associated with corporate KMS. Considering the availability and popularity of the software Oracle 9i, it was selected to design the database for the KMS, Microsoft Frontpage for designing the Interface and Protégé 3.1 for creating the ontology used in the ontology driven search engine of the portal. The languages used for the interface design were HTML, Javascript and php script and for database connectivity php script was used. The server software used for the study was Zend which includes Apache Server and supports both php scripting and Oracle.

The portal was implemented in a Windows XP based PC, loaded with Oracle 9i Server and Zend server software. This PC was connected to the internet via the gateway of Tezpur University internet connectivity (details discussed in Chapter 6).

### **3.7 Feedback**

Feedback of the implemented KMS for academics was obtained to analyze for its effectiveness. Details regarding the survey and the questionnaire details are discussed in the next sections.

#### **3.7.1 Sample Survey - 2**

Feedback of the implemented system was obtained by conducting an email survey and also by conducting a physical survey among the users in Tezpur University and those within a radius of 200 kms from the university. The study population was the same as described earlier.

**3.7.1.1 Study Population – 2:** The population for the survey, from which the samples was drawn, was academicians from Computer Science or Management disciplines, and who worked in an academic institute in Eastern India.

Element: For the purpose of this research, elements are individuals who fulfill the following criteria:

- (a) An academician working in a Computer Science or Management Institute in Eastern India.
- (b) Eastern India comprises of Assam, Arunachal Pradesh, Bihar, Jharkand, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Sikkim, Tripura and West Bengal.

Sampling Unit: The sampling unit for this study is defined as the individual academician.

Extent: The survey has been conducted in Eastern India.

Survey period: The feedback was collected during the period December 2010 through April 2011.

**3.7.1.2 Sampling Procedure – 2:** Convenience sampling procedure was used for the study.

**3.7.1.3 Sampling Frame – 2:** The sampling frame used for the feedback survey is same as that of the user requirement survey, discussed in Section 3.4.2.3 of this Chapter.

**3.7.1.4 Sample Size – 2:** A couple of studies were identified that used survey method to validate a KMS. A table showing the sample size of these surveys is shown below.

**Table 3.1: Sample Size of Survey Used to Validate KMS**

<b>Researcher &amp; Year</b>	<b>Sample Size</b>
Ong & Lai, 2007	147
Jennex et al. , 2007	103
Tseng, 2008	57
Hashim & Sultan, 2009	14

From Table 3.1, it was found that the sample size used in surveys to gather feedback about a KMS ranged from 14 to 147. Therefore, a sample size within this range was considered for gathering the feedback of the implemented KMS for academics. 66 responses were gathered and taken into consideration.

**3.7.1.5 Area Covered – 2:** Although feedback was sought via email from all respondents featuring in the user requirement study, responses were slow. This necessitated an offline survey also. Feedback was finally obtained from the following institutions:

## **Assam**

Assam Institute of Management, Guwahati

Centre for Management Studies, Dibrugarh University, Dibrugarh

Department of Business Administration, Tezpur University, Tezpur

Department of Computer Science & Engineering, Tezpur University, Tezpur

Department of Management, Gauhati Commerce College, Guwahati

Don Bosco Institute of Management, Guwahati

Girijnanda Chowdhury Institute of Management and Technology, Guwahati

North Eastern Regional Institute of Management (NERIM), Guwahati

## **Jharkhand**

Department of Computer Science Engineering, Birla Institute of Technology, Mesra,  
Ranchi

School of Management, Xavier Labour Relation Institute (XLRI), Jamshedpur

## **Orissa**

Xavier Institute of Management (XIM), Bhubaneswar

## **West Bengal**

Department of Computer Science & Engineering, Indian Institute of Technology (IIT),  
Kharagpur

### **3.7.2 Questionnaire for the Feedback Survey**

For the feedback survey on the implemented KMS for academics, the data collection instrument employed was a questionnaire distributed both through email and also self-administered. The questionnaire was an adaptation of the ISO Consolidated Usability Model (Abran et al., 2003). In the feedback survey, the attributes considered for measuring user's subjective satisfaction were KMS effectiveness, efficiency, security, satisfaction, and learnability. Besides these attributes, qualitative data on additions to be incorporated and reasons for dissatisfaction (if any) were also sought for.

The questionnaire had eight questions [See Annexure VIII].

The first three questions tried to find out the security aspect of the system. All these questions were in the nominal scale. The 4<sup>th</sup> question was based on a five-point Likert scale, with a highest score of 2 (if Strongly Agreed with the statement) and a lowest score of -2 (if Strongly Disagreed with the statement). This question tried to measure the satisfaction of the users on the various components of the implemented KMS by trying to find out the usefulness of the component. The 5<sup>th</sup> question was based on a three-point scale, with a highest score of 1 (if Agreed with the statement) and a lowest score of -1 (if Disagreed with the statement). This question tried to determine the effectiveness and efficiency of the implemented KMS by seeking users' perception of the processing time taken by each of the component. Since, the implemented KMS is only a prototype; therefore it has scope for improvement. In order to upgrade the system, a qualitative question on the additions and improvements of each of the components of the KMS is included in QNo.6. A three-point scale was used in QNo.7, to determine the user satisfaction on the KMS as a whole. QNo. 8 was in ordinal scale and it asked for a overall score of the implemented KMS, on a five point scale, 1 taken as the lowest and 5 taken as the highest score The questionnaire ended with a request for information regarding name, designation, department , organization and any additional responsibility performed by the respondent.

The suggestions were incorporated and upgraded version has been uploaded. It is available at [http://agnee.tezu.ernet.in:8000/gyan\\_jyoti/login.htm](http://agnee.tezu.ernet.in:8000/gyan_jyoti/login.htm).

# Chapter 4

## Requirement Analysis

# Requirement Analysis

## 4.1 Introduction

The first objective of the research was to classify the attributes of KMS. To meet this objective both primary and secondary data collection methods were used. Primary data was gathered from observation of Knowledge Management System in practice whereas secondary data was collected from literature review. To meet the second objective another primary data collection method i.e a user requirement survey was also conducted in the study. The results and findings of these three data collection procedures are discussed in this chapter.

## 4.2 Attributes of KMS Identified from Literature Review

The following are the set of KMS attributes that came up in the course of the literature survey.

1. Authorization (Tiwana, 2000)
2. Document Management
  - a. Indexing (Metadata) (Satyadas et al., 2001)
  - b. Categorization or Classification (Satyadas et al., 2001)
3. Information Storage (Abdullah et al., 2005; Tiwana, 2000)
4. Information Retrieval (Abdullah et al., 2005; Tiwana, 2000)
5. Collaboration
  - a. Discussion forum (Abdullah et al., 2005; Satyadas, et al., 2001)
  - b. Email (Abdullah et al., 2005; Satyadas, et al., 2001)

## 4.3 Knowledge Management System in Practice

In India Knowledge Management Systems (KMS) are already deployed in a few public and private sector organizations. To name a few we have KnowNet – the knowledge management portal of Larson & Toubro , WiseGuy – the knowledge

management portal of ICICI Bank, KalpaVriksha – the knowledge management portal of Wipro Infotech; Infosys and BSNL also have their own KMS.

Personal visit was made to observe the KMS implemented in BSNL, Wipro and ICICI. KMS of Sky Technologies, Alcatel Lucent, Net Apps and Oracle were also observed through internet access. The intention was that if a KMS already in practice could be observed it would help in understanding the processes and the type of interface design that the portal has, and thus use these inputs to design the architecture of a KMS for academics.

#### 4.3.1 Attributes of KMS Observed

Observation of KMS in practice revealed the following. The processing features included a Server Operating System, Web Server Configuration, Backend (the database software where data will be stored), Frontend (software used to design the web interface) and Networking. The attributes identified from literature review (refer to Section 4.2) were taken as the basis for observing the interface of the KMS. Besides these attributes, other features of the interface of these KM portals were also observed. Considering these processing and interface features, an overview of the KM portals of BSNL, Wipro Infotech, ICICI, Sky Technologies, Alcatel Lucent, Net Apps and Oracle are presented in a tabular form (refer to Table 4.1 & Table 4.2).

**Table 4.1: Processing Features of KMS in Practice**

<b>Processing Features</b> <b>Organisation Name</b>	<b>Web Server Software</b>	<b>Backend</b>	<b>Frontend</b>	<b>Networking</b>
<b>BSNL</b>	Apache	My Sql	php script	Intranet
<b>Wipro</b>	IIS Webserver	Microsoft Sql Server	Dot Net	Intranet
<b>Oracle</b>	Apache	Oracle11g	Flash	Intranet
<b>Sky Technologies</b>	IIS Webserver	My Sql	Java, JSP, Java Servlet	Intranet
<b>Alcatel Lucent</b>	IIS Webserver	Microsoft SQL Server 2008	Microsoft SharePoint	Intranet



**Table 4.1: Processing Features of KMS in Practice**

<b>Processing Features</b> <b>Organisation Name</b>	<b>Web Server Software</b>	<b>Backend</b>	<b>Frontend</b>	<b>Networking</b>
<b>ICICI</b>	IIS Webserver	Microsoft SQL Server 2000	Java, JSP, Java Servlet	Intranet
<b>Net Apps</b>	Jetty	Sybase	JSP, Javascript, Java Servlet	Intranet

**Table 4.2: Interface Features of KMS in Practice**

<b>Interface Features</b> <b>Organisation Name</b>	<b>Document Management</b>	<b>Collaboration</b>	<b>Information Storage</b>	<b>Information Retrieval</b>	<b>Others</b>
<b>BSNL</b>	Circulars, Form download, E-magazine	Email, Discussion Board	File upload	Circular Search, Site Search	Feedback, News
<b>Wipro</b>	Document Manager, Best Practices, Document for Tenders	Message Board, Chat Room, Web cast, CoP, I-speak	File upload, Chat transcript		Feedback, Award Winner's List, External Links to E-learning, Help
<b>Oracle</b>	Knowledge, Reports	Service Requests	Patches & Updates	Search Knowledge Base, Search FAQ, Search System, Search Target	Oracle.Support, Training, Help
<b>Sky Technologies</b>	Knowledge Base, Operations, Processes	Post Suggestion, Post Artifact	File Upload	Online Search	Help
<b>Alcatel Lucent</b>	Knowledge Base, Customer Details	General Discussion	Document Repository	General Search	Help, Site Settings, Surveys, Alerts

**Table 4.2: Interface Features of KMS in practice**

<b>Interface Features Organisation Name</b>	<b>Document Management</b>	<b>Collaboration</b>	<b>Information Storage</b>	<b>Information Retrieval</b>	<b>Others</b>
<b>ICICI</b>	Document Manager, Commercial Business groups, Customer Service, Group Companies	KM Forum, Member Speak, Notice Board,	File Upload	General Search, People Locator, Search Useful links	News & Updates (Internal), News Headlines (External), Tools & Calculators, Help, Feedback, Stock Market, e-Library Sources (other Databanks), KM Query Point (Test)
<b>Net Apps</b>	Field Portal, My Workbench	Email, NetApp Live	File Upload	Search Intranet, Search People, General Search	Help, Feedback, Learning@Net App, News

#### **4.3.2 Inference drawn from Observing KMS**

From the observations of KMS, it was found that in order to enter a KMS, authorization by means of login and password was essential. So, Authorization can be considered as an important component of KMS interface. Other important components identified in the observed KMS interface are classified under five headings as shown in Table in 4.2. The first component was identified as Document Management which comprises of Technical Documents, Office Circulars, Best Practices, Customer related information, Organisation's Norms, E-magazines, Forms, etc. The second component was identified as Collaboration, which comprises of Email, Discussion Board / Chat, Message Board / Notice Board, Web cast, Member Speak / I-speak, Post Suggestion

and Service Request. The third component identified was Information Storage which is also named as Document Repository. The functions performed through this component are file upload, download and updating of files. The next component identified was Information Retrieval or Search. Different types of search were identified from the observations. They are Online Search (External), Intranet Search, People Search, Knowledge Search, Search FAQ, and Search Links. Others component comprised of Help, Feedback, News (Internal / External), Alerts, Links to E-learning sites, External Reports, Training, Tools and Calculator, Tests and Awards.

The processing requirements identified from the observations are:

- The interface (frontend) can be developed using php script or Dot Net or Microsoft SharePoint or Java or JSP or Javascript or Java Servlet or Flash.
- The database (backend) can be developed using MySql or Oracle or MS Sql Server or Sybase.
- The server software can either be IIS server or Apache server or Jetty.

#### **4.4 Classification of Attributes of Knowledge Management System**

Considering the attributes of KMS from literature survey and the primary data gathered on interface and processing requirement (obtained by observing KMS in practice), the attributes of KMS were classified as follows.

1. Authorization
2. Document Management
3. Information Storage
  - a. File upload
  - b. Uploading chat script
4. Information Retrieval
  - a. Web Search
  - b. Site Search
  - c. Database Search
  - d. File download

## 5. Collaboration

- a. Discussion forum
- b. Email
- c. Message Board
- d. Web cast

## 6. Miscellaneous

- a. News
- b. Feedback
- c. External Links
- d. Awards

### **4.5 User Requirement Survey**

In order to design the architecture of the KMS for academics a user requirement survey was carried out. The profile of the respondents and the inferences drawn from the survey, are discussed in the following sections.

#### **4.5.1 Profile of the Respondents**

General profiling of all 72 respondents was done with respect to various variables and they are presented here. The eleven participants of the focus group discussion are not included in the survey.

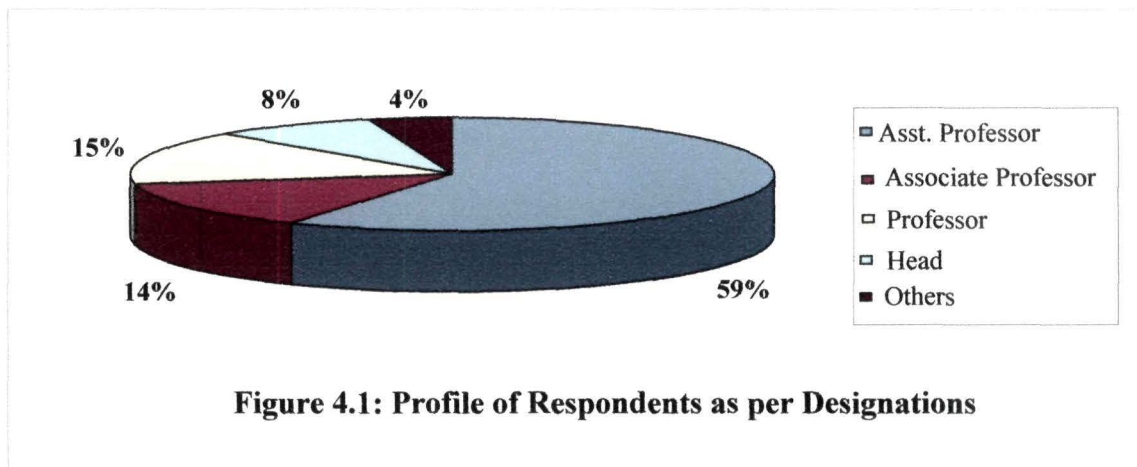
**4.5.1.1 Area Covered:** The states of Eastern India from where responses were obtained are Assam, West Bengal, Sikkim, Orissa, Jharkhand and Meghalaya. The discipline taught by these respondents is Management or Computer science. A table showing the profile of the respondents based on locations of the organisations where they work and the discipline they teach is given in Table 4.3.

**Table 4.3: Area Covered**

<b>Discipline State</b>	<b>Computer Science</b>	<b>Management</b>	<b>Total</b>	<b>Percent</b>
Assam	3	8	11	15.3
West Bengal	10	4	14	19.4
Sikkim	3	0	3	4.2
Orissa	8	21	29	40.3
Jharkhand	2	6	8	11.1
Meghalaya	0	7	7	9.7
Total	26	46	72	100

From the Table 4.3 it is observed that 36% of the respondents are from Computer Science and 64% are from Management discipline. Also, from the table it is observed that the highest number of respondents (40%) is from Orissa, whereas the lowest number of respondents (4%) is from Sikkim.

**4.5.1.2 Profile of Respondents as per Designations:**



**Figure 4.1: Profile of Respondents as per Designations**

From Figure 4.1, it can be seen that 59 % of the respondents are Assistant Professors, 14 % are Associate Professors, 15 % are Professors, 8 % are Heads of Department or Institute and 4 % comprises of Academic Associates.

#### 4.5.1.3 Teaching and Research Requirements:

**Table 4.4: Teaching & Research Requirements**

	<b>Teaching &amp; Research Aids</b>	<b>Frequency</b>	<b>Percent</b>
1	Journals	68	94.4
2	Databank	56	77.8
3	Report writing guidelines	37	51.4
4	Access to research details	58	80.6
5	Recent trends	67	93.1
6	Ready Reference for a topic	54	75.0
7	Software information	44	61.1
8	Abstract of Projects	40	55.6
9	Consultancy information	39	54.2
10	Teaching methodologies	48	66.7
11	Question Paper setting styles	38	52.8
12	Names of Experts	51	70.8
13	Funding agencies	49	68.1
14	Others	15	20.8

As may be seen from Table 4.4, the important teaching and research requirements of the respondents are Access to Journals (94.4 %) and Recent trends in a Research area (93.1 %). Access to Research details (80.6 %), Databank (77.8 %) and Ready reference of a topic (75 %) were the other important requirements. Other teaching and research requirements include information regarding conferences, collaborations, latest topics in the teaching subjects, management cases, similar courses running in renowned institutions, abstract of research, procedure of patenting/scouting of new research, book references, soft copy of chapters, websites of newspapers and magazines and online help.

#### 4.5.1.4 Information sought from Library:

**Table 4.5: Information from Library**

	<b>Library Information</b>	<b>Frequency</b>	<b>Percent</b>
1	New arrivals	68	94.4
2	Books and Journals available	69	95.8
3	Reader's comments	41	56.9
4	Status of a book	58	80.6
5	Others	21	29.2

From the Table 4.5, it can be observed that the information that the respondents mostly sought from the Library are Availability of Books and Journals (95.8 %), followed by information regarding New Arrivals (94.4 %) and Status of a Book (80.6 %). Reader's comments are sought relatively by a few respondents (56.9 %). Other information sought from Library include Online Journals, Citation of Books, Question Bank, Online Issuing of Books, Linkage to Other Libraries, Online Study Materials, Customized Book Search Facility and Status of a Book Indented for purchase by a teacher.

#### 4.5.1.5 Curriculum Requirements:

**Table 4.6: Curriculum Requirements**

	Sources of Information	Frequency	Percent
1	Course structures of other institutes	67	93.1
2	Feedback from Recruiters / Industry	64	88.9
3	Feedback from Alumni	52	72.2
4	Model syllabus of other institutes	62	86.1
5	Others	12	16.7

From Table 4.6, it can be seen that for revising and designing a curriculum, respondents sought Course structure of other institutes (93.1 %), Feedback from Recruiters / Industry (88.9 %) and Model syllabus of other institutes (86.1 %). Feedback from Alumni (72.2 %) was also perceived to be important in revising and designing a curriculum. Other curriculum requirements include Feedback from Senior Faculty, Inputs from Consultancy Reports, Emerging Issues in different Subjects and Feedback from Faculties of other Institutes.

#### 4.5.1.6 Type of Administrative Work Performed:

**Table 4.7: Administrative Work Performed**

	Administrative work performed	Frequency	Percent
1	Head of the Department	17	23.6
2	Placement Co-ordinator	11	15.3
3	Examination Co-ordinator	19	26.4
4	Laboratory Supervisor	9	12.5
5	Others	27	37.5

From Table 4.7 it can be observed that, 26.4 % of the respondents were involved with additional duties of Examination coordinator, 23.6 % as Head of the Department, 15.3 % acted also as a Placement coordinator, 12.5 % as Laboratory Supervisor and 37.5 % of the respondents did other administrative work like Course Co-ordinator, Webmaster, Procurement In-charge, etc.

#### 4.5.1.7 Aids for Administrative Work:

**Table 4.8: Aids for Administrative Work**

	<b>Aids</b>	<b>Frequency</b>	<b>Percent</b>
1	Information system	60	83.3
2	Rules & Regulations of the Institute	58	80.6
3	List of Experts	36	50.0
4	List of Suppliers	26	36.1
5	Others	14	19.4

From Table 4.8 it can be seen that existence of an Information System (83.3 %) and easy access to Rules & Regulations (80.6 %) was expected to facilitate the respondents in performing their administrative work. Other administrative aids required were Rules of Other Institutes, Office Automation Devices like Speech Software etc., Ongoing Projects in National and International Institutes and Names of Stakeholders of the Institute.

#### 4.5.1.8 Aids for Strategic Planning:

**Table 4.9: Aids for Strategic Planning**

	<b>Aids</b>	<b>Frequency</b>	<b>Percent</b>
1	Recent developments in the programme	27	96.4
2	Funding Agencies	21	75.0
3	UGC & AICTE guidelines	23	82.1
4	Others	7	25.0



From the survey, it has been found that 38.9 % of the respondents were involved in Strategic Planning. According to them, Recent Developments in the domain area (96.4 %), UGC & AICTE guidelines (82.1 %) and information about Funding Agencies (75 %) were some of the important information required for Strategic Planning (refer to Table 4.9). Other aids for Strategic Planning required were inputs and opinion from industry, Corporate Information, Students' interest, information regarding DST.

**4.5.1.9 Frequently Required Information:** In response to the open ended question regarding frequently required information, the responses were:

- Availability of new journals
- New funding for projects
- International Agencies and their guidelines
- Name of Guests and Visiting faculties
- MHRD Rules/Guidelines
- Project and consulting requirements
- Changes in educational curriculum and recent trends in corporate sector
- State-of-the-art hardware and software platforms available
- Student Details
- Alumni details
- Faculty details
- Technology changes and product information and
- Research & Development work done abroad.

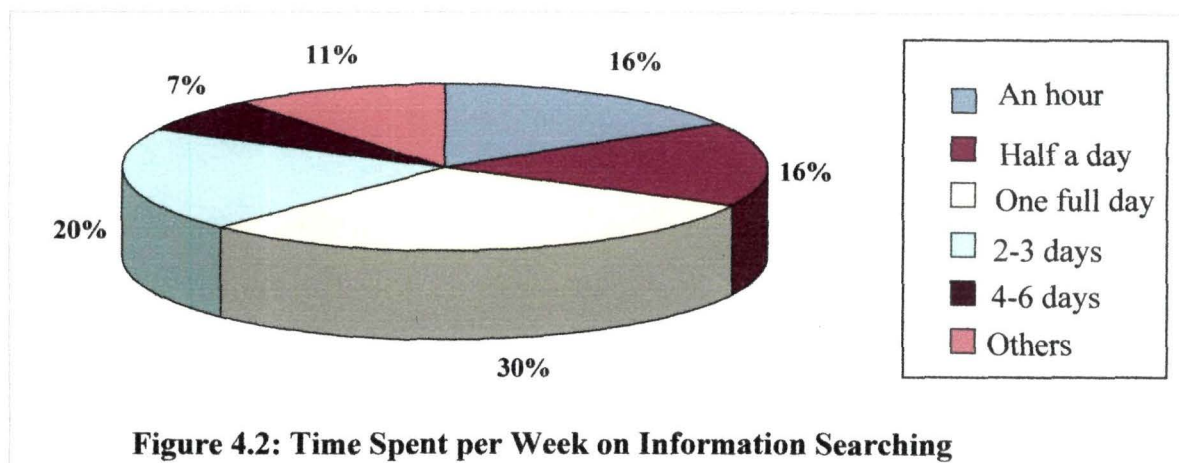
**4.5.1.10 Sources of information:**

**Table 4.10: Sources of Information**

	Sources	Frequency	Percent
1	Search on my own	69	95.8
2	Ask colleagues / friends	59	81.9
3	Others	18	25.0

From Table 4.10, it was observed that 95.8 % of the respondents searched for information on their own, 81.9 % got information from their colleagues/ friends and 25 % searched information from other sources like the Internet.

#### 4.5.1.11 Time Spent on Searching Information:



From Figure 4.2, it can be observed that 16 % of the respondents spent an hour a week, 16 % spent half a day, 30 % spent a day, 20 % spent between 2 to 3 days, 7 % spent between 4 to 6 days per week searching for information while 11 % told that it depends on the information to be searched.

Almost 60 % of the respondents spent on an average about 2 days per week in search of information.

#### 4.5.1.12 Reading Pattern of Newspaper:

**Table 4.11: Reading Pattern of Newspaper**

	Newspaper Items	Frequency	Percent
1	Headlines	59	81.9
2	Sports section	12	16.7
3	Editorial	21	29.2
4	Cartoons/Comics	4	5.6
5	Read Sequentially	17	23.6
6	Others	6	8.3

On being asked about the reading pattern of newspapers, majority of the respondents preferred to focus on the Headlines (81.9 %) first. 29.2% read the Editorial and 23.6% read through sequentially. Other news that respondents preferred were Business News, Leading Articles and Travel related news.



#### **4.5.2 General Inferences from the User Requirement Survey**

1. Respondents are research oriented and have high need for journal information and the recent trends in a particular research area.
2. Respondents require summarized information. The survey results showed that 75 percent of the respondents preferred to get a ready reference list of all publications in a particular topic.
3. Most respondents preferred to search for information on their own but are not averse to seeking help from colleagues / friends.
4. *Most of the respondents are receptive. This can be inferred from the survey results, which showed that 66.7 percent of the respondents wanted to know about the different teaching methodologies. Also survey results showed that 70.8 percent of the respondents wanted to know the names of experts in a particular area. The fact that the editorial section is the second preference in reading a newspaper indicates the need for current/expert opinion.*
5. Respondents want easy access to information. This can be inferred from the survey results, which showed that 77.8 percent of the respondents want to get access to databank. However they will prioritize what they would like to follow up. This has been inferred from the reading pattern where majority said they preferred to go through headlines of the newspaper instead of sequential reading.
6. Respondents like to keep themselves up-to-date. This can be inferred from the survey results, which showed that 93.1 percent of the respondents wanted to know about the recent trends in a particular area.
7. Respondents play multiple roles in their work place. This can be inferred from the survey results, which showed that apart from being a teacher and a researcher, they also played roles of the Head of the Department, Placement Co-ordinators, Examination Co-ordinators, Laboratory Supervisor, Course Co-ordinator, Webmaster, Procurement In-charge, etc.
8. Respondents are techno-savvy. This can be inferred from the survey results, which showed that 83.3 percent of the respondents felt the need for an information system to aid them in their administrative work.

From the survey, the following inferences were drawn regarding the components to be incorporated for designing the prototype.

1. Respondents need to search a variety of information to carry out their academic pursuits. This can be inferred from the survey results, which showed that respondents search for Journals (94.4%), Recent Trends (93.1%), Access to research details (80.6%), Databank (77.8%) and Ready Reference for a topic (75.0%), to carry out research and teaching activities. The respondents also searched for available books and journals (95.8 %) in the library and Course structure of other institutes (93.1%) and Model syllabus of other institutes (86.1%) in order to revise or design a new curriculum.

Moreover, the survey results revealed that almost 60% of the respondents spent on an average about 2 days per week in search of information.

Therefore, from the survey, it can be inferred that Search is the most important component of a KMS for academics. The outcome of every search is a document, which needs to be properly stored in the KMS for further use. So, document management is also an important component of a KMS.

2. Respondents need to hold discussions about various academic and administrative issues.

This can be inferred from the survey results, which showed that 70.8 % of the respondents require names of experts for academic purpose and 50% of the respondents require expert names for administrative purpose. Survey results also revealed that respondents need feedback from recruiters/industry (88.9%) and feedback from alumni (72.2%).

Therefore, from the survey, it can be inferred that a Databank of Experts or an external link to experts along with a Discussion Forum need to be in the prototype.

#### 4.6 Results of Chi-square Tests

Chi-square tests were done using SPSS 11.0, to find out if the responses were independent of the level in the hierarchy. [See Annexure IV]

A summary of the results is presented in the next page.

**Table 4.12: Chi-square Test Results**

<b>Activities</b>	<b>Responses Dependent on Designations</b>	<b>Responses Independent of Designations</b>
Teaching & Research Requirements	Report Writing Guidelines Access to Research Details Teaching Methodologies Question Paper Setting Styles Funding Agencies	Databank Ready Reference for a Topic Software Information Abstract of Projects Consultancy Information List of Experts
Information sought from Library	Reader's Comment Status of a Book.	
Curriculum Requirements		Feedback from Alumni
Administrative Aids	Suppliers	Rules and Regulations of the Institute List of Experts
Aids for Strategic Planning	Recent Development of the programme Funding Agencies UGC/AICTE guidelines	

The following inferences were drawn from the Chi-square tests:

1. For teaching and research it was seen that the respondents opined that access to databanks, ready references, software information, abstracts of projects, consultancy information and names of subject experts would facilitate their work and this opinion was independent of designations.

Some differences in responses, designation wise, are as follows:

- Junior faculty have a greater need for Report Writing Guidelines than Senior faculty.
  - Junior faculty have more need for accessibility to research details.
  - Junior faculty have a greater need for Teaching Methodologies than Senior faculty.
  - Junior faculty have a greater need for Question Paper Setting Styles than Senior faculty.
  - Junior faculty have more need of information regarding Funding Agencies than Senior faculty.
3. As for information sought from Library, it was seen that there was differences in responses designation wise. The differences are:
    - Junior faculty have more need for readers' comments for a book than Senior faculty.
    - Junior faculty have more need of information about the status of a book than Senior faculty.
  4. For devising and revising a curriculum it was seen that the respondents felt that Feedback from Alumni would be helpful and this opinion was independent of designations.
  5. As far as requirement for Administrative aids was concerned, it was seen that that the respondents felt that Rules and Regulations of the Institute and List of subject experts would facilitate their work and this feeling was independent of designations. It was also seen that there was difference in responses designation wise for Supplier's list. In

this regard, it was found that Junior faculty have more need for Supplier's List than Senior faculty.

6. With regard to requirements for Strategic Planning aids, it was seen that there was differences in responses designation wise. The differences are:

- Senior faculty have more need for information regarding recent development of the programme, Funding Agencies for Planning and UGC/AICTE guidelines than Junior faculty.

The Chi-square tests were conducted to identify the components of the KM portal which were preferred by all the respondents irrespective of designations and those which were preferred by a specific group of respondents. This was done so that the components which were preferred by all were not missed out when designing the KMS portal and also that these components are preferably placed in the home page of the KMS portal.



Knowledge Management System Architecture

- A Specific Study for Management and Computer Academics

## Chapter 5

# Architecture of KMS for Academics

Knowledge Management System Architecture

- A Specific Study for Management and Computer Academics

# Architecture of KMS for Academics

## 5.1 Introduction

Software architecture can be viewed as a style or a method of design and construction or strategic policies and patterns that shape a system (Mowbray & Ruh, 1997). It is a system design that specifies how the overall functionality of the design is to be decomposed into individual functional components and the way in which these components are to interact to provide the overall functionality of the system (Iyer & Gottlieb, 2004). It is the blueprint of any system design. Therefore, designing the system architecture is the first step towards developing a Knowledge Management System.

According to the second objective of the study, stated in Chapter 3, Section 3.1, architecture of a KMS for academics is to be designed. In order to fulfill this objective, an extensive review of literature was done. A user requirement survey was also done to identify the components of the interface that should be incorporated in the KMS. The different architectures revealed by literature review, summary of the survey findings and the proposed architecture of KMS for academics are discussed here.

## 5.2 Review of KMS Architectures

Studies on KMS architecture were reviewed to identify the technologies used in designing these architectures and also to study the styles of the existing KMS architectures.

### 5.2.1 Review of Technologies used in KMS Architecture

From Table 2.2 of Chapter 2 it can be observed that the KMS architectures were based on either agent technology or ontology or client-server technology or case-based reasoning or object-oriented paradigm or were a combination of these technologies. Agent technology was used in a number of KMS architecture, both in corporate sector

and in educational institute (Anbulgan & Kuswara, 2001; Chiu et al., 2002; Hlupic et al., 2002; Tacla & Barthes, 2002; Aldea et al., 2003; Abar et al., 2004; Yan et al., 2004; Abdullah et al., 2005; Gracia & Cobos, 2006; Soto et al., 2006; Vizcaino et al., 2007; Zhang et al., 2008).

Anbulgan and Kuswara (2001) used agent to automate reminders and work flow application in a KMS of an IT institute. On the other hand, Chiu et al. (2002) took the advantage of agents to enable a user-centric office environment. In this KMS, agents were also used to assist workers in daily tasks by detecting regularities in worker's behavior. Agents were also used to improve the performance of e-commerce websites and portals by providing visitors with an intelligent personalised one-to-one service (Hlupic et al., 2002). In this study, agents also acted as negotiator between the portal and the visitor. Automation of documentation and communication process were also done by agents (Tacla & Barthes, 2002). Agents were also used to generate ontology that was utilized in retrieving and rating relevant web pages (Aldea et al., 2003). In another study, agents answered the queries of network administrators with the help of ontology (Abar et al., 2004). Agents also served as a negotiator between buyer and supplier in a B2B e-commerce model (Yan et al., 2004). Abdullah et al. (2005) utilised agents to monitor knowledge resources and for alerting users about the addition of new information or changes in the information. Agents were also used for automating user profile building and calculation of expert status (Gracia & Cobos, 2006). Automation of the work of a software maintenance engineer was also done using agents (Soto et al., 2006). Agents also took the help of ontology to handle KM activities like storage, retrieval, maintenance and revision (Zhang et al., 2008). From the review of studies discussed so far, it can be inferred that agents were mostly used in these KMS architectures to automate the system's processes.

Apart from the studies on KMS architectures that used both agents and ontology (Aldea et al., 2003; Abar et al., 2004; Zhang et al., 2008), literature review also identified few KMS architectures that were based on ontology alone (Li et al., 2002;

Alani et al., 2003; Antunes et al., 2007; Liu et al., 2007). Ontology was used in these architectures, mainly to define various types of search.

Li et al. (2002) used ontology to share and search information in a metal industry. On the other hand, (Alani et al. 2003 ) used ontology to search knowledge about artists from the web. Ontology was also used to improve expert search (Liu et al., 2007) and to search for knowledge about software development (Antunes et al., 2007). Some KMS architectures were designed using client-server technology. Out of this, two KMS architectures were based on both agents and client-server technology (Anbulgan & Kuswara, 2001; Abdullah et al., 2005) whereas one architecture was solely based on client-server technology (Gaines & Shaw, 1996). From these studies, it was observed that client-server technology enables distributed architecture i.e. a resource stored in a server can be used by all its clients at the same time. The internet is also based on the client-server technology. Client-server technology was used for collaborative research between various groups stationed at different parts of the world (Gaines & Shaw, 1996).

Case-based Reasoning (CBR) is another technology based on which few KMS architectures were designed (Leake, 1999; Li et al.; Weber & Wu, 2004; Minor & Bierman, 2005; Zhang et al., 2006). CBR automatically presents the designer of automatic parts, with the information required by them to design stamped automatic parts, from the stored cases (Leake, 1999). CBR was also used for learning previous experiences of repairing domestic appliances (Zhang et al., 2006). Information of previous construction project registered in KMS was shared with other people working in construction industry using CBR (Li et al., 2002). CBR was also used to retrieve previous cases in Computational Intelligence to improve the present execution (Weber & Wu, 2004). From these studies, it was observed that CBR was used to provide solution to a problem based on previous experiences stored in the case base.

From the review, two studies using object-oriented technology in KMS architecture design was also identified (Carlson & Ram, 1991; Frank, 1999). Object-oriented

technology had enabled parallel processing of sub-tasks by individual Knowledge Based Systems ( Carlson & Ram, 1991). Object-oriented technology was also used for integrating KMS and Information System (Frank, 1999).

As identified in literature review, each of these technologies are capable of performing specific activities. The activities that can be identified against each of these technologies are shown in Table 5.1.

**Table 5.1: Activities Performed by Different Technologies**

<b>Technology</b>	<b>Activity</b>
Agent	Automation of KMS activities
Ontology	Search or Information Retrieval
Client Server	Sharing of resources
Case Based Reasoning	Reusability of previous solutions
Object-oriented	Parallel processing and integration with other Information system.

### 5.2.2 Review of Styles of Software Architectures

According to Galan and Shaw (1994), there are eight common software architectural styles. They are:

1. Pipes and Filters
2. Data Abstraction and Object-Oriented Organization
3. Event Based, Implicit Innovation
4. Layered systems
5. Repositories
6. Table Driven Interpreters
7. Other Familiar Architecture like Distributed process
8. Heterogenous Architecture

From the review of the existing KMS architectures, it was observed that these architectures were either following the layered system style or distributed process style. Moreover, layered style was used to draw the architecture for the full fledged system whereas distributed style was used to draw the detailed architecture of the components of a KMS.

The layered architecture observed from review were either three-layered (Frank, 1999; Li et al., 2003; Abar et al., 2004; Soto et al., 2006; Vizcaino et al., 2007) or four-layered (Anbulgan & Kuswara, 2001; Abdullah et al., 2005). The distributed architecture observed addressed a specific component of the KMS like expert search (Gracia & Cobos, 2006; Liu et al., 2007), search (Aldea et al., 2003), knowledge extraction (Alani et al., 2003), B2B e-commerce transaction (Yan et al., 2004) project information sharing (Tacla & Barthes, 2002; Zhang et al., 2008) and the internet (Gaines & Shaw, 1996).

The architectural style of five KMS for educational institutes was also observed. Out of these five, two followed layered style (Anbulgan & Kuswara, 2001; Abdullah et al., 2005) and the rest three followed the distributed style (Aldea et al., 2003; Gracia & Cobos, 2006; Liu et al., 2007). The four layer KMS architecture proposed by Anbulgan & Kuswara (2001) comprises of User Interface Layer, Logical/Intelligence Layer, Communication / Transport Layer and the Knowledge Repositories. On the other hand, the four layer architecture proposed by Abdullah et al. (2005) comprises of Application Layer, Transport Layer, Infrastructure Layer and Repositories Layer. The three distributed style architecture were used to design a search module.

### **5.3 Summary of the Survey Findings**

A summary of the survey findings and its relevance to designing of the KMS is presented in Table 5.2. From the primary responses, it has been seen that an academician is involved with different activities as mentioned in the first column of Table 5.2. To facilitate these activities, keeping in mind the respondent requirements, list of items to be included in the main web page and the subsequent inner pages have

been provided in the second and third column of Table 5.2. The links to the important items identified from the respondent requirements are placed in the main page; it serves as the index to the information content of the Knowledge portal. Moreover the main page must not look cluttered and have an aesthetic appeal. The details are given in the inner pages. It has been found that the parameters presented in Table 5.2, mostly fall under Document Manager, Search, Discussion Forum and Miscellaneous components of a KM portal. Therefore, these are important components needed to be kept in mind while designing the architecture of KMS for academics and also while developing the prototype.

**Table 5.2: Summary of Survey Findings**

<b>Activities Identified for Academics</b>	<b>Items to be added in the Main Page of the Website</b>	<b>Items to be added in the Inner Pages of the Website</b>
Teaching & Research	<ul style="list-style-type: none"> <li>• Link to Online Journals</li> <li>• Link to Databanks</li> <li>• Link to Reference list of a particular topic</li> <li>• Link to Current trends of a particular topic</li> <li>• Link to Teaching Techniques</li> <li>• Link to software</li> <li>• Link to Library</li> <li>• List of new arrivals in the Library</li> </ul>	<ul style="list-style-type: none"> <li>• Research Details</li> <li>• Teaching Methodologies of a subject</li> <li>• Question Paper Setting Styles</li> <li>• Consultancy information</li> <li>• List of Experts of a subject</li> <li>• List of Funding Agencies</li> <li>• List of software available for a subject</li> <li>• List of Books and Journals available in the Library</li> <li>• Book searching facility</li> </ul>
Curriculum Development	<ul style="list-style-type: none"> <li>• Link to list of other academic institutes</li> </ul>	<ul style="list-style-type: none"> <li>• List of other academic institutes</li> <li>• Model syllabus provided by regulatory bodies</li> <li>• Syllabus of other institutes</li> </ul>

**Table 5.2: Summary of Survey Findings**

<b>Activities Identified for Academics</b>	<b>Items to be added in the Main Page of the Website</b>	<b>Items to be added in the Inner Pages of the Website</b>
Administrative Work	<ul style="list-style-type: none"> <li>• Link to list of Information System needed for administrative work</li> <li>• Link to Rules &amp; Regulations of the Institute</li> <li>• Link to list of Suppliers</li> </ul>	<ul style="list-style-type: none"> <li>• Rules &amp; Regulations of the Institute</li> <li>• List of available Information System</li> <li>• List of Suppliers</li> <li>• Recruiters</li> <li>• Alumni database</li> </ul>
Strategic Planning	<ul style="list-style-type: none"> <li>• Link to UGC guidelines</li> <li>• Link to AICTE guidelines</li> </ul>	<ul style="list-style-type: none"> <li>• UGC guidelines</li> <li>• AICTE guidelines</li> </ul>
News	<ul style="list-style-type: none"> <li>• News Headlines.</li> </ul>	<ul style="list-style-type: none"> <li>• News Details</li> </ul>
Miscellaneous	<ul style="list-style-type: none"> <li>• Discussion Forum</li> <li>• Message Board</li> <li>• Link to Important Meetings</li> <li>• Link to official mail website</li> <li>• General Search Facility</li> <li>• Feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Details of Important Meetings</li> <li>• Details of Important Documents</li> </ul>

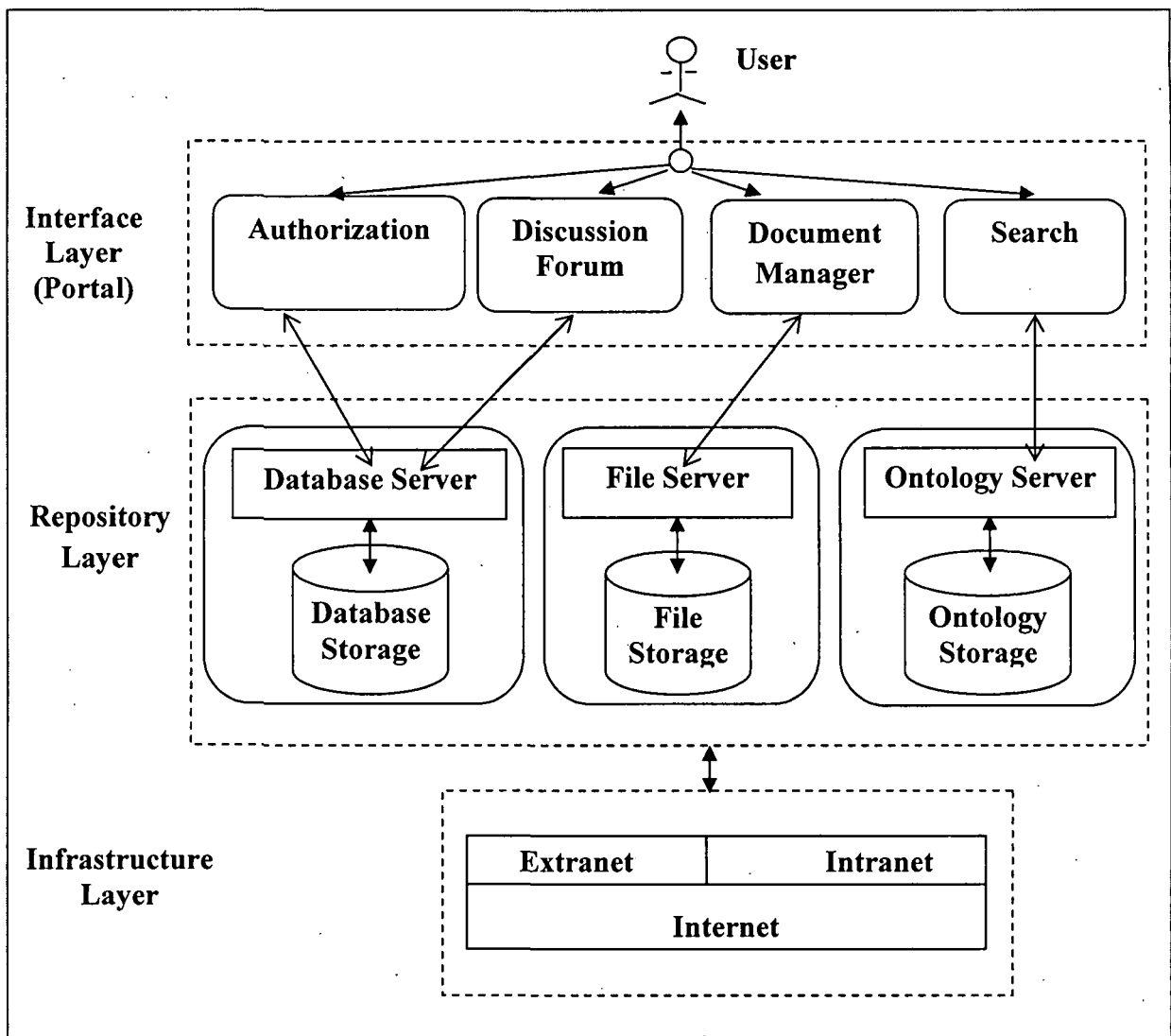
#### **5.4 Proposed KMS Architecture for Academics**

- From the findings of the user requirement study, it was inferred that **Search** is the most important feature required by academics. From literature review, it was observed that better search can be obtained by the use of ontology (Wu, 2005; Tomassen & Strasunskas, 2009).
- Also, from the literature and the observations of KMS in practice, it was found that sharing of resources is a unique feature of a KMS. Sharing of resources can be best achieved by client server technology.



- Considering these factors and also other inputs from user requirement study, observation of KMS in practice and review of the existing KMS architectures, three layer KMS architecture was designed which is shown in Figure 5.1. The architecture is based on both ontology and client server technology. The main strength of the proposed KMS architecture for academics is the *ontology driven search*.

Layers are popularly termed as tier in software architecture. As shown in Figure 5.1, the three tiers of the proposed KMS architecture for academics comprises of Interface layer, Repository layer and Infrastructure layer.



**Figure 5.1 Knowledge Management System Architecture for Academics**

The details of these three layers are described in the following sections.

#### 5.4.1 Interface Layer

This layer is the medium through which a user can interact with the other layers. From the inferences drawn from the user requirement survey (refer to Section 4.5.2 of Chapter 4) the components of the Interface layer of the proposed KMS architecture for academics were identified as Search, Document Manager and Discussion Forum. Moreover, from the findings of the observation of KMS in practice, authorization was found to be an important component of the interface of a KMS. As KMS are targeted for specific group of people and in order to prevent outsiders from entering the system, proper authorization is essential.

Therefore, the components considered in this layer are Authorization, Search, Document Manager and Discussion Forum. The functionality of these components is discussed below. The schematic diagram of this layer is shown in Figure 5.2.

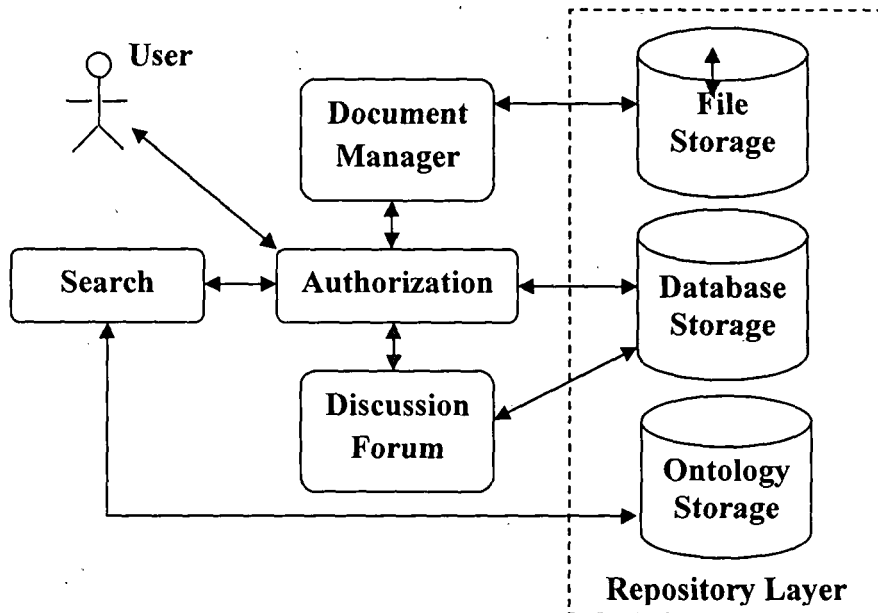
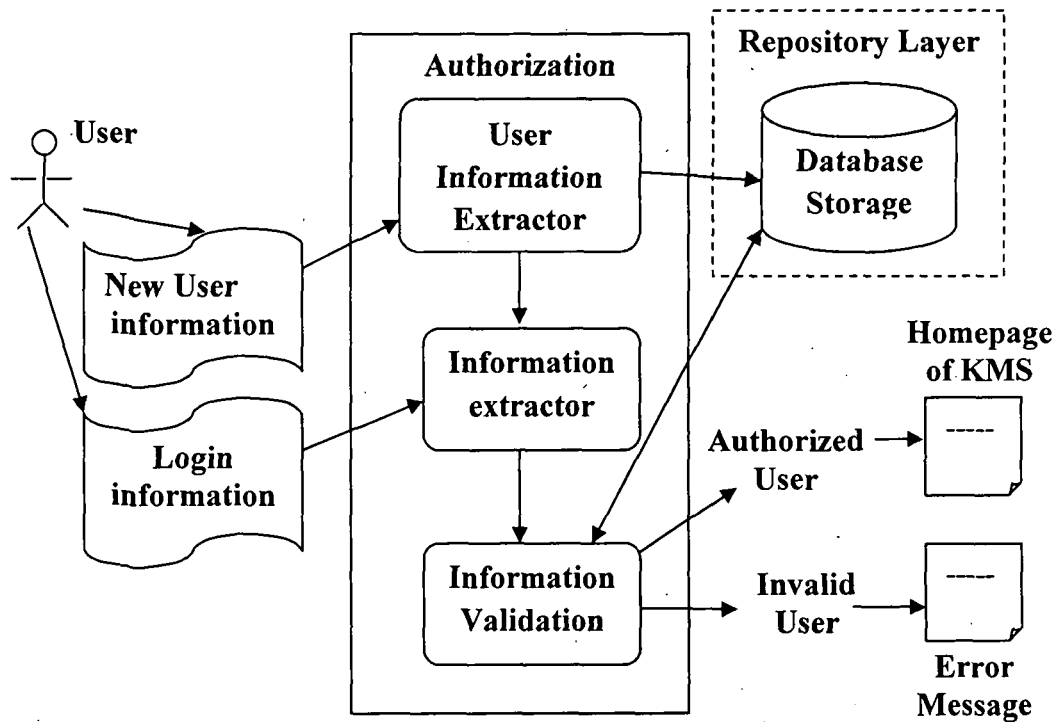


Figure 5.2: Schematic Diagram of Architecture for Interface Layer

As shown in Figure 5.2, a user must first be authorized by the Authorization module in order to interact with the Search, Document Manager and Discussion Forum modules of the Interface layer. The Authorization module interacts with the Database Storage in order to authorize the user. Also, from the figure it can be observed that the Search module interacts with the Ontology Storage, Document Manager interacts with the File Storage and Discussion Forum interacts with the Database Storage.

**5.4.1.1 Authorization:** This component is responsible for validating a user. Only an authentic user can enter the KMS portal. The schematic diagram of this component is shown in Figure 5.3.



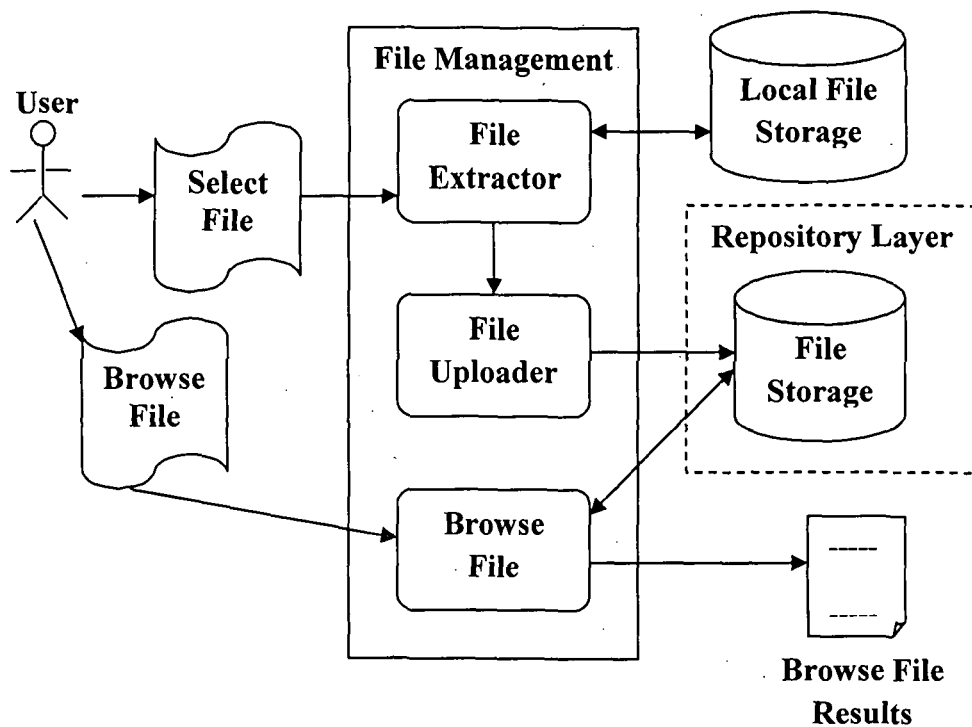
**Figure 5.3: Schematic Diagram of Architecture for Authorization Module**

As shown in Figure 5.3, the user can create a new user login by giving his/her information. The **User Information Extractor** collects this information from the user and stores it in the **Database Storage**.

After creating the user login, the user can enter his/her login info, which the **Information Extractor** collects from the user and sends it for validation to **Information Validation**. The **Information Validation** then searches the **Database Storage** to find out whether the user exists. If the user is authentic, then such a user is directed to the **Homepage of the KMS** portal otherwise an **error message** is displayed.

**5.4.1.2 Document Manager:** This component comprises of the File Management i.e Uploading and Browsing of Files and the components that were identified from the User Requirement survey (Refer to Table 5.2).

The schematic diagram of the File Management component is shown in Figure 5.4.



**Figure 5.4: Schematic Diagram of Architecture for File Management Component of Document Manager**

Figure 5.4 depicts the Schematic Diagram of the File Management component of Document Manager. As shown in Figure 5.4, a user requests the File Extractor to extract a file from the Local File Storage (Client Machine) and submit it to **File Uploader**. The **File Uploader** then uploads the specified file in the File Storage of the server.

For browsing of files, the user requests **Browse File** to browse the files in the **File Storage** of the server and displays the browse file results.

**5.4.1.3 Discussion Forum:** This component provides a platform to hold discussion among the users. It also saves the transcript of these discussions in the database, so that it can be used in future. The schematic diagram of this component is shown in Figure 5.5.

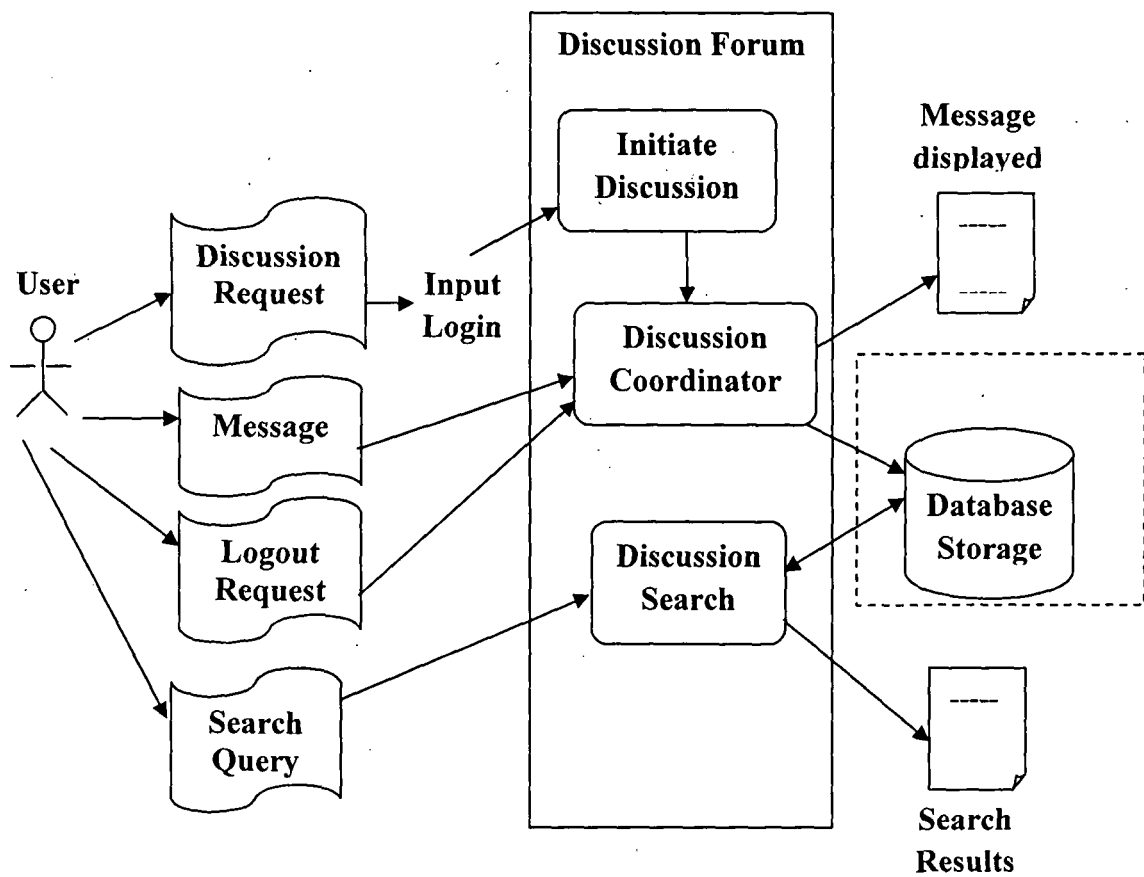


Figure 5.5: Schematic Diagram of Architecture for Discussion Forum

As shown in Figure 5.5, the user requests **Initiate Discussion** module to initiate the discussion by entering his/her login name. **Initiate Discussion Module** then initiates the discussion and hands over the control to **Discussion Coordinator**, which then conducts the discussion. The message input by the user is both displayed in the screen and stored in the **Database Storage** by the **Discussion Coordinator**. The process continues until the user sends a logout request.

To search from the stored discussions, the user gives a search query to the **Discussion Search**, which then searches the **Database Storage** and displays the **Search Results**.

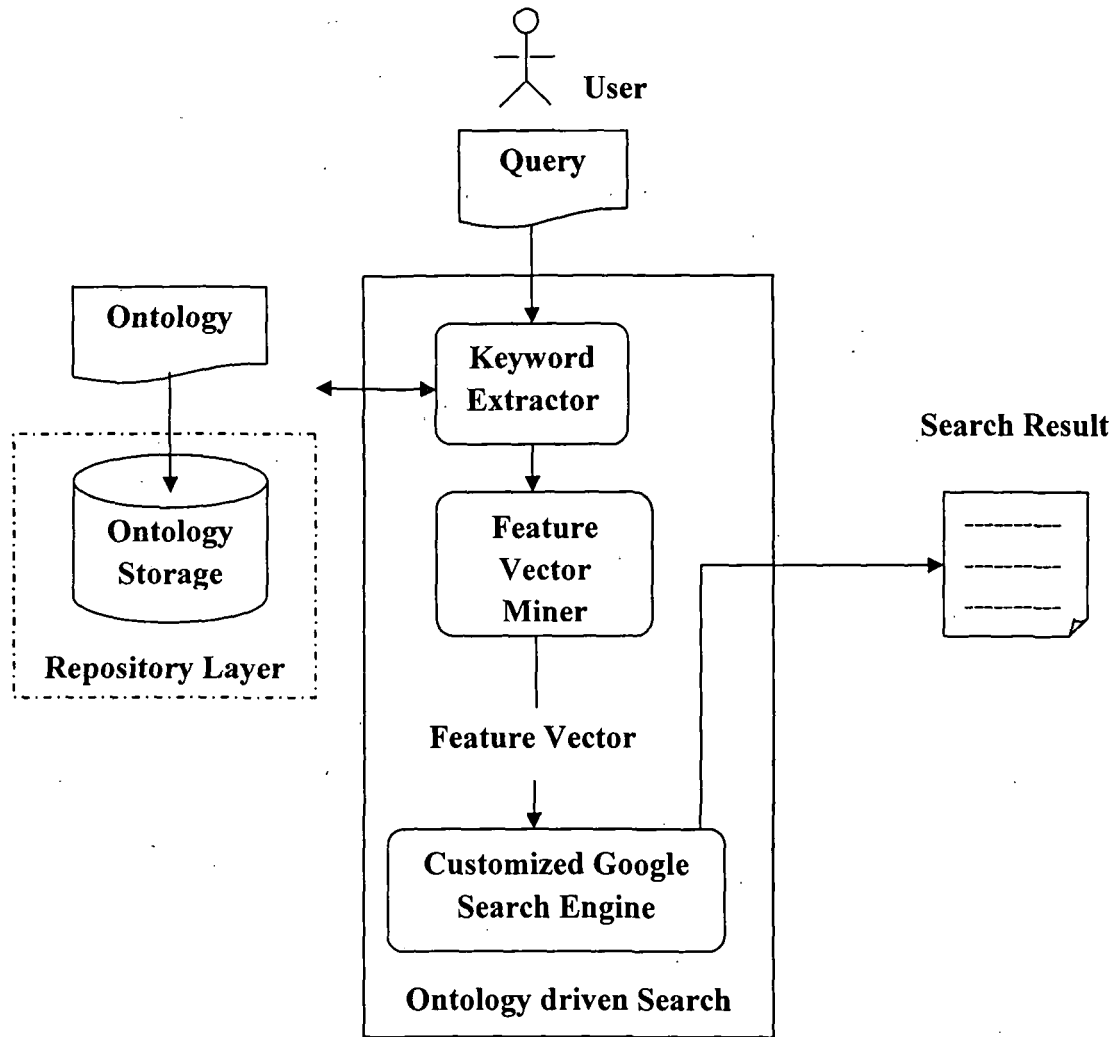
**5.4.1.4 Search:** This is the most important component in KMS architecture for academics. There are four types of search considered in this architecture. They are database search, file search, customized external search engine and ontology based search.

The transcripts of the discussions done through discussion forum are stored in the database. In order to search for specific discussions, database search is done. The detail of this search has been discussed in Section 5.4.1.3.

To browse for files that have been uploaded using document manager, file search technique is adopted. This search has been discussed in detail in Section 5.4.1.2.

Customization of external search engine like google was another type of search used in this architecture. This type of search was used in the Ontology based search. The implementation detail of this search is discussed in Section 6.1.2.2 (d).

In order to search for research papers, an ontology based search is used. The search retrieves the related terms of the search text (Feature Vector) from the ontology storage and sends all the terms to customized google search engine, which returns the search results. The schematic diagram of the proposed architecture for ontology based search is shown in Figure 5.6.



**Figure 5.6: Schematic Diagram of Architecture for Ontology based Search**

As shown in Figure 5.6, the **Keyword Extractor** module extracts the keywords from the search query given by the user and sends it to **Feature Vector Miner** module. The **Feature Vector Miner** then creates a **Feature Vector** (related terms of the search query) by consulting the **Ontology Repository** where Ontology on the related area is previously created and stored. The **Feature Vector Miner** then sends the **Feature Vector** to the **Customized Google Search Engine**, which then searches the network taking the **Feature Vector** as the keyword and returns **Search Results**. The details of the ontology created for the search is discussed in Section 6.1.2.2 (a) of the next chapter.

### **5.4.2 Repository Layer**

This layer is used as the storage space. There are three forms of storage. They are Ontology storage, Data storage and File storage.

The search component of the Interface layer accesses the ontology from the Ontology Storage through the Ontology Server. The Ontology Storage contains ontology that helps to retrieve better search results. The Document manager uploads and retrieves files in the File Storage with the aid of the File Server. On the other hand, during authorization, the user information is verified from the user data stored in the Data Storage, which can be accessed through the Database Server. Moreover, discussion transcripts are stored and retrieved from the Data Storage through the Database Server.

### **5.4.3 Infrastructure Layer**

This layer forms the base on which the whole architecture rests. It comprises of a network infrastructure, such as internet, intranet and extranet. Intranet i.e. Local Area Network (LAN) will connect the users within the institute whereas Extranet will facilitate inter institutional connectivity. On the other hand, Internet will act as the backbone of both these networks.



Knowledge Management System Architecture

– A Specific Study for Management and Computer Academics

## Chapter 6

# Implementation and Validation of the KMS for Academics

Knowledge Management System Architecture

– A Specific Study for Management and Computer Academics

# Implementation and Validation of the KMS for Academics

## 6.1 Implementation of the KMS for Academics

In order to test the architecture of KMS for academics (refer to Figure 5.4 of Chapter 5), a prototype of the system named Gyan Jyoti (a Hindi phrase) meaning Light of Knowledge was developed and implemented at Tezpur University. This was in part-fulfillment of the third objective

The development of the KMS was done in four phases. Firstly, the authorization component was developed, followed by the search component, after that the discussion forum and lastly document manager component, which comprised of file uploading and browsing and the main body of the KMS was developed. After the KMS was developed, it was uploaded in the network via Tezpur University internet gateway. The portal was uploaded in a PC loaded with Windows XP Professional, Oracle 9i Server and Zend Server software (includes Apache Server software). This PC is connected to the Tezpur University internet gateway via the Local Area Network of the university. The portal was available in the network since December 2010 at [http://agnee.tezu.ernet.in:8000/gyan\\_jyoti/login.htm](http://agnee.tezu.ernet.in:8000/gyan_jyoti/login.htm). The details of the software tools used for the development of the KMS and the development details of each of these components are discussed in the following sections.

### 6.1.1 Software Used

In order to develop the proposed web-based KMS, basically a backend is required to develop the database and a frontend is required to design the web pages of the portal. As the search is ontology driven, an ontology editor is also another software requirement.

In order to create the database, although any of the available Relational Database Management Systems like MS Access, My Sql, Sql Server, etc. could have been used, but for the proposed KMS, Oracle was chosen because:

- a. Oracle Database supports all multi-user Windows-based and Unix-based platforms.
- b. It is widely used, stable and well supported.
- c. The license version of Oracle 9i was available at Tezpur University.

For creating the static components of the web pages, HTML (Hypertext Markup Language) was used. Though, to the develop the dynamic component of the web pages, different software tools, such as Java, ASP (Active Server Page), DHTML (Dynamic Hypertext Markup Language), etc could have been used, but for the proposed KMS, php script was used because:

- a. php is an open source which runs on Apache server, which itself is a open source that is compatible with any platform.
- b. php is one of the widely used scripting language for developing KMS (refer to Table 4.1 in Chapter 4).

To identify the ontology editor and ontology implementation language to be used for creating the domain ontology for the study, a review of the existing literature was done. Table 6.1 shows the findings of the review.

**Table 6.1 Ontology Editors and Ontology Implementation Languages**

<b>Researcher &amp; Year</b>	<b>Domain Ontology</b>	<b>Ontology Editor</b>	<b>Ontology * Implementation Language</b>
Benjamin et al., 1998	Automobile Industry	Ontolingua	KIF
Alani et al., 2002	Artists	Protégé	XML
Aldea et al., 2003	Biosensors	OntoEdit	XML
Yoo et al., 2005	Pizza	Protégé v3.1	RDF/XML
Knight et al., 2006	Learning Design & Learning Content	Protégé	OWL/XML
Antunes et al., 2007	Software Development Knowledge Reuse	Jena Semantic Framework	RDF, OWL
Chang et al., 2007	Middle School Mathematics	Protégé	OWL-DL
Grandbastien et al., 2007	Learning Situation	Protégé	OWL
Li et al., 2008	Geo-Ontology	Protégé	RDF
Dag, 2009	Personalized E-learning Environment	Protégé 2000	OWL

- \* KIF : Knowledge Interchange Format
- XML : Extensive Markup Language
- RDF : Resource Description Framework
- OWL : Ontology Web Language
- OWL-DL : Ontology Web Language Description Language

From Table 6.1 it can be observed that Protégé was most the preferred ontology editor used for developing domain ontology. Also, from Table 6.1 it can be observed that XML, RDF and OWL were the mostly used Ontology Implementation Languages.

For creating domain ontology for the study, the ontology editor Protégé 3.4.3 was used because it can generate XML document.

XML was the ontology implementation language used for the study because XML files can be easily parsed with php script.

## 6.1.2 Development Details of the Components of the Knowledge Management System

The development details of Authorization, Search, Discussion Forum and Document Manager are described here.

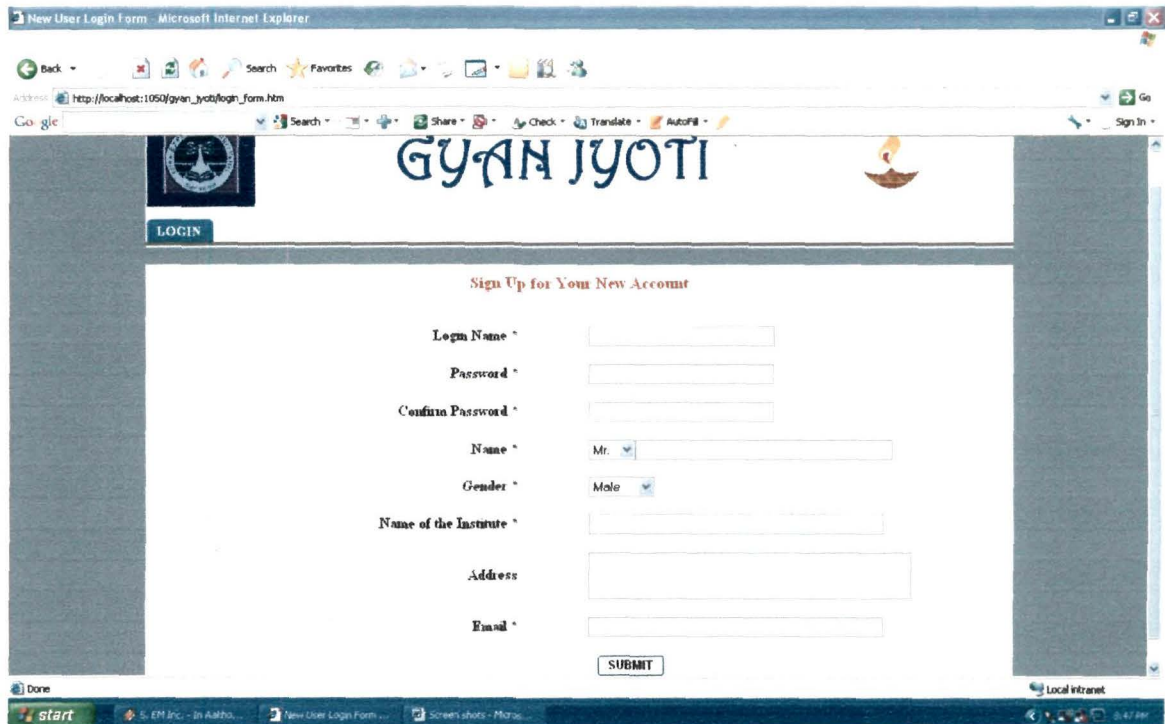
**6.1.2.1 Authorization:** Authorization is a very important component of any KMS. Since exchange of knowledge through a KMS is confined to a specific group of people, therefore the access of KMS should be confined to only that targeted group. One way of restricting access, is to authorize the users of the KMS by means of login and password.

Authorization of the proposed KMS was also done by means of login and password. For this purpose, a table named **Member** was created using Oracle 9i. The structure of the table is as follows.

**Table 6.2: Database Table for Member**

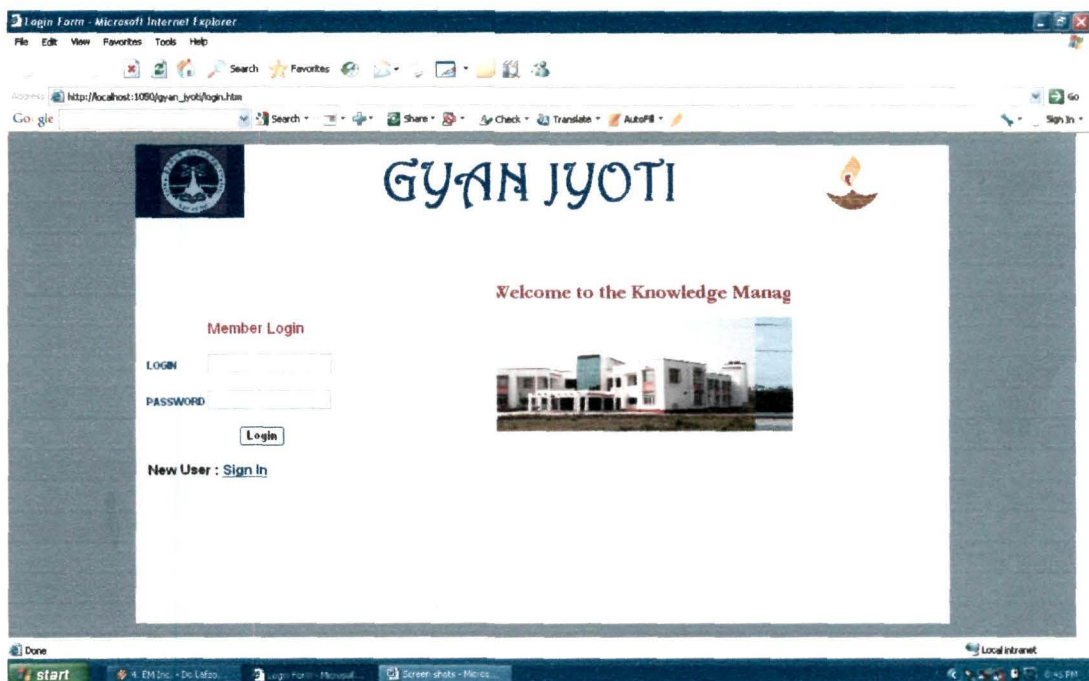
Field Name	Data Type	Size	Primary Key?
Login	Character	15	Yes
Password	Character	15	No
Name	Character	60	No
Gender	Character	7	No
Institute	Character	100	No
Address	Character	100	No
Email	Character	100	No

Whenever a user, enters the system for the first time he/she must create a user account by filling up a form which is shown in Figure 6.1.



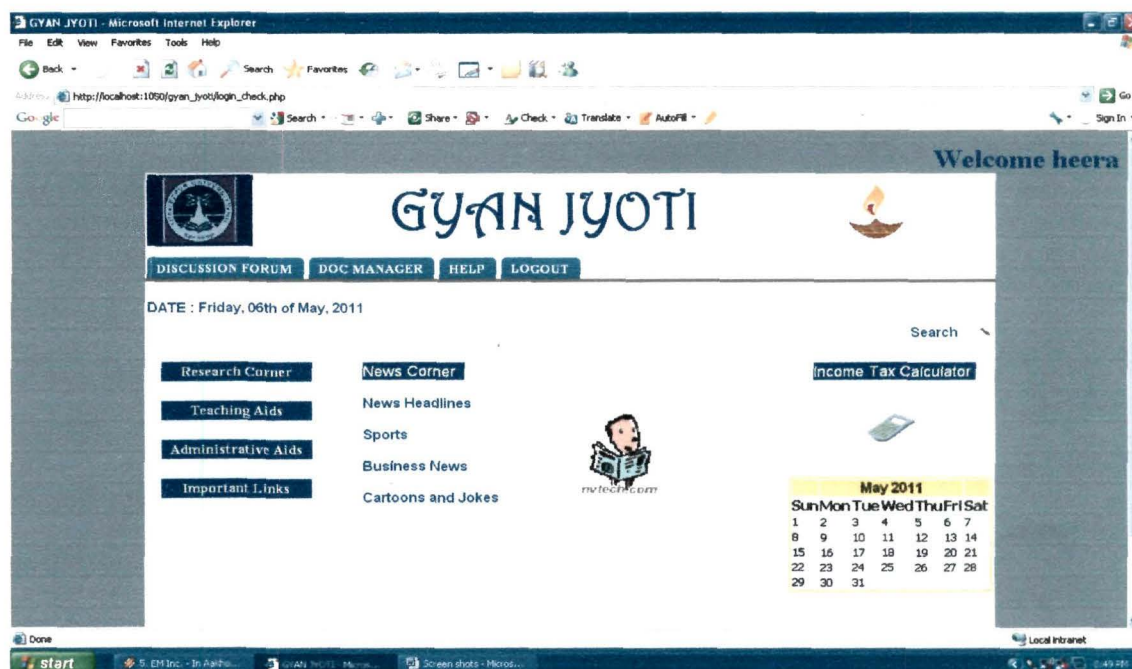
**Figure 6.1: Form to Create a New User Account**

After creating the user account, the user must enter the login and password in the form shown in Figure 6.2 and click the login button.



**Figure 6.2: Login Form**

On clicking the login button the user is authenticated and a valid user is allowed to enter the homepage of the Knowledge Management System, which is shown in Figure 6.3.

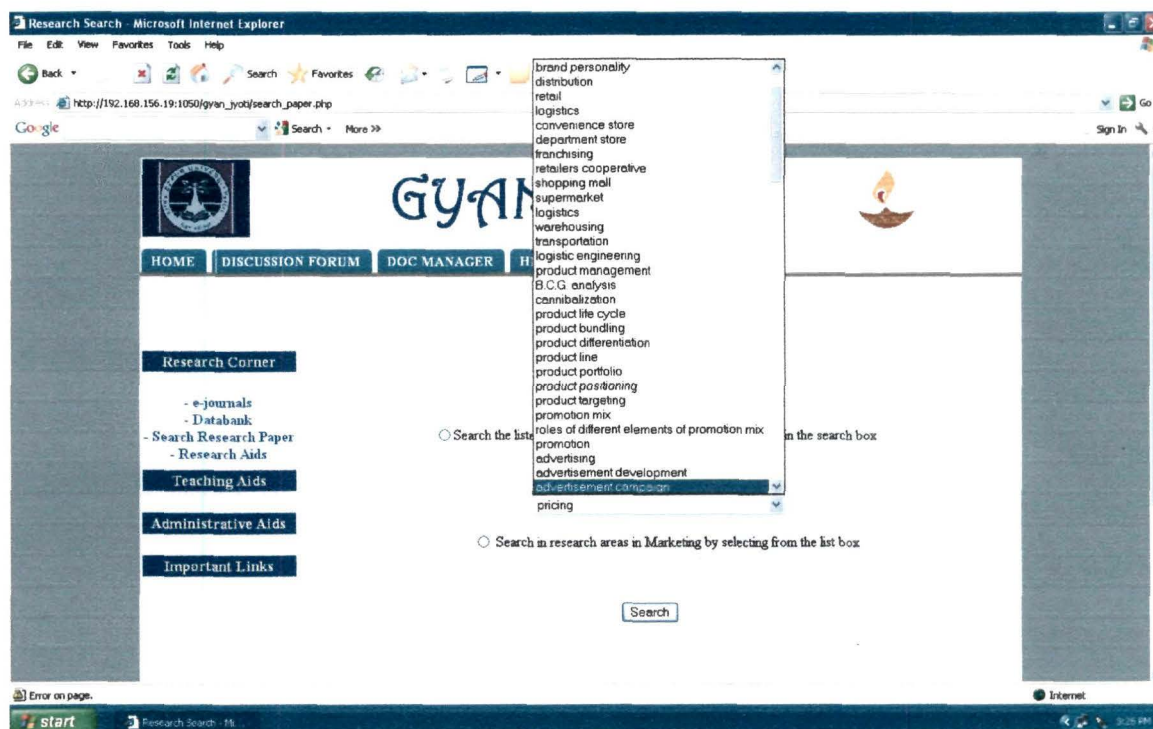


**Figure 6.3 Homepage of Gyan Jyoti**

The system displays messages to the user if the user enters a wrong login and/or password or forgets to enter either the login and / or password. (See Figure VI.3 and Figure VI.4 of Annexure VI). The codes used in the authorization process i.e. from creating new user login to logging into the system, were written using php and is given in Annexure VII (Program Listing 1).

**6.1.2.2 Search:** Search was identified as the most important component of the KMS for academics. In the prototype developed, four types of Search were implemented. They are ontology based search, database search, file search and customized google search. Database search was done in the Authorization component to validate a user. It is also used in Discussion Forum to search previous chat transcripts. File search is used to browse the files from the server. The development details of the other two searches i.e. ontology based search and customized google search, are described in the next sections.

**(a) Ontology Driven Search:** The Ontology Driven Search was based on the concept of construction of Feature Vector adopted by Tomassen (2008). The schematic diagram shown in Figure 5.6 of Chapter 5 depicts the search process of the Ontology Driven Search. Ontology on Research Areas of Marketing was created for this Ontology Driven Search, details of which are discussed in Section 6.1.2.2 (b) The algorithm used for construction of Feature Vector is discussed in Section 6.1.2.2 (c). Here the user selects a keyword from the drop down list as shown in Figure 6.4. For the prototype only one area i.e Research Areas in Marketing was included. The drop down list comprises of the concepts of the ontology of Research Areas of Marketing. After selecting the keyword the user selects the *Search option*. This will result in links to research papers related to that search.

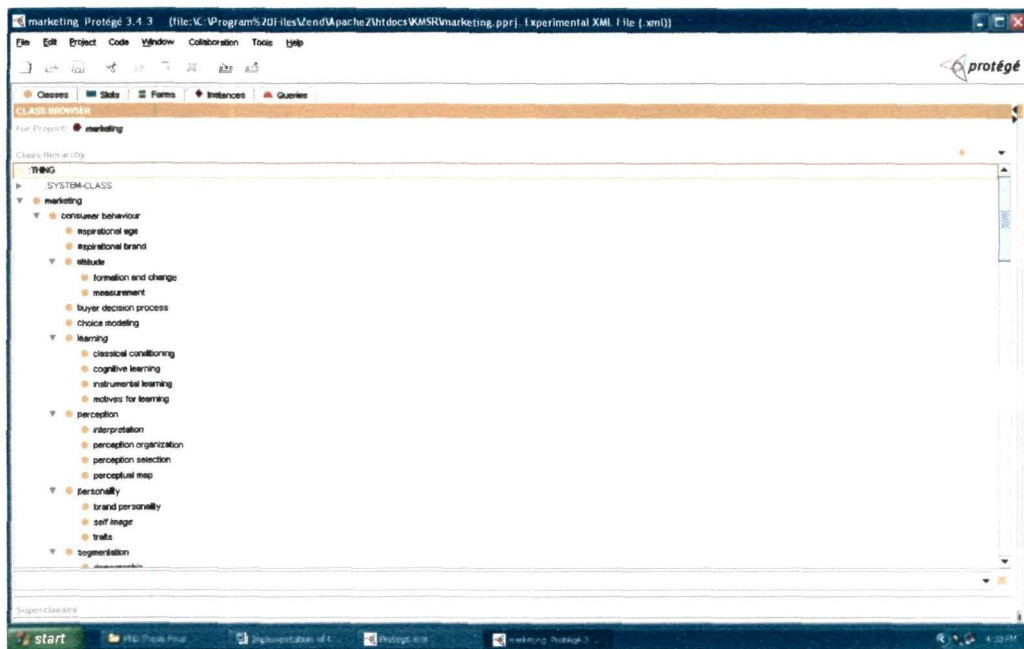


**Figure 6.4 Search page of Gyan Jyoti**

**(b) Ontology on Research Areas in Marketing:** In order to develop the ontology based search, keywords of the research areas in marketing were gathered from literature. The keywords derived from literature were used to create the domain ontology of Research areas of Marketing which was verified by experts working in



marketing research. The major research areas of marketing were identified as Consumer Behavior, Distribution, Product Management, Promotion, Pricing, Service Marketing and Relational Marketing. The detailed ontology of Research Areas of Marketing is given in Annexure V. The domain ontology was then developed using Protégé 3.4.3, which then generated an XML file that was used for Feature Vector Construction. A screenshot of the ontology as viewed through Protégé 3.4.3 is shown in Figure 6.5.



**Figure 6.5: Screenshot of the Ontology on Research Areas of Marketing in Protégé 3.4.3**

**(c) Algorithm for Feature Vector Construction:** For a given user search query ‘q’, a feature vector ‘fv’ is generated by including all ontological concepts ‘c’, provided  $q \in O$ , where O is the Ontology. This feature vector ‘fv’ is fed to the customized google search engine. Algorithm ‘Feature Vector Constructor’ is used to build the feature vector which is described in next page.

**Algorithm Feature Vector Constructor (Q, O)**

**Input: Query Q, Ontology O**

**Output: Feature Vector FV**

Let  $q_i$  be the search query, where  $q_i \in Q$ .

Let  $C_i$  be a concept, where  $C_i \in O$ .

Let  $fv$  be the feature vector, where  $fv \in FV$ .

Let  $r$  be the root of the Ontology tree.

For each concept  $C_i \in O$

If ( $C_i = q_i$ ) then

$fv = C_i$

    If ( $C_j = \text{parent}(C_i)$ ) then

        Append  $C_j$  to  $fv$

    End If

End For

While ( $\text{parent}(C_i) \neq r$ )

    For each concept  $C_i \in O$

        If ( $C_i = C_j$ )

            Append  $\text{parent}(C_i)$  to  $fv$

$C_j = C_i$

        End If

    End For

End while

Return  $fv$

**End Algorithm**

The algorithm stated above was implemented using php script, details of which are given in Annexure VII (Program Listing 3).

**(d) Customized Google Search:** The customization feature of google search engine was utilized to create different customized searches that searched for the following information.

- Research Papers
- Databanks
- Model Question Papers
- Syllabus

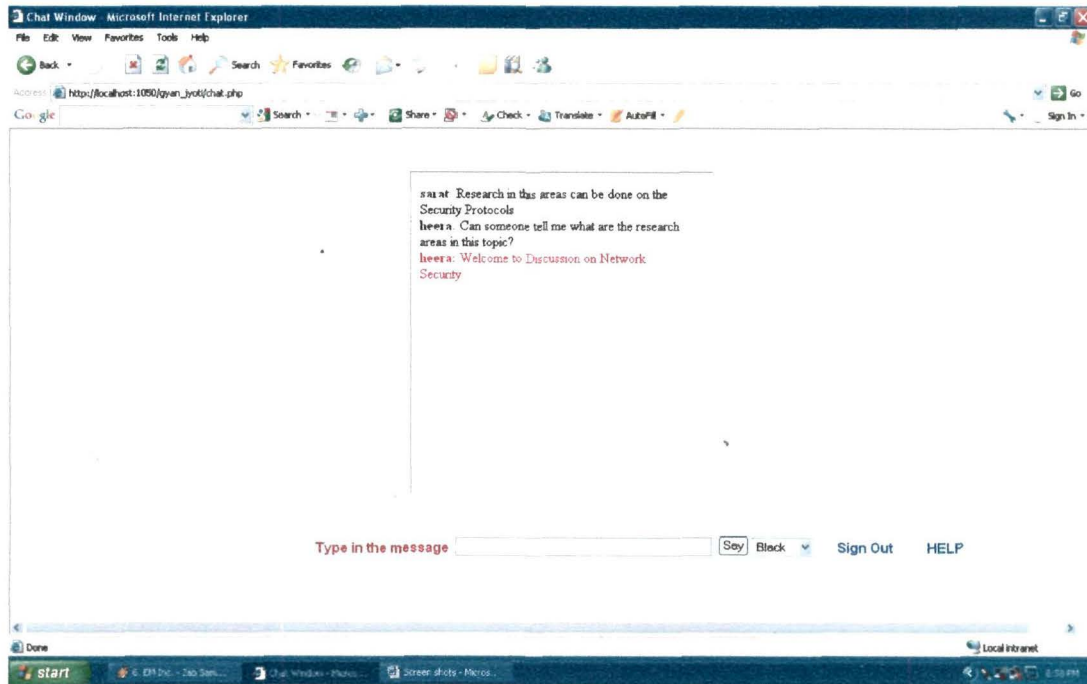
Google was customized by adding related websites and google search in *Search List* of Customized google. During the search process, the customized google searches the internet by focusing more on the added websites.

**6.1.2.3 Discussion Forum:** Another important component of KMS for academics is the Discussion Forum. In the prototype this component allows the users to hold discussions, which are stored in a table named **Chatscript** created by using Oracle 9i. The structure of the table is as follows.

**Table 6.3: Database Table for Chatscript**

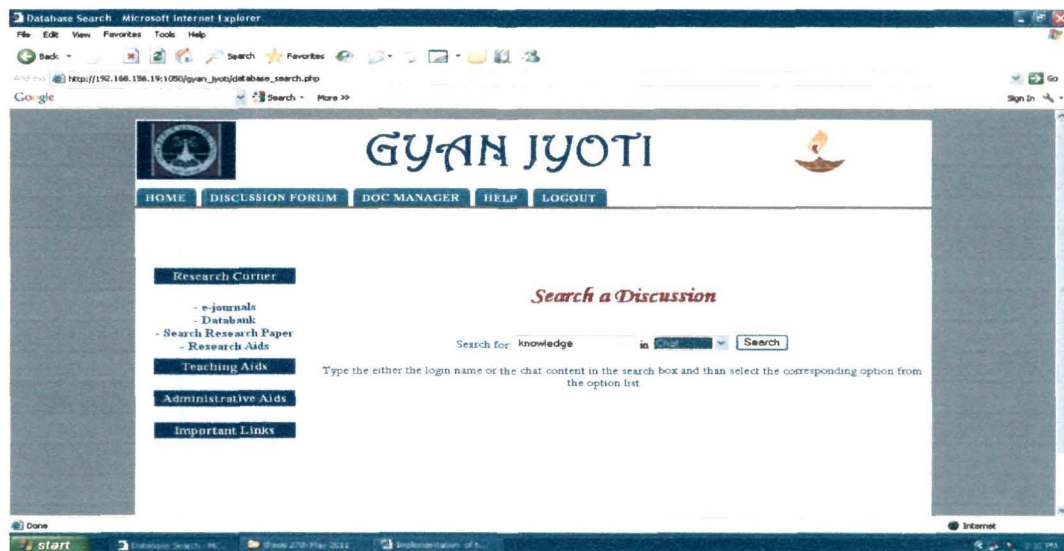
Field Name	Data Type	Size	Primary Key?
Id	Number	4	Yes
Nickname	Character	15	No
Chat	Character	100	No

The screenshot of a discussion session is shown in Figure 6.6.

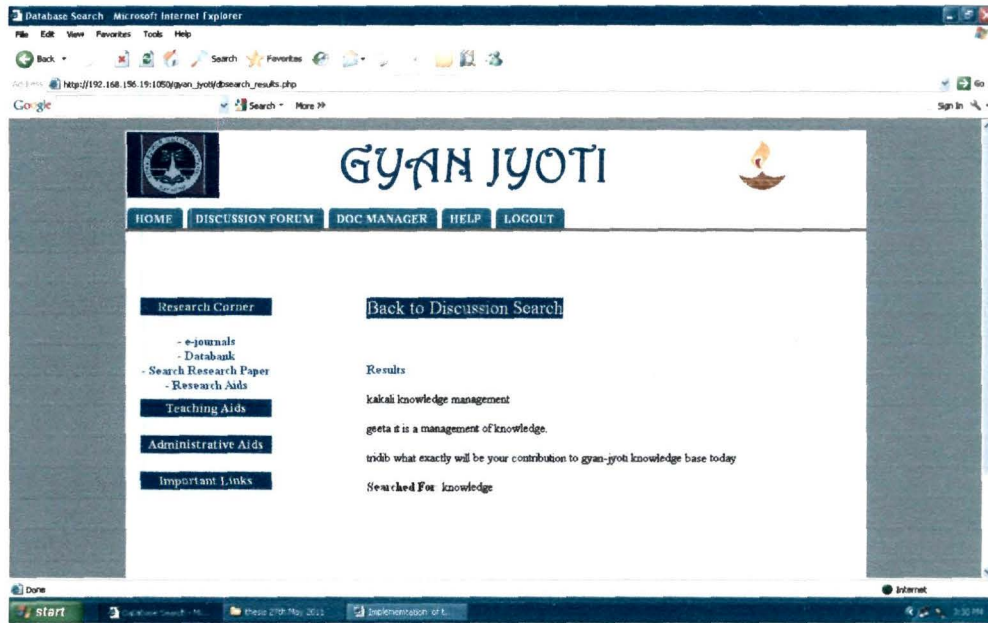


**Figure 6.6: Screenshot of a Discussion Session of Gyan Jyoti**

Besides, enabling discussions this component also facilitates searching of previous discussions either by name or by a keyword. A screenshots showing the input of a previous discussion search query and the results of that search query are shown in Figure 6.7 and Figure 6.8.



**Figure 6.7: Screenshot showing the input of a Discussion Search in Gyan Jyoti**

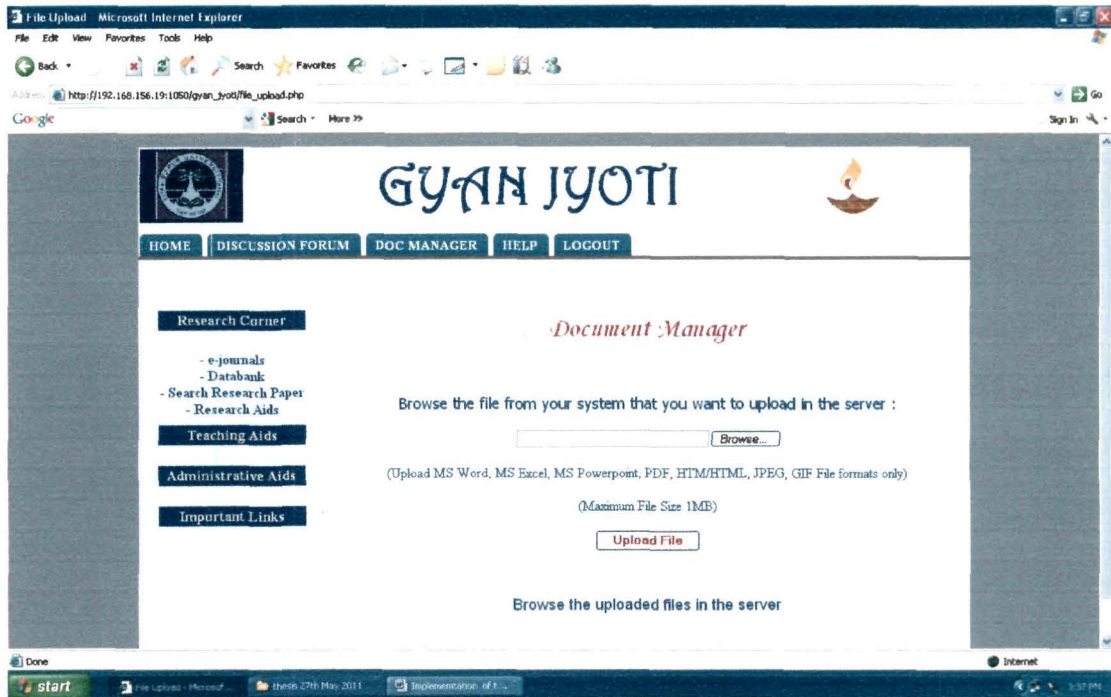


**Figure 6.8: Screenshot showing the results of a Discussion Search in Gyan Jyoti**

The codes for holding a Discussion Session and for Searching Discussions were written using php script and are given in Annexure VII .(Program Listing 6,7,8)

**6.1.2.4 Document Manager:** Document Manager component comprises of the File Management i.e Uploading and Browsing of Files and the components that were identified from the User Requirement survey (Refer to Table 5.2 of Chapter 5).

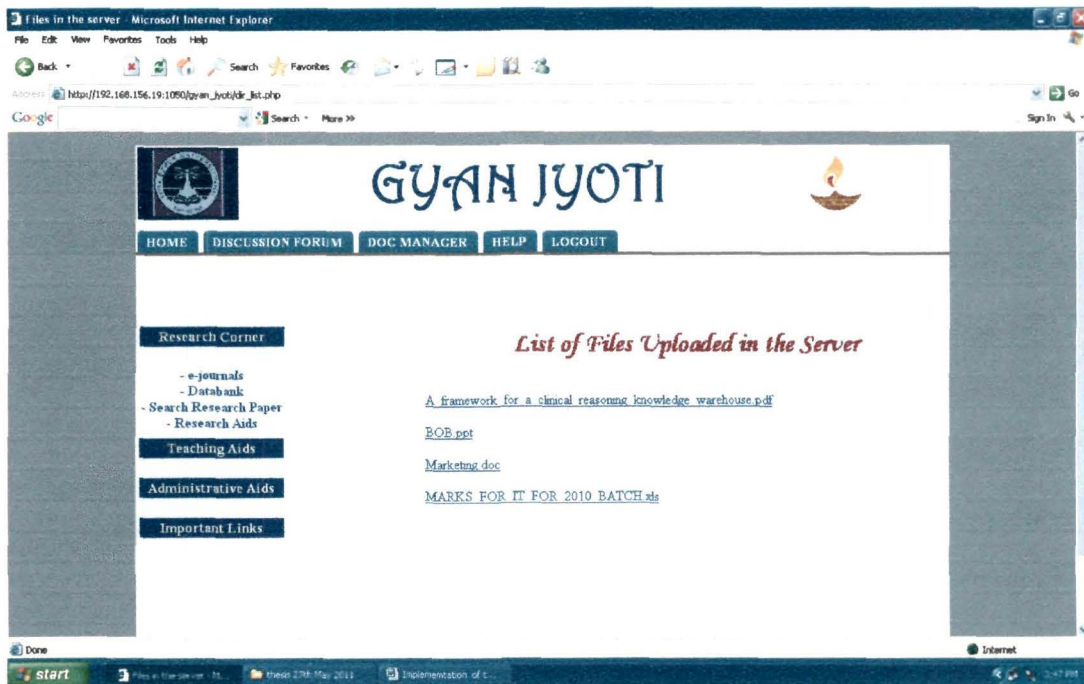
For uploading files in the server and browsing the files, the user must click the Doc Manager component of the Home page. A screenshot of the Doc Manager component is shown in Figure 6.9. The codes used to design this component were written using php and is given in Annexure VII .(Program Listing 4 & 5).



**Figure 6.9: Screenshot of the Document Manager of Gyan Jyoti**

To upload a file in the server, the user must browse the file from his machine and then click the “Upload File” button to upload the file in the server.

To browse the uploaded files in the server the user has to click the link “Browse the upload files in the server” and then the files in the server will be displayed as shown in Figure 6.10.



**Figure 6.10: Screenshot of the List of Files Browsed from the Server of Gyan Jyoti**

The other components of the Document Manager that were identified from the user requirement survey were grouped under three headings. They are Research Corner, Teaching Aids and Administrative Aids. The links available under Research Corner are e-journals, Databanks, Search Research Paper and Research Aids. Teaching Aids comprises of Methodologies, Question Paper Styles, Syllabus and ebooks. Again, links under Administrative Aids were UGC site, AICTE site, site of 6<sup>th</sup> Pay Commission and Expert List. The screenshots of the webpages of these components are given in Annexure VI.

Besides these components, some important links and components were also added in the portal. Links to the websites of Academic Institutes, website of Tezpur University, webmail page of Tezpur University, links to different sections of local and national news papers and news channels and an income tax calculator were also incorporated in the portal.

## **6.2 Validation of the Implemented KMS for Academics**

The second part of the third objective of the study was to analyze the effectiveness of the implemented system via feedback. Feedback was obtained by conducting an email survey among the users of the system and also by conducting a physical survey among the users in Tezpur University and those within a radius of 200 kms from the university. The questionnaire used for the survey was an adaptation of the ISO Consolidated Usability Model (Abran et al., 2003). In the survey, the attributes considered for measuring user's subjective satisfaction were KMS effectiveness, efficiency, security, satisfaction, and learnability. Besides these attributes, qualitative data on additions to be incorporated and reasons for dissatisfaction (if any) were also sought for. The questionnaire for the feedback survey is given in Annexure VIII. 66 responses were gathered and taken into consideration for the analysis. The profile of these respondents is discussed in the next section

### **6.2.1 Profile of the Respondents**

General profiling of all 66 respondents was done with respect to various variables and they are presented here. Responses from outside the State of Assam was poor because the KMS could not be accessed due to internet connectivity problems.

**6.2.1.1 Area Covered:** The states of Eastern India from where responses were obtained are Assam, West Bengal, Sikkim, Orissa and Jharkhand. A table showing the profile of the respondents based on locations of the organizations where they work and the discipline they teach is given in the next page.



**Table 6.4: Area Covered**

<b>Discipline</b>	<b>Computer Science</b>	<b>Management</b>	<b>Total</b>
<b>State</b>			
Assam	17	42	59
West Bengal	1	1	2
Orissa	0	2	2
Jharkhand	1	2	3
Total	19	47	66

From Table 6.4 it can be seen that 29% of the respondents are from Computer Science and 71% are from Management discipline. Also, from the table it is observed that the highest number of respondents (89%) is from Assam. This is because both email survey and self administered survey was conducted to gather responses from the academics of Assam. Apart from carrying out their academic pursuits, 10.6% of the respondents also perform the duty of Placement Co-ordinator and 10.6% perform other duties like Dean, Director, Director Distant Education, System Administrator, Event Co-ordinator and Co-ordinator Social Forum...

**6.2.1.2 Feedback on Security:**

**Table 6.5: Feedback on Security**

<b>Questions</b>	<b>Yes (%)</b>	<b>No (%)</b>	
1. Are you able to create a new user login easily?	97%	3%	
2. Can you enter the main page of Knowledge portal without entering login and password?	0%	100%	
3. If the portal suddenly quits, do you have to enter login and password again to enter the main page of the portal?	<b>Agree (%)</b>	<b>Can't Say (%)</b>	<b>Disagree (%)</b>
	68.2%	28.8%	1.5%

Maximum percentage of respondents agreed that the KMS cannot be entered without proper authorization. Therefore, it can be concluded that the system is secured.

### 6.2.1.3 Feedback on Effectiveness:

**Table 6.6: Feedback on Effectiveness**

Questions	Strongly Agree (%)	Agree (%)	Can't Say (%)	Disagree (%)	Strongly Disagree (%)
4.a. Document Manager is a useful component for carrying out my type of work.	31.8%	60.6%	7.6%	0%	0%
4.b. Provision for File uploading is a useful feature.	36.4%	59.1%	4.1%	0%	0%
4.c. Provision for Browsing of uploaded files is a useful feature.	48.5%	48.5%	3.0%	0%	0%
4.d. Discussion forum is a useful component for carrying out my type of work.	22.7%	57.6%	16.7%	1.5%	1.5%
4.e. Provision for Starting a discussion is a useful feature.	24.2%	60.6%	12.9%	1.5%	1.5%
4.f. Provision for Searching a discussion is a useful feature.	31.8%	59.1%	7.6%	0%	1.5%
4.g. Search facility for research papers is a useful component.	59.1%	34.8%	6.1%	0%	0%
4.h. Relevant research paper is obtained in search results.	25.8%	53.0%	21.2%	0%	0%
4.i. Options given in Research Corner are useful for research work.	28.8%	60.6%	10.6%	0%	0%
4.j. Options given in Teaching Aids are useful for teaching.	28.8%	54.5%	15.2%	1.5%	0%
4.k. Options given in Administrative aids are useful for administrative work.	21.2%	39.4%	31.8%	1.5%	0%
4.l. Options given under Important Links are useful.	16.7%	68.2%	13.6%	0%	0%
4.m. Income tax calculator is a useful component.	19.7%	48.5%	25.8%	1.5%	1.5%
4.n. News items under News Corner are an attractive feature of the Knowledge portal.	36.4%	50.0%	9.1%	3.0%	0%

As may be seen from Table 6.6, maximum percentage of respondents agreed that the components of the implemented KMS were useful for their work. 100 % of the respondents also agreed that the knowledge portal as a whole was useful for their work. Therefore, it can be inferred that the system is effective.

#### 6.2.1.4 Feedback on Efficiency:

**Table 6.7: Feedback on Efficiency**

Features	Agree (%)	Can't Say (%)	Disagree (%)
5. a. File uploading can be done without much delay.	81.8%	16.7%	0%
5.b. Browsing of uploaded files can be viewed without much delay.	84.8%	13.6%	0%
5. c. Starting a discussion can be done without much delay.	78.8%	19.7%	0%
5.d. Searching a discussion can be done without much delay	80.3%	19.7%	0%
5.e. Searching research paper does not take much time.	83.3%	13.6%	3.0%
5.f. Searching model question paper does not take much time.	66.7%	33.3%	0%
5.g. Databanks can be searched without much delay.	78.8%	19.7%	0%
5.h. Syllabus can be searched within a short time.	78.8%	19.7%	0%

From Table 6.7 it can be seen that maximum percentage of respondents agreed that the components of the implemented KMS opened without delay. Therefore, it can be concluded that the system is efficient.

**6.2.1.5 Feedback on Learnability:** 93.9% of the respondents agreed that the knowledge portal is easy to operate. Moreover, 87.9% of the respondent agreed that the help provided in the system helped the users to learn the system easily. Therefore, it can be concluded that the system can be easily learned and operated.

**6.2.1.6 Overall Score of the KMS for Academics:** Question No. 8 of the questionnaire, asked the respondents to give an overall rating to the implemented KMS for academics, on a scale of 1-5 (1 is the lowest score and 5 is the highest score). The weighted score from the responses obtained from the survey is calculated as shown below.

$$\text{Weighted Score} = \frac{1 * n_1 + 2 * n_2 + 3 * n_3 + 4 * n_4 + 5 * n_5}{n_1 + n_2 + n_3 + n_4 + n_5} = 3.92$$

where,            n1 = No. of Respondents who gave a rating of 1 = nil  
                      n2 = No. of Respondents who gave a rating of 2 = nil  
                      n3 = No. of Respondents who gave a rating of 3 = 14  
                      n4 = No. of Respondents who gave a rating of 4 = 43  
                      n5 = No. of Respondents who gave a rating of 5 = 9

The weighted score obtained from the calculation is 3.92, which is a high score in a scale of 1 – 5. Therefore, the survey results showed that the users are satisfied with the system.

#### **6.2.1.7 Additions to be Incorporated in the Implemented KMS for Academics:**

Besides measuring the users' satisfaction, the questionnaire for feedback survey also included an open question (Q. No. 6) to gather inputs on any the additional requirements sought in the portal for academics. Survey revealed that the respondents sought additions in most of the components of the system. The additions sought by the respondents are presented in Table 6.8.

**Table 6.8: Additions to be Incorporated in the KMS for Academics**

<b>Component Name</b>	<b>Additions</b>
Document Manager	Control what type of documents can be uploaded / even limit the file size
File Uploading	Make separate tags/headings for different types of uploaded files, file protection, personalized uploading provision
Browsing of Upload files	Result should be well presented
Discussion Forum	Categories may be provided based on topic of discussion More user friendly
Starting a Discussion	Space for Multiple lines
Searching a Discussion	Result should be well presented
Research Corner	More e-journals, Search History, Details of Journals with the links, Details of Databanks, Online Conferences
Teaching Aids	Examples, Web Links to be displayed in Methodology, Videos, PPTs
Administrative Aids	Service Rules
Important Links	No comments
News Corner	Important News to be highlighted
Income Tax Calculator	Updated, Information about Tax saving instruments
Help	Site Map
Any other feature that you feel would add value to the portal	No comments

As may be seen from Table 6.8, additions were sought for only the existing components and in most of the cases, presentation of the components needed to be improved. Therefore, it can be inferred that the respondents were satisfied with all the major

components included in the portal and have no additional requirement. Additions sought by them were extra features of these components only.

Some of the suggestions like setting a limit to file size to be uploaded, controlling the type of files to be uploaded, adding Powerpoint presentations for different subjects in teaching aids and updating the income tax calculator were incorporated.

### **6.2.2 Inference drawn from the Feedback Survey**

1. From the findings of the survey, it can be inferred that the respondents were satisfied with the prototype in terms of effectiveness, efficiency, security, satisfaction, and learnability attributes.
2. Again, from the findings of the survey, it can be inferred that though the respondents were satisfied with the existing prototype, they wished to have additional features incorporated to make it even more attractive.

Knowledge Management System Architecture

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## **Chapter 7**

# **Conclusion and Recommendation**

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# Conclusion and Recommendation

## 7.1 Conclusion

Knowledge Management System (KMS) is a tool that can help academicians to increase their efficiency. This study aims at designing this tool for the academicians by understanding their needs. A review of existing literature on KMS was carried out to determine the technologies used in designing the KMS architectures of both corporate sectors and academic institutes. To gather processing and interface information, seven corporate KMS in practice were also observed. Also, a survey was conducted to collect the knowledge requirements of the academicians. To determine a geographical boundary, the survey was restricted to the management and computer institutes of Eastern India. The review of all these factors provided the rationale for development of architecture of a Web-based KMS for academics.

A Web-based Architecture for a KMS for academics was designed. This architecture aimed at meeting both the academic and administrative requirements of academicians, specifically for those working in management and computer science institutes. To validate the architecture, a prototype based on the architecture named "Gyan Jyoti" was developed and implemented at Tezpur University. To analyze the effectiveness of the implemented system, feedback of the KMS was sought from the users of the system.

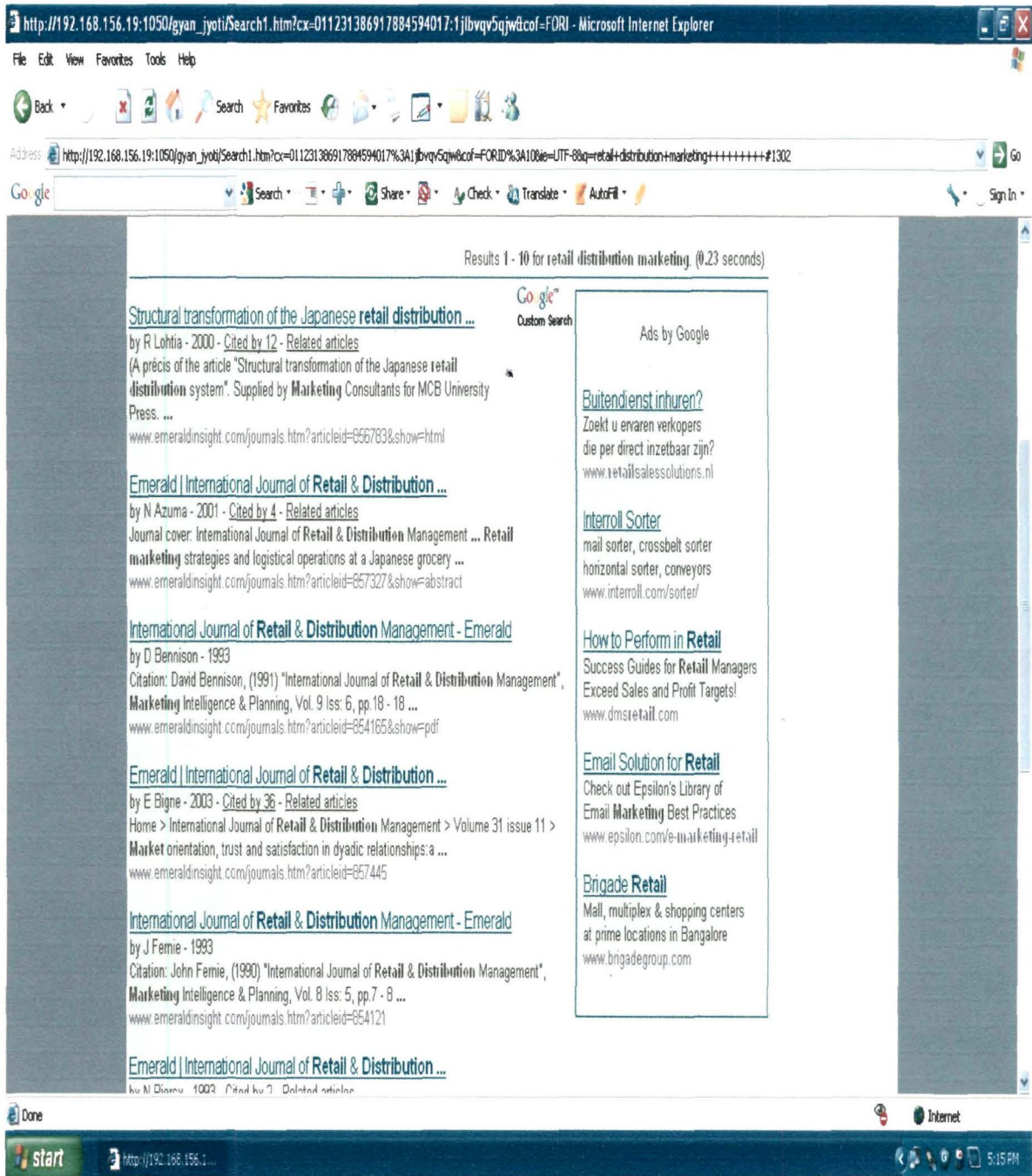
### 7.1.1 Features of the Study

The important features of this study are:

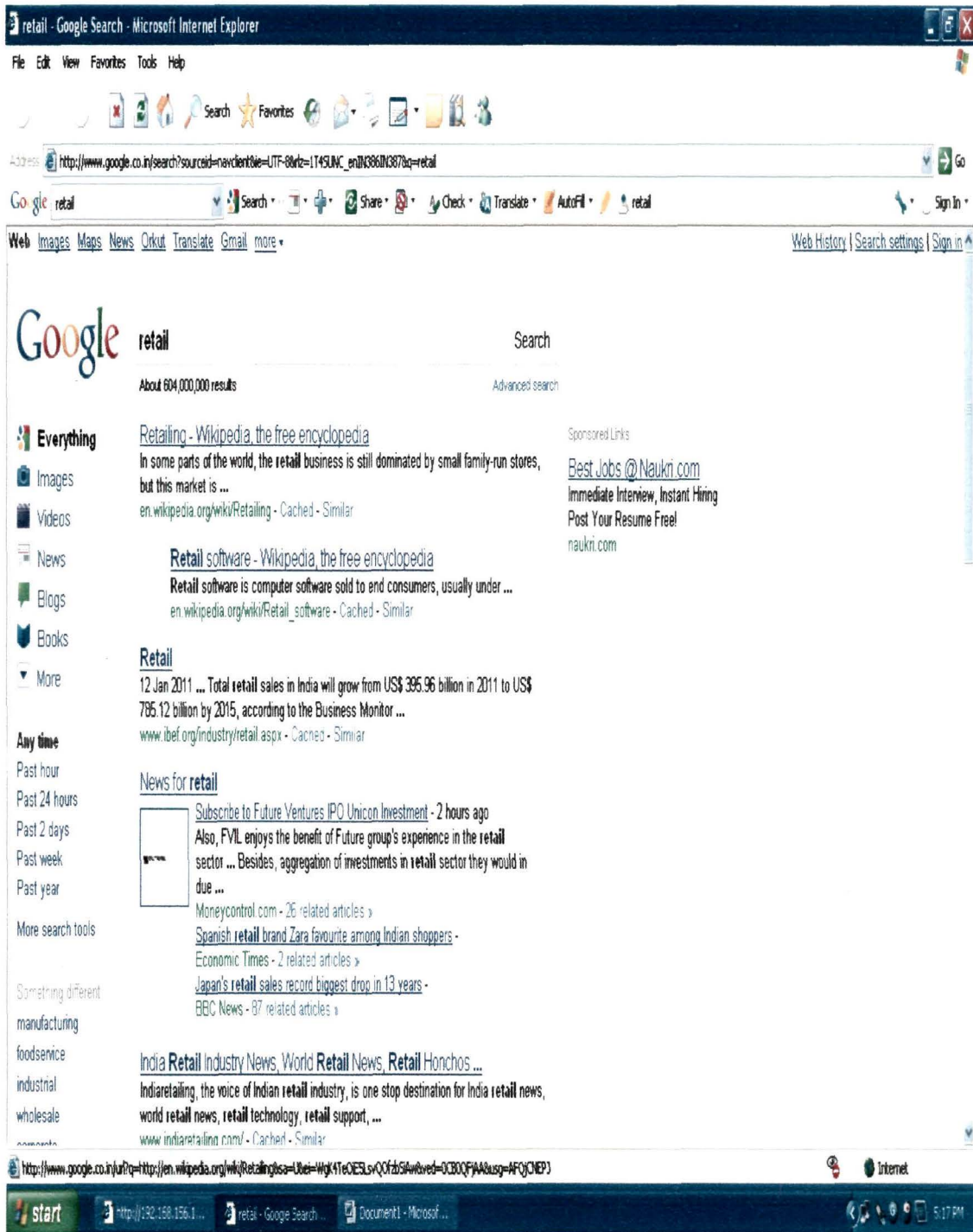
1. Classification of attributes of KMS, considering literature review and observations of KMS in practice.
2. Determining the knowledge requirements of academicians (specifically those teaching in management and computer science institutions) in terms of what is needed to pursue their academic and administrative activities.



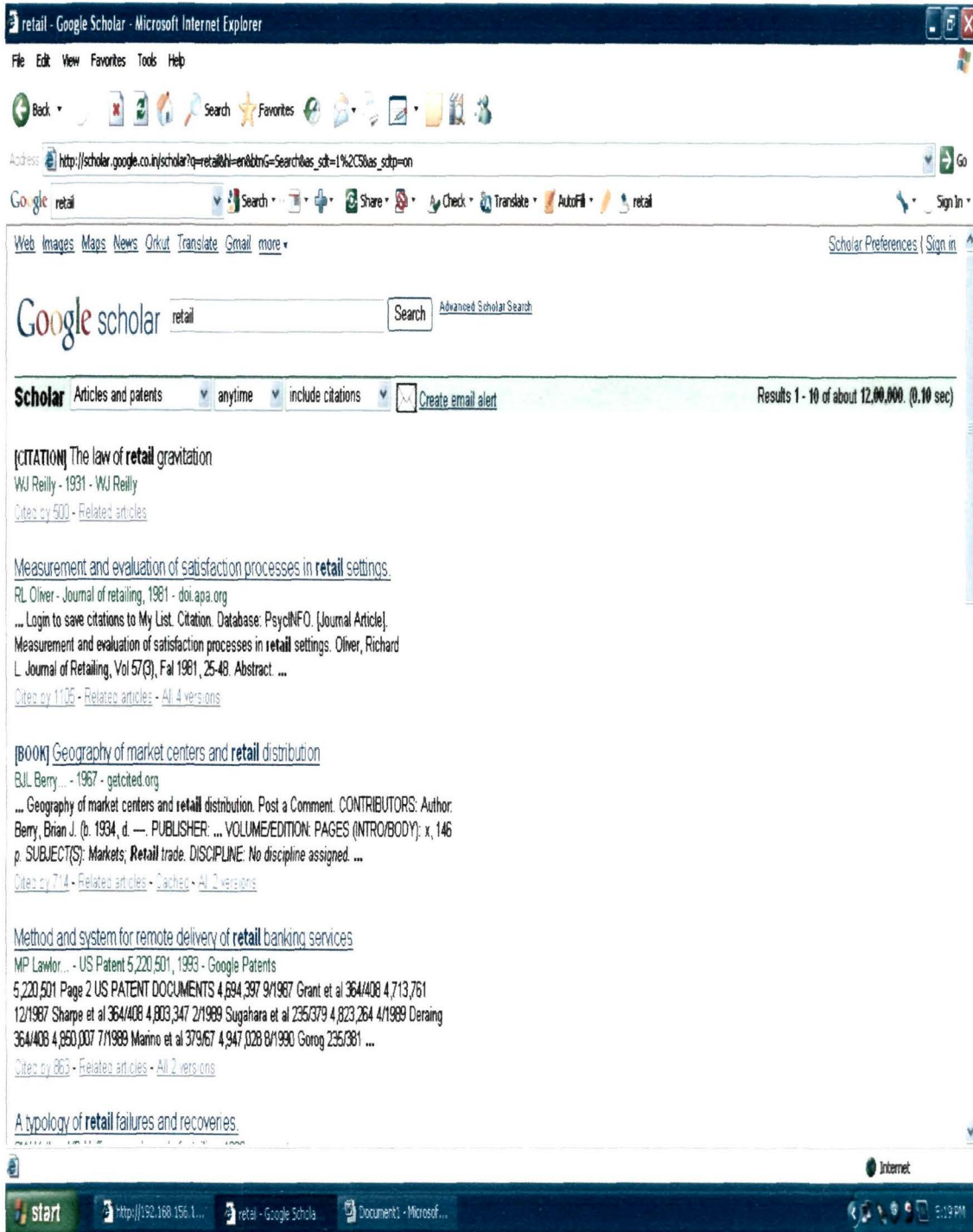
3. Designing the architecture of KMS, by considering the specific requirements of the academicians and identifying the associated technologies from literature to meet those requirements.
4. Development of a prototype named “Gyan Jyoti” based on this architecture and implementing it at Tezpur University.
5. Developing ontology on Research Areas on Marketing, in order to test an ontology-driven search engine in the prototype. This search engine will be able to search for Research Papers on Marketing. The search results for a keyword in marketing, obtained from this search engine, is more relevant than search results obtained from google search and scholar google for the same keyword. This can be observed by comparing the search results obtained for the keyword “retail”, in the ontology-driven search engine in the prototype, google search and scholar google search results, which are shown in Figure 7.1, Figure 7.2 and Figure 7.3 respectively.



**Figure 7.1: Search Results of the Ontology Driven Search Engine of the Implemented KMS for Academics for the Search Keyword ‘retail’**



**Figure 7.2: Search Results of Google Search Engine for the Search Keyword 'retail'**



**Figure 7.3: Search Results of Scholar Google for the Search Keyword ‘retail’**

### **7.1.2 Specific Contribution of the Study**

For designing a KMS for academics, the architecture design in this study can be used as a framework, based on which a need based KMS can be developed and implemented in an academic institution for meeting academic as well as administrative requirements.

### **7.1.3 Limitation of the Research**

The research has the following limitations.

1. The primary data on observation of KMS in practice, required for fulfilling objective 1 and objective 2 considered only KMS of corporate sector as KMS of academic institutions could not be accessed.
2. Two questionnaire surveys conducted to gather the requirements of academicians and to collect the feedback of the implemented KMS for academics were restricted to academics of Management and Computer Science Institutions of Eastern India. A larger audience may have resulted in an improved KMS for academics.

### **7.1.4 Scope for Future Work**

1. While developing the ontology driven search engine for the prototype, a static ontology was used. For future study, this ontology can be used as a base to construct a dynamic ontology that may further improve the search results.
2. As an ontology driven search engine for marketing research was developed in the study, same concept can be used to develop ontology driven search engine for other research areas.
3. While going through literature, it was observed that use of Agent technology in a KMS, automates the different activities of the KMS. So, a study may be conducted to design KMS architecture for academics considering both agent technology and ontology.
4. The interface of the prototype of the proposed KMS architecture for academics was designed using php and html, for which the interface looks simple. Further studies may implement the prototype using VB.Net, Flash and other interface designing tools that will make the interface more attractive

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Yoo, D., Kim, G., & Suh, Y. (2005). An Attempt to Use Ontology for Semantic Information Retrieval. Retrieved from <http://gkim.info/research/proceeding/kmis2005b.pdf>.

#### **WEBSITES OF KNOWLEDGE PORTALS OF ORGANISATIONS** (Observed for study)

<http://fbiweb.etb.bel.alcatel.be/knowledgebase/content/>

<http://intranet.bsnl.co.in/bsnl/intranetsite/home.php>

<http://my.netapp.com/mynetapp/index.jsp>

<http://support.oracle.com>

#### **WEBSITES VISITED**

<http://protege.stanford.edu/>

<http://www.free-php.net/>

<http://www.w3schools.com/php/default.asp>

Knowledge Management System Architecture  
– A Specific Study for Management and Computer Academics

## **ANNEXURE**

Knowledge Management System Architecture  
– A Specific Study for Management and Computer Academics

# ANNEXURE I

We are proposing to develop a Knowledge Management System for academics (specially from Computer Science and Management) as part of our research work. The system will be a Web-based interactive system, which will serve as a platform to share knowledge among academicians. In order to develop the system, we want to know from you, your requirements from such a system.

The questionnaire aims at identifying these requirements. It is purely for research use only. We look forward for your help and co-operation and assure that your response will be kept confidential.

## Questionnaire

*Write 'y' against each selected option and write down (if any) in the space provided.*

1. What would facilitate you in teaching and research activities?

Journals	
Databank	
Report writing guidelines	
Access to research details	
Recent trends in a research area	
Ready Reference for a topic	
Software information	
Abstract of Projects	
Consultancy information	
Teaching methodologies	
Question Paper setting styles	
Names of Experts in a particular subject	
Funding agencies & their guidelines	
Others, please mention	

2. What type of information do you require from your Library?

New arrivals in the library	
List of Books and Journals available	
Reader's comments about books	
Availability status of a book	
Others, please mention	

3. What would help you in developing a new curriculum or revising the existing one?

Course structures of other institutes	
Feedback from Recruiters / Industry	
Feedback from Alumni	
Model syllabus of other institutes	
Others, please mention	

4. What type of Administrative work do you perform?

Head of the Department	
Placement Co-ordinator	
Examination Co-ordinator	
Laboratory Supervisor	
Others, please mention	

5. What would facilitate you in administrative work?

Information system to aid your work	
Rules & Regulations of the Institute	
List of Experts	
List of Suppliers	
Others, please mention	

6. (a) Are you involved in Strategic planning in your organization?

(a) Yes (b) No

6.(b) If yes, then what type of information would you require?

Recent developments in that programme	
Funding Agencies	
UGC & AICTE guidelines	
Others, please mention	

7. What other information do you require frequently in your organization?

\_\_\_\_\_

\_\_\_\_\_

8. When you are in need of information related to your work, what you do?

Search on my own	
Ask colleagues / friends	
Others, please mention	

9. On an average how much time is spent per week in searching for information?

An hour	
Half a day	
One full day	
2-3 days	
4-6 days	
Others, please mention	

10. What is the first thing you look up, when you read the daily newspaper?

Headlines	
Sports section	
Editorial	
Cartoons/Comics	
Read Sequentially	
Others, please mention	

Name:

Designation:

Department:

Organization:

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		M.N. Tripathi	mnt@ximb.ac.in
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**Email Address of Faculties of Management Institutes of Eastern India**

<b>State</b>	<b>Institute Name &amp; Place</b>	<b>Name of the Faculty</b>	<b>Email Address</b>
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		Prof. C. Shambu Prasad	shambu@ximb.ac.in
		Jeevan J. Arakal	jeevan@ximb.ac.in
		Prof. K.T. Chandy	ktchandy@ximb.ac.in
		Dr. Niraj Kumar	niraj@ximb.ac.in
		Prof. S. Peppin	peppin@ximb.ac.in
		Dr. Sudhansu Sekhar Singh	sssingh@ximb.ac.in
West Bengal	Indian Institute of Management, Calcutta (IIMC), Kolkatta	Abhishek Goel	agoel@iimcal.ac.in
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**Email Address of Faculties of Management Institutes of Eastern India**

<b>State</b>	<b>Institute Name &amp; Place</b>	<b>Name of the Faculty</b>	<b>Email Address</b>
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## ANNEXURE III

### Website Address of Computer Science and Management Institutes of Eastern India

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Assam	Computer Science	Department of Computer Science, Assam University, Silchar	<a href="http://www.assamuniversity.nic.in/computerscience.html">http://www.assamuniversity.nic.in/computerscience.html</a>
		Department of Computer Science, Gauhati University, Guwahati	<a href="http://www.gauhati.ac.in/computer_science/index.htm">http://www.gauhati.ac.in/computer_science/index.htm</a>
		Department of Computer Application, Girijnanda Chowdhury Institute of Management and Technology, Guwahati	<a href="http://www.gimt-guwahati.ac.in/mca/index.html">http://www.gimt-guwahati.ac.in/mca/index.html</a>
		Department of Computer Science & Engineering, Girijnanda Chowdhury Institute of Management and Technology, Guwahati	<a href="http://www.gimt-guwahati.ac.in/comsc&amp;enginerring.php">http://www.gimt-guwahati.ac.in/comsc&amp;enginerring.php</a>
		Department of Computer Science & Engineering, Indian Institute of Technology (IIT), Guwahati	<a href="http://cse.iitg.ernet.in/">http://cse.iitg.ernet.in/</a>
		Department of Electronics and Telecommunication, National Institute of Technology (NIT), Silchar	<a href="http://www.nits.ac.in/departement/new%20cse%20blue/homecse.html">http://www.nits.ac.in/departement/new%20cse%20blue/homecse.html</a>
		Department of Computer Science & Engineering, Tezpur University, Tezpur	<a href="http://www.tezu.ernet.in/dcompssc/">http://www.tezu.ernet.in/dcompssc/</a>

State	Branch	Institute Name & Place	Website Address
Assam	Management	Assam Institute of Management, Guwahati	<a href="http://www.aimguwahati.edu.in/">http://www.aimguwahati.edu.in/</a>
		Centre for Management Studies, Dibrugarh University, Dibrugarh	<a href="http://www.cmsdu.org/">http://www.cmsdu.org/</a>
		Darwin School of Business, Guwahati	<a href="http://www.darwinschool.com/">http://www.darwinschool.com/</a>
		Department of Business Administration, Assam University, Silchar	<a href="http://www.assamuniversity.nic.in/dba.html">http://www.assamuniversity.nic.in/dba.html</a>
		Department of Business Administration, Gauhati University, Guwahati	<a href="http://www.gauhati.ac.in/business_administration/index.htm">http://www.gauhati.ac.in/business_administration/index.htm</a>
		Department of Business Administration, Girijnanda Chowdhury Institute of Management and Technology, Guwahati	<a href="http://www.gimt-guwahati.ac.in/mba/index.html">http://www.gimt-guwahati.ac.in/mba/index.html</a>
		Department of Business Administration, Tezpur University, Tezpur	<a href="http://www.tezu.ernet.in/dba/new/">http://www.tezu.ernet.in/dba/new/</a>
		Don Bosco Institute of Management, Guwahati	<a href="http://www.dbim.ac.in/">http://www.dbim.ac.in/</a>
		North Eastern Regional Institute of Management (NERIM), Guwahati	<a href="http://nerimmba.org/nerim/index.asp">http://nerimmba.org/nerim/index.asp</a>



State	Branch	Institute Name & Place	Website Address
Arunachal Pradesh	Computer Science	Department of Computer Science, NERIST, Nirjuli	<a href="http://www.nerist.ac.in/departments/computer_science/index.htm">http://www.nerist.ac.in/departments/computer_science/index.htm</a>
Bihar	Computer Science	Department of Computer Science & Engineering, Maulana Azad College of Engineering & Technology, Patna	<a href="http://www.macet.net.in/computer.htm">http://www.macet.net.in/computer.htm</a>
	Management	Arcade Business College, Bodhgaya	<a href="http://www.abcollege.org/">http://www.abcollege.org/</a>
		Department of Business Administration, Anurag Narayan College, Patna	<a href="http://www.ancpatna.com/business%20administration%20home.html">http://www.ancpatna.com/business%20administration%20home.html</a>
		Department of Business Administration, Tilkha Manjhi Bhagalpur University, Bhagalpur	<a href="http://tmbu.org/mbahome.asp">http://tmbu.org/mbahome.asp</a>
		L N Mishra Institute of Economic Development & Social Change, Patna	<a href="http://lnmipat.ac.in/home/index.htm">http://lnmipat.ac.in/home/index.htm</a>
		Patna Women's College, Patna	<a href="http://www.patnawomenscollege.in/bba.htm">http://www.patnawomenscollege.in/bba.htm</a>
		Vaishali Institute of Business & Rural Management Muzaffarpur	<a href="http://www.vibrm.in/">http://www.vibrm.in/</a>
Jharkhand	Computer Science	Department of Computer Science & Engineering, Birla Institute of Technology, Ranchi	<a href="http://www.bitmesra.ac.in/cms.aspx?this=1&amp;mid=42">http://www.bitmesra.ac.in/cms.aspx?this=1&amp;mid=42</a>
		Department of Computer Science & Engineering, Indian School of Mines, Dhanbad	<a href="http://www.ismdhanbad.ac.in/depart/cse/index.htm">http://www.ismdhanbad.ac.in/depart/cse/index.htm</a>

State	Branch	Institute Name & Place	Website Address
Jharkhand	Management	Department of Management, Birla Institute of Technology, Ranchi	<a href="http://www.bitmesra.ac.in/cms.aspx?this=1&amp;mid=33">http://www.bitmesra.ac.in/cms.aspx?this=1&amp;mid=33</a>
		Department of Management Studies, Indian School of Mines, Dhanbad	<a href="http://www.ismdhanbad.ac.in/depart/management/index.htm">http://www.ismdhanbad.ac.in/depart/management/index.htm</a>
		XLRI, Jamespur	<a href="http://www.xlri.ac.in/">http://www.xlri.ac.in/</a>
Meghalaya	Management	Rajiv Gandhi Indian Institute of Management, Shillong	<a href="http://www.iimshillong.in/">http://www.iimshillong.in/</a>
Orissa	Computer Science	Department of Computer Science Engineering, Silicon Institute of Technology, Bhubaneswar	<a href="http://www.silicon.ac.in/cs-dept.php">http://www.silicon.ac.in/cs-dept.php</a>
		Department of Master in Computer Application, Silicon Institute of Technology, Bhubaneswar	<a href="http://www.silicon.ac.in/mca-dept.php">http://www.silicon.ac.in/mca-dept.php</a>
		Department of Computer Science and Engineering and Information Technology, College of Engineering and Management, Kolaghat	<a href="http://www.cemkolaghat.org/">http://www.cemkolaghat.org/</a>
		Department of Computer Science & Engineering, Jagnath Institute for Technology and Management, Gajapati, Orissa	<a href="http://www.jitm.org/computer-engineering.htm">http://www.jitm.org/computer-engineering.htm</a>
		Department of Computer Science & Engineering, NIT, Rourkela	<a href="http://www.nitrkl.ac.in/departments/cs/aboutus.asp">http://www.nitrkl.ac.in/departments/cs/aboutus.asp</a>
		Kalinga Institute of Technology, Orissa	<a href="http://www.kiit.org/">http://www.kiit.org/</a>

State	Branch	Institute Name & Place	Website Address
Orissa	Computer Science	Department of Computer Science, National Institute of Science and Technology, Berhampur	<a href="http://www.nist.edu/">http://www.nist.edu/</a>
		Orissa Computer Academy, Bhubaneswar	<a href="http://www.krupajalgroup.org/oca/index.html">http://www.krupajalgroup.org/oca/index.html</a>
		Trident Academy of Creative Technology, Bhubaneswar	<a href="http://www.tactindia.org/">http://www.tactindia.org/</a>
	Management	Academy of Management Studies, Bhubaneswar	<a href="http://www.amskrupajal.org/">http://www.amskrupajal.org/</a>
		Department of Basics Sciences & Humanities, Jagnath Institute for Technology and Management, Gajapati, Orissa	<a href="http://www.jitm.org/basic-sciences.htm">http://www.jitm.org/basic-sciences.htm</a>
		Institute of Management & Information Science (IMIS), Bhubaneswar	<a href="http://www.imis.ac.in/">http://www.imis.ac.in/</a>
		KIIT School of Management, Bhubaneswar	<a href="http://www.ksom.ac.in/pages/home/home.htm">http://www.ksom.ac.in/pages/home/home.htm</a>
		Department of Management Studies, National Institute of Science and Technology, Berhampur	<a href="http://www.nist.edu/">http://www.nist.edu/</a>
		Xavier Institute of Management, Bhubaneswar	<a href="http://www.ximb.ac.in/ximb/">http://www.ximb.ac.in/ximb/</a>
		Sikkim	Computer Science & Management
Tripura	Computer Science	Department of Computer Science & Engineering, NIIT, Agartala	<a href="http://www.nitagartala.in/cse/">http://www.nitagartala.in/cse/</a>

State	Branch	Institute Name & Place	Website Address
West Bengal	Computer Science	Department of Computer Science & Engineering, Indian Institute of Technology (IIT), Kharagpur	<a href="http://www.iitkgp.ac.in/departments/home.php?deptcode=CS">http://www.iitkgp.ac.in/departments/home.php?deptcode=CS</a>
		Department of Computer Science & Engineering, Birbhum Institute of Engineering & Technology, Kolkotta	<a href="http://bietsuri.com/WEB_PAGES/CSE.htm">http://bietsuri.com/WEB_PAGES/CSE.htm</a>
		Department of Computer Science and Technology, Bengal Engineering College, Shibpur	<a href="http://www.becs.ac.in/cst.html">http://www.becs.ac.in/cst.html</a>
	Management	Indian Institute of Management, Calcutta (IIMC), Kolkatta	<a href="http://www.iimcal.ac.in/">http://www.iimcal.ac.in/</a>
		Vinod Gupta School of Management, IIT, Kharagpur	<a href="http://www.iitkgp.ac.in/departments/home.php?deptcode=SM">http://www.iitkgp.ac.in/departments/home.php?deptcode=SM</a>

# ANNEXURE IV

## Results of Chi-Square Tests

### 1. Teaching & Research Requirements

#### 1(a) Designation & Research Journals

$H_0$ =There is no relationship between Research Journals preferences and Designations.

$H_1$ =There is relationship between Research Journals preferences and Designations.

**Designation & Research Journals Cross tabulation**

Designation	Research Journals		Total
	No	Yes	
Assistant Professors & Others	3	42	45
Associate Professors & Professors	1	26	27
<b>Total</b>	<b>4</b>	<b>68</b>	<b>72</b>

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.282	1	.595
Continuity Correction	.000	1	1.000
Likelihood Ratio	.299	1	.585
Fisher's Exact Test			
Linear-by-Linear Association	.278	1	.598
N of Valid Cases	72		

a Computed only for a 2x2 table

b 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.50.

#### Interpretation:

Invalid result as expected count is less than 5 in more 20% of the cells.

### 1(b) Designation & Databanks

$H_0$ =There is no relationship between Databank preferences and Designations.

$H_1$ =There is relationship between Databank preferences and Designations.

**Designation & Databanks Cross tabulation**

Designation	Databanks		Total
	No	Yes	
Assistant Professors & Others	8	37	45
Associate Professors & Professors	8	19	27
Total	16	56	72

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.371	1	.242
Continuity Correction	.771	1	.380
Likelihood Ratio	1.342	1	.247
Fisher's Exact Test			
Linear-by-Linear Association	1.352	1	.245
N of Valid Cases	72		

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.00.

#### Interpretation:

Here, p value =0.242

Since p value > alpha (=0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between Databanks preferences and Designations.

### 1(c) Designation & Report Writing Guidelines

$H_0$ =There is no relationship between preferences for Report Writing Guidelines and Designations.

$H_1$ =There is relationship between preferences for Report Writing Guidelines and Designations.

**Designation & Report Writing Guidelines Cross tabulation**

Designation	Report Writing Guidelines		Total
	No	Yes	
Assistant Professors & Others	18	27	45
Associate Professors & Professors	17	10	27
<b>Total</b>	<b>35</b>	<b>37</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.562	1	.059
Continuity Correction	2.702	1	.100
Likelihood Ratio	3.592	1	.058
Fisher's Exact Test			
Linear-by-Linear Association	3.513	1	.061
N of Valid Cases	72		

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.13.

**Interpretation:**

Here, p value =0.059

Since p value < alpha (= 0.1)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preferences for Report Writing Guidelines and Designations.

**1(d) Designation & Access to Research Details**

$H_0$ =There is no relationship between preferences for accessibility of Research Details and Designations.

$H_1$ = There is relationship between preferences for accessibility of Research Details and Designations.

**Designation & Access to Research Details Cross tabulation**

Designation	Access to Research Details		Total
	No	Yes	
Assistant Professors & Others	6	39	45
Associate Professors & Professors	8	19	27
<b>Total</b>	<b>14</b>	<b>58</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.861	1	.091
Continuity Correction	1.915	1	.166
Likelihood Ratio	2.779	1	.096
Fisher's Exact Test			
Linear-by-Linear Association	2.821	1	.093
N of Valid Cases	72		

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.13.

**Interpretation:**

Here, p value =0.091

Since p value < alpha (= 0.1)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preferences for accessibility of Research Details and Designations.

**1(e) Designation & Recent Trends**

$H_0$ =There is no relationship between preferences for Recent Trends and Designations.

$H_1$ =There is relationship between preferences for Recent Trends and Designations.



**Designation & Recent Trends Cross tabulation**

Designation	Recent Trends		Total
	No	Yes	
Assistant Professors & Others	2	43	45
Associate Professors & Professors	3	24	27
<b>Total</b>	<b>5</b>	<b>67</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.161	1	.281
Continuity Correction	.358	1	.550
Likelihood Ratio	1.116	1	.291
Fisher's Exact Test			
Linear-by-Linear Association	1.144	1	.285
N of Valid Cases	72		

- a. Computed only for a 2x2 table
- b. **2 cells (50.0%) have expected count less than 5.** The minimum expected count is 1.88.

**Interpretation:**

Invalid result as expected count is less than 5 in more 20% of the cells.

**1(f) Designation & Ready Reference for a topic**

$H_0$  = There is no relationship between Ready Reference preferences and Designations.

$H_1$  = There is relationship between Ready Reference preferences and Designations.

**Designation & Ready Reference for a topic Cross tabulation**

Designation	Ready Reference for a topic		Total
	No	Yes	
Assistant Professors & Others	11	34	45
Associate Professors & Professors	7	20	27
<b>Total</b>	<b>18</b>	<b>54</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.020	1	.888
Continuity Correction	.000	1	1.000
Likelihood Ratio	.020	1	.888
Fisher's Exact Test			
Linear-by-Linear Association	.019	1	.889
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.75.

**Interpretation:**

Here, p value = 0.888

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between Ready Reference preferences and Designations.

**1(g) Designation & Software Information**

H<sub>0</sub>=There is no relationship between Software Information preferences and Designations.

H<sub>1</sub>=There is relationship between Software Information preferences and Designations.

### Designation & Software Information Cross tabulation

Designation	Software Information		Total
	No	Yes	
Assistant Professors & Others	15	30	45
Associate Professors & Professors	13	14	27
<b>Total</b>	<b>28</b>	<b>44</b>	<b>72</b>

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.558	1	.212
Continuity Correction	.997	1	.318
Likelihood Ratio	1.549	1	.213
Fisher's Exact Test			
Linear-by-Linear Association	1.537	1	.215
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.50.

### Interpretation:

Here, p value = 0.212

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between Software Information preferences and Designations.

### 1(h) Designation & Abstract of Projects

$H_0$  = There is no relationship between preferences for Projects Abstracts and Designations.

$H_1$  = There is relationship between preferences for Projects Abstracts and Designations.

### Designation & Abstract of Projects Cross tabulation

Designation	Abstract of Projects		Total
	No	Yes	
Assistant Professors & Others	17	28	45
Associate Professors & Professors	15	12	27
<b>Total</b>	<b>32</b>	<b>40</b>	<b>72</b>

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.160	1	.142
Continuity Correction	1.500	1	.221
Likelihood Ratio	2.160	1	.142
Fisher's Exact Test			
Linear-by-Linear Association	2.130	1	.144
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.00.

#### Interpretation:

Here, p value = 0.142

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between preferences for Projects Abstracts and Designations.

#### 1(i) Designation & Consultancy Information

H<sub>0</sub> = There is no relationship between preference for Consultancy Information and Designations.

H<sub>1</sub> = There is relationship between preference for Consultancy Information and Designations.

**Designation & Consultancy Information Cross tabulation**

Designation	Consultancy Information		Total
	No	Yes	
Assistant Professors & Others	19	26	45
Associate Professors & Professors	14	13	27
<b>Total</b>	<b>33</b>	<b>39</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.630	1	.427
Continuity Correction	.302	1	.583
Likelihood Ratio	.630	1	.427
Fisher's Exact Test			
Linear-by-Linear Association	.622	1	.430
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.38.

**Interpretation:**

Here, p value = 0.427

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between preference for Consultancy information and Designations.

**1(j) Designation & Teaching Methodologies**

H<sub>0</sub>=There is no relationship between preference for Teaching Methodologies and Designations.

H<sub>1</sub>=There is relationship between preference for Teaching Methodologies and Designations.

### Designation & Teaching Methodologies Cross tabulation

Designation	Teaching Methodologies		Total
	No	Yes	
Assistant Professors & Others	10	35	45
Associate Professors & Professors	14	13	27
<b>Total</b>	<b>24</b>	<b>48</b>	<b>72</b>

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.667	1	.010
Continuity Correction	5.400	1	.020
Likelihood Ratio	6.592	1	.010
Fisher's Exact Test			
Linear-by-Linear Association	6.574	1	.010
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.00.

### Interpretation:

Here, p value = 0.010.

Since p value < alpha (= 0.05)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preference for Teaching Methodologies and Designations.

### 1(k) Designation & Question Paper Setting Styles

$H_0$  = There is no relationship between preference for Question Paper Styles and Designations.

$H_1$  = There is relationship between preference for Question Paper Styles and Designations.

### Designation & Question Paper Setting Styles Cross tabulation

Designation	Question Paper Setting Styles		Total
	No	Yes	
Assistant Professors & Others	17	28	45
Associate Professors & Professors	17	10	27
<b>Total</b>	<b>34</b>	<b>38</b>	<b>72</b>

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.295	1	.038
Continuity Correction	3.344	1	.067
Likelihood Ratio	4.330	1	.037
Fisher's Exact Test			
Linear-by-Linear Association	4.235	1	.040
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.75.

### Interpretation:

Here, p value = 0.038.

Since p value < alpha (= 0.05)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preference for Question Paper Styles and Designations.

### 1(I) Designation & Experts

H<sub>0</sub>=There is no relationship between preference for list of Experts and Designations.

H<sub>1</sub>=There is relationship between preference for list of Experts and Designations.

### Designation & Experts Cross tabulation

Designation	Experts		Total
	No	Yes	
Assistant Professors & Others	11	34	45
Associate Professors & Professors	10	17	27
<b>Total</b>	<b>21</b>	<b>51</b>	<b>72</b>

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.295	1	.255
Continuity Correction	.757	1	.384
Likelihood Ratio	1.276	1	.259
Fisher's Exact Test			
Linear-by-Linear Association	1.277	1	.258
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.88.

#### Interpretation:

Here, p value = 0.255.

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between preference for list of Experts and Designations.

#### 1(m) Designation & Funding Agencies

$H_0$  = There is no relationship between preference for information on Funding Agencies and Designations.

$H_1$  = There is relationship between preference for information on Funding Agencies and Designations.



### Designation & Funding Agencies Cross tabulation

Designation	Funding Agencies		Total
	No	Yes	
Assistant Professors & Others	10	35	45
Associate Professors & Professors	13	14	27
<b>Total</b>	<b>23</b>	<b>49</b>	<b>72</b>

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.217	1	.022
Continuity Correction	4.093	1	.043
Likelihood Ratio	5.142	1	.023
Fisher's Exact Test			
Linear-by-Linear Association	5.145	1	.023
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.63.

#### Interpretation:

Here, p value = 0.022.

Since p value < alpha (= 0.05)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preference for information on Funding Agencies and Designations.

## 2. Information sought from Library

### 2(a) Information regarding New Arrivals in Library

$H_0$  = There is no relationship between preferences towards information about new arrivals in Library and Designations.

H<sub>1</sub>=There is relationship between preferences towards information about new arrivals in Library and Designations.

**Designation & New Arrivals in Library Cross tabulation**

Designation	New Arrivals in Library		Total
	No	Yes	
Assistant Professors & Others	3	42	45
Associate Professors & Professors	1	26	27
<b>Total</b>	<b>4</b>	<b>68</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.282	1	.595
Continuity Correction	.000	1	1.000
Likelihood Ratio	.299	1	.585
Fisher's Exact Test			
Linear-by-Linear Association	.278	1	.598
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.50.

**Interpretation:**

Invalid result as expected count is less than 5 in more 20% of the cells.

**2(b) Information regarding Books & Journals available in Library**

H<sub>0</sub>=There is no relationship between preferences towards information about books and journals in Library and Designations.

H<sub>1</sub>=There is relationship between preferences towards information about books and journals in Library and Designations.

**Designation & Books & Journals available in Library Cross tabulation**

Designation	Books & Journals available in Library		Total
	No	Yes	
Assistant Professors & Others	0	45	45
Associate Professors & Professors	3	24	27
<b>Total</b>	3	69	72

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.217	1	.022
Continuity Correction	2.806	1	.094
Likelihood Ratio	6.105	1	.013
Fisher's Exact Test			
Linear-by-Linear Association	5.145	1	.023
N of Valid Cases	72		

- a. Computed only for a 2x2 table
- b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.13.

**Interpretation:**

Invalid result as expected count is less than 5 in more 20% of the cells.

**2(c) Information regarding Reader's Comments**

$H_0$ =There is no relationship between preference for Reader's Comments and Designations.

$H_1$ =There is relationship between preference for Reader's Comments and Designations.

### Designation & Reader's Comments Cross tabulation

Designation	Reader's Comments		Total
	No	Yes	
Assistant Professors & Others	16	29	45
Associate Professors & Professors	15	12	27
<b>Total</b>	<b>31</b>	<b>41</b>	<b>72</b>

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.753	1	.097
Continuity Correction	1.998	1	.158
Likelihood Ratio	2.750	1	.097
Fisher's Exact Test			
Linear-by-Linear Association	2.715	1	.099
N of Valid Cases	72		

- a. Computed only for a 2x2 table  
 b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.63.

#### Interpretation:

Here, p value = 0.097.

Since p value < alpha (= 0.1)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preference for Reader's Comments and Designations.

#### 2(d) Information regarding Status of a book

H<sub>0</sub>=There is no relationship between preferences towards finding status of a book in Library and Designations.

H<sub>1</sub>=There is relationship between preferences towards finding status of a book in Library and Designations.

**.Designation & Status of a book Cross tabulation**

Designation	Status of a book		Total
	No	Yes	
Assistant Professors & Others	5	40	45
Associate Professors & Professors	9	18	27
<b>Total</b>	<b>14</b>	<b>58</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.320	1	<b>.021</b>
Continuity Correction	3.996	1	.046
Likelihood Ratio	5.168	1	.023
Fisher's Exact Test			
Linear-by-Linear Association	5.246	1	.022
N of Valid Cases	72		

- a. Computed only for a 2x2 table
- b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.25.

**Interpretation:**

Here, p value =0.021.

Since p value < alpha (= 0.05)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preferences towards finding status of a book in Library and Designations.

**3. Curriculum Requirements**

**3(a) Course structure of other institutes**

H<sub>0</sub>=There is no relationship between preferences towards knowing about course structure of other institutes and Designations.

$H_1$ =There is relationship between preferences towards knowing about course structure of other institutes and Designations.

**Designation & Course structure of other institutes Cross tabulation**

Designation	Course structure of other institutes		Total
	No	Yes	
Assistant Professors & Others	3	42	45
Associate Professors & Professors	2	25	27
<b>Total</b>	<b>5</b>	<b>67</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.014	1	.905
Continuity Correction	.000	1	1.000
Likelihood Ratio	.014	1	.905
Fisher's Exact Test			
Linear-by-Linear Association	.014	1	.905
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.88.

**Interpretation:**

Invalid result as expected count is less than 5 in more 20% of the cells.

**3(b) Feedback from Recruiters/Industry**

$H_0$ =There is no relationship between preferences towards feedback from Recruiters/Industry and Designations.

$H_1$ =There is relationship between preferences towards feedback from Recruiters/Industry and Designations.

**Designation & Feedback from Recruiters/Industry Cross tabulation**

Designation	Feedback from Recruiters/Industry		Total
	No	Yes	
Assistant Professors & Others	6	39	45
Associate Professors & Professors	2	25	27
<b>Total</b>	<b>8</b>	<b>64</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.600	1	.439
Continuity Correction	.150	1	.699
Likelihood Ratio	.632	1	.427
Fisher's Exact Test			
Linear-by-Linear Association	.592	1	.442
N of Valid Cases	72		

- a. Computed only for a 2x2 table
- b. 1 cell (25.0%) has expected count less than 5. The minimum expected count is 3.00.

**Interpretation:**

Invalid result as expected count is less than 5 in more 20% of the cells.

**3(c) Feedback from Alumni**

$H_0$ =There is no relationship between preferences towards Feedback from Alumni and Designations.

$H_1$ =There is relationship between preferences towards Feedback from Alumni and Designations.

### Designation & Feedback from Alumni Cross tabulation

Designation	Feedback from Alumni		Total
	No	Yes	
Assistant Professors & Others	11	34	45
Associate Professors & Professors	9	18	27
<b>Total</b>	<b>20</b>	<b>52</b>	<b>72</b>

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.665	1	.415
Continuity Correction	.295	1	.587
Likelihood Ratio	.656	1	.418
Fisher's Exact Test			
Linear-by-Linear Association	.655	1	.418
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.50.

#### Interpretation:

Here, p value = 0.415.

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between preferences towards Feedback from Alumni and Designations.

#### 3(d) Model syllabus of other Institutes

$H_0$  = There is no relationship between preferences towards Model syllabus of other Institutes and Designations.

$H_1$  = There is relationship between preferences towards Model syllabus, of other Institutes and Designations.



**Designation & Model syllabus of other Institutes Cross tabulation**

Designation	Model syllabus of other Institutes		Total
	No	Yes	
Assistant Professors & Others	3	42	45
Associate Professors & Professors	7	20	27
<b>Total</b>	<b>10</b>	<b>62</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.234	1	.022
Continuity Correction	3.747	1	.053
Likelihood Ratio	5.077	1	.024
Fisher's Exact Test			
Linear-by-Linear Association	5.161	1	.023
N of Valid Cases	72		

- a. Computed only for a 2x2 table
- b. 1 cell (25.0%) has expected count less than 5. The minimum expected count is 3.75.

**Interpretation:**

Invalid result as expected count is less than 5 in more 20% of the cells.

**4. Aids for Administrative works**

**4(a) Information System**

H<sub>0</sub>= There is no relationship between preferences towards Information System and Designations.

H<sub>1</sub>=There is relationship between preferences towards Information System and Designations.

**Designation & Information System Cross tabulation**

Designation	Information System		Total
	No	Yes	
Assistant Professors & Others	9	36	45
Associate Professors & Professors	3	24	27
<b>Total</b>	<b>12</b>	<b>60</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.960	1	.327
Continuity Correction	.427	1	.514
Likelihood Ratio	1.008	1	.315
Fisher's Exact Test			
Linear-by-Linear Association	.947	1	.331
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 1 cell (25.0%) has expected count less than 5. The minimum expected count is 4.50

**Interpretation:**

Invalid result as expected count is less than 5 in more 20% of the cells.

**4(b) Rules and Regulations of the Institute**

$H_0$ =There is no relationship between preferences towards knowing about Rules and Regulations of the Institute and Designations.

$H_1$ =There is relationship between preferences towards knowing about Rules and Regulations of the Institute and Designations.

**Designation & Rules and Regulations of the Institute Cross tabulation**

Designation	Rules and Regulations of the Institute		Total
	No	Yes	
Assistant Professors & Others	8	37	45
Associate Professors & Professors	6	21	27
<b>Total</b>	<b>14</b>	<b>58</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.213	1	.645
Continuity Correction	.024	1	.878
Likelihood Ratio	.210	1	.647
Fisher's Exact Test			
Linear-by-Linear Association	.210	1	.647
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.25.

**Interpretation:**

Here, p value =0.645.

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between preferences towards knowing about Rules and Regulations of the Institute and Designations.

**4(c) Experts**

$H_0$ =There is no relationship between preference for list of Experts and Designations.

$H_1$ =There is relationship between preference for list of Experts and Designations.

### Designation & Experts Cross tabulation

Designation	Experts		Total
	No	Yes	
Assistant Professors & Others	20	25	45
Associate Professors & Professors	16	11	27
<b>Total</b>	<b>36</b>	<b>36</b>	<b>72</b>

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.481	1	.224
Continuity Correction	.948	1	.330
Likelihood Ratio	1.488	1	.223
Fisher's Exact Test			
Linear-by-Linear Association	1.461	1	.227
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.50.

#### **Interpretation:**

Here, p value = 0.224.

Since p value > alpha (= 0.1)

Therefore, null hypothesis cannot be rejected.

Therefore, there is no relationship between preference for list of Experts and Designations.

#### **4(d) Suppliers**

$H_0$  = There is no relationship between preference for list of Suppliers and Designations.

$H_1$  = There is relationship between preference for list of Suppliers and Designations.

### Designation & Suppliers Cross tabulation

Designation	Suppliers		Total
	No	Yes	
Assistant Professors & Others	24	21	45
Associate Professors & Professors	22	5	27
<b>Total</b>	<b>46</b>	<b>26</b>	<b>72</b>

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.795	1	.016
Continuity Correction	4.639	1	.031
Likelihood Ratio	6.126	1	.013
Fisher's Exact Test			
Linear-by-Linear Association	5.715	1	.017
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.75.

#### **Interpretation:**

Here, p value = 0.016.

Since p value < alpha (= 0.05)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preference for list of Suppliers and Designations.

### **5. Aids for Strategic Planning**

#### **5(a) Recent development in the programme**

$H_0$  = There is no relationship between preferences for recent development and Designations.

$H_1$  = There is relationship between preferences for recent development and Designations.

### Designation & Recent development in the programme Cross tabulation

Designation	Recent development in the programme		Total
	No	Yes	
Assistant Professors & Others	36	9	45
Associate Professors & Professors	9	18	27
<b>Total</b>	45	27	72

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.680	1	.000
Continuity Correction	13.752	1	.000
Likelihood Ratio	15.857	1	.000
Fisher's Exact Test			
Linear-by-Linear Association	15.462	1	.000
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.13.

#### Interpretation:

Here, p value = 0.000.

Since p value < alpha (= 0.01)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preferences for recent development and Designations.

#### 5(b) Funding Agencies

$H_0$  = There is no relationship between preferences for information on Funding Agencies and Designations.

$H_1$  = There is relationship between preferences for information on Funding Agencies and Designations.

**Designation & Funding Agencies Cross tabulation**

Designation	Funding Agencies		Total
	No	Yes	
Assistant Professors & Others	37	8	45
Associate Professors & Professors	14	13	27
<b>Total</b>	<b>51</b>	<b>21</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.534	1	.006
Continuity Correction	6.136	1	.013
Likelihood Ratio	7.410	1	.006
Fisher's Exact Test			
Linear-by-Linear Association	7.429	1	.006
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.88.

**Interpretation:**

Here, p value =0.006.

Since p value < alpha (= 0.01)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preferences for information on Funding Agencies and Designations.

**5(c) UGC / AICTE Guidelines**

H<sub>0</sub>=There is no relationship between preferences for information on UGC / AICTE Guidelines and Designations.

H<sub>1</sub>=There is relationship between preferences for information on UGC / AICTE Guidelines and Designations.

**Designation & UGC / AICTE Guidelines Cross tabulation**

Designation	UGC / AICTE Guidelines		Total
	No	Yes	
Assistant Professors & Others	37	8	45
Associate Professors & Professors	12	15	27
<b>Total</b>	<b>49</b>	<b>23</b>	<b>72</b>

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.078	1	.001
Continuity Correction	9.408	1	.002
Likelihood Ratio	10.992	1	.001
Fisher's Exact Test			
Linear-by-Linear Association	10.924	1	.001
N of Valid Cases	72		

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.63.

**Interpretation:**

Here, p value =0.001.

Since p value < alpha (= 0.01)

Therefore, null hypothesis can be rejected.

Therefore, there is relationship between preferences for information on UGC / AICTE Guidelines and Designations.



# ANNEXURE V

## Ontology of Research Areas in Marketing

- Consumer behavior
  - Aspirational age
  - Aspirational brand
  - Buyer decision process
  - Choice modeling
  - Segmentation
    - Demographic
    - Lifestyle segmentation
  - Maslow hierarchy of needs
  - Perception
    - Perception selection
    - Perception organization
    - Perceptual map
    - Interpretation
  - Learning
    - Classical conditioning
    - Instrumental learning
    - Cognitive learning
    - Motives for learning
  - Attitude
    - Formation and change
    - Measurement
  - Personality
    - Traits
    - Brand personality
    - Self image
- Distribution
  - Retail
    - Convenience store
    - Department store
    - Franchising
    - Retailer's cooperative
    - Shopping mall
    - Supermarket
  - Logistics
    - Warehousing
    - Transportation
    - Logistic engineering

- Product management
  - B.C.G. Analysis
  - Cannibalization
  - *Product life cycle*
  - Product bundling
  - Product differentiation
  - Product line
  - Product portfolio
  - Product positioning
  - Product targeting
- Promotion mix
- Roles of different elements of Promotion mix
- Promotion
  - Advertising
    - Advertising Role
    - Broadcast
    - Internet
      - Email
      - Pay per click
      - Website
    - Radio
    - television
      - cable
      - network
      - satellite
    - Celebrity
    - Outdoor
    - billboard
    - kiosks
    - event
    - trade shows
    - Film video
    - Covert
    - Print
      - newspaper
      - brochures
      - direct mail
      - fliers
      - magazines
      - public service
      - surrogate
  - Advertisement development
  - Advertisement campaign

- Media and campaign planning
  - Media
  - Print
  - electronic media
  - photography
  - Campaigning
  - Advertising
  - Military
  - Political
- Pricing
  - Barter
  - Choice modeling
  - Competitor indexing
  - Cost-plus pricing
  - Discounts and allowances
    - Price leaders
  - Geographical pricing and price zoning
  - Penetration price
  - Joint product price
  - Price discrimination
  - Price elasticity of demand
  - Price points
  - Pricing objectives
  - Pricing for profit maximization
  - Psychological pricing
  - Rate of return pricing
  - Transfer pricing
  - Variable pricing and real-time pricing
  - Willingness to pay
- Service marketing
  - Service
  - Borderless selling
  - Gap analysis
  - SERVQUAL
  - Complaint handling
  - Experience handling
  - Service sector
  - Service mark
  - Reservation /Queuing
  - Physical evidence process
    - Service scope
  - Emotional labour
  - Cross skill
  - Flower of service
- Relational marketing
  - Satisfaction

- Retention
- Internal marketing
- Six market models
- Customer delight
- Retention
  - Loyalty
  - Bonus
  - Discount
- Likelihood of learning
- Confidence benefit
- Special treatment benefit
- Social benefit
- Life time value of customer
- Recency, frequency, monetary value (RFM)
- Referral
  - Referral benefit

# ANNEXURE VI

## Screenshots of Gyan Jyoti

New User Login Form - Microsoft Internet Explorer

Address: http://localhost:1050/gyan\_jyoti/login\_form.htm

GYAN JYOTI

LOGIN

Sign Up for Your New Account

Login Name \*

Password \*

Confirm Password \*

Name \* Mr.

Gender \* Male

Name of the Institute \*

Address

Email \*

SUBMIT

Figure VI.1: Form to Create a New User Account

Login Form - Microsoft Internet Explorer

Address: http://localhost:1050/gyan\_jyoti/login.htm

GYAN JYOTI

Welcome to the Knowledge Manag

Member Login

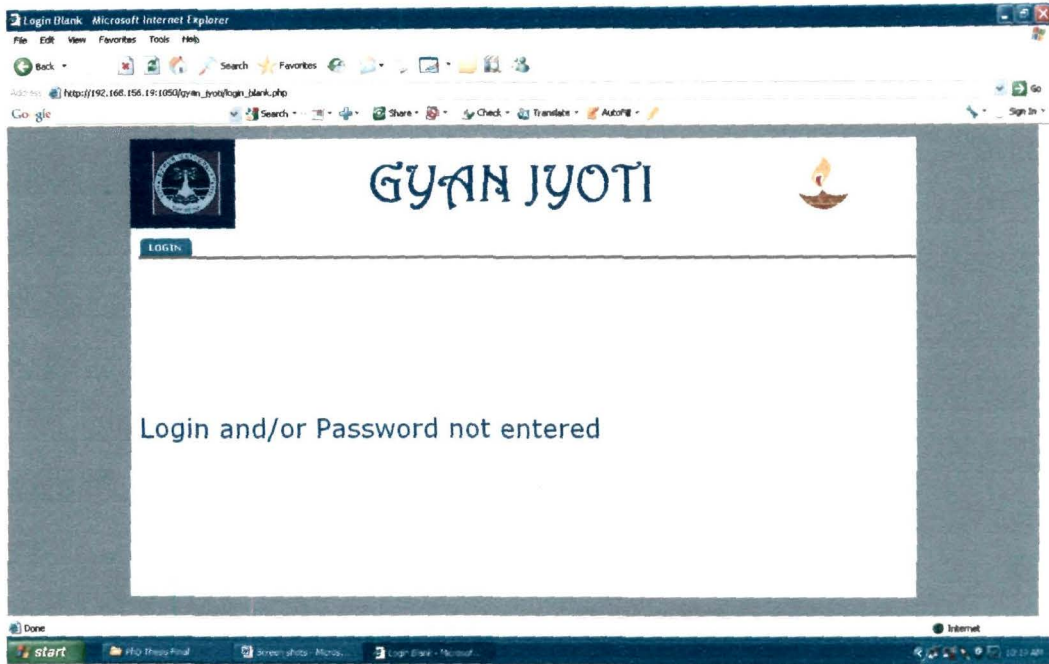
LOGIN

PASSWORD

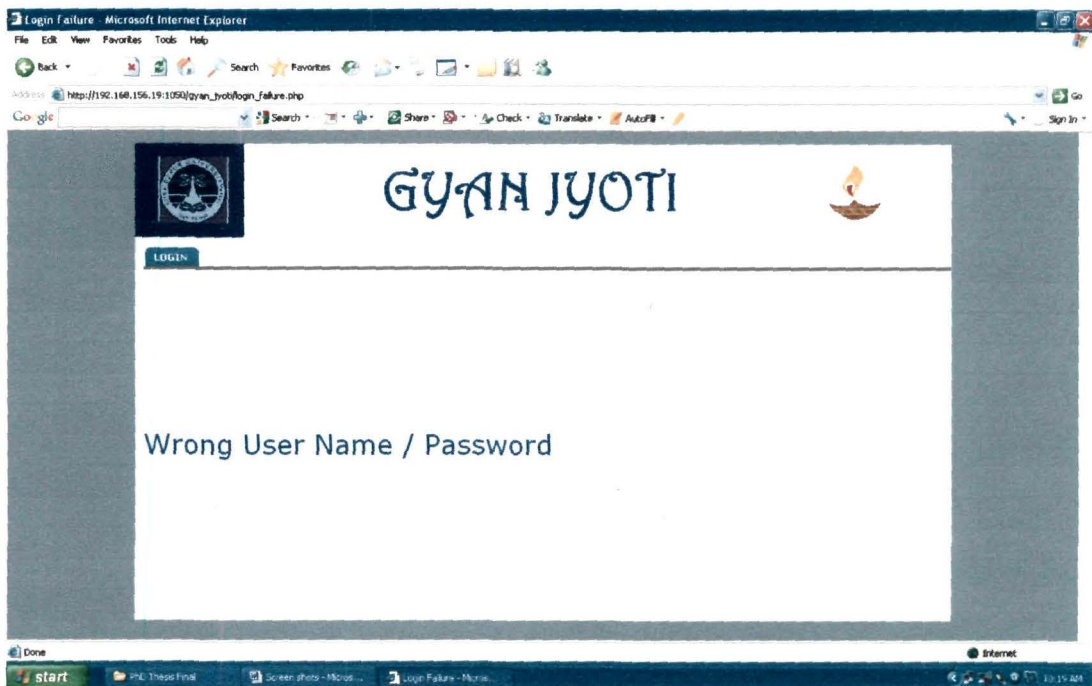
Login

New User : [Sign In](#)

Figure VI.2: Login form



**Figure VI.3: Error Message if Login and / Password not entered**



**Figure VI.4: Error Message if Wrong Login and / Password entered**

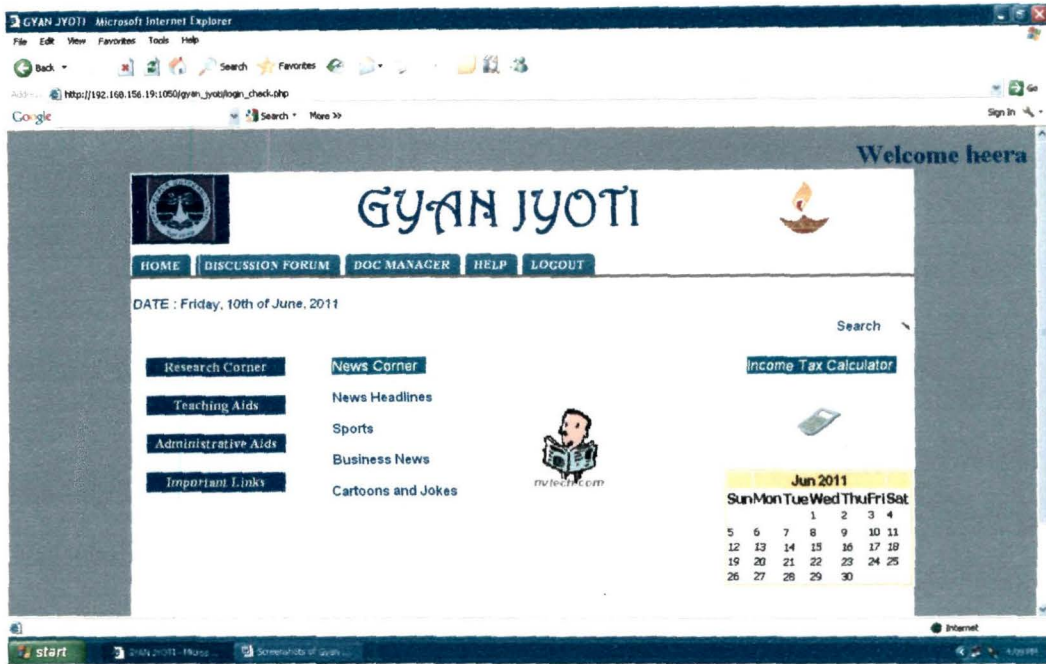


Figure VI.5: Homepage of Gyan Jyoti

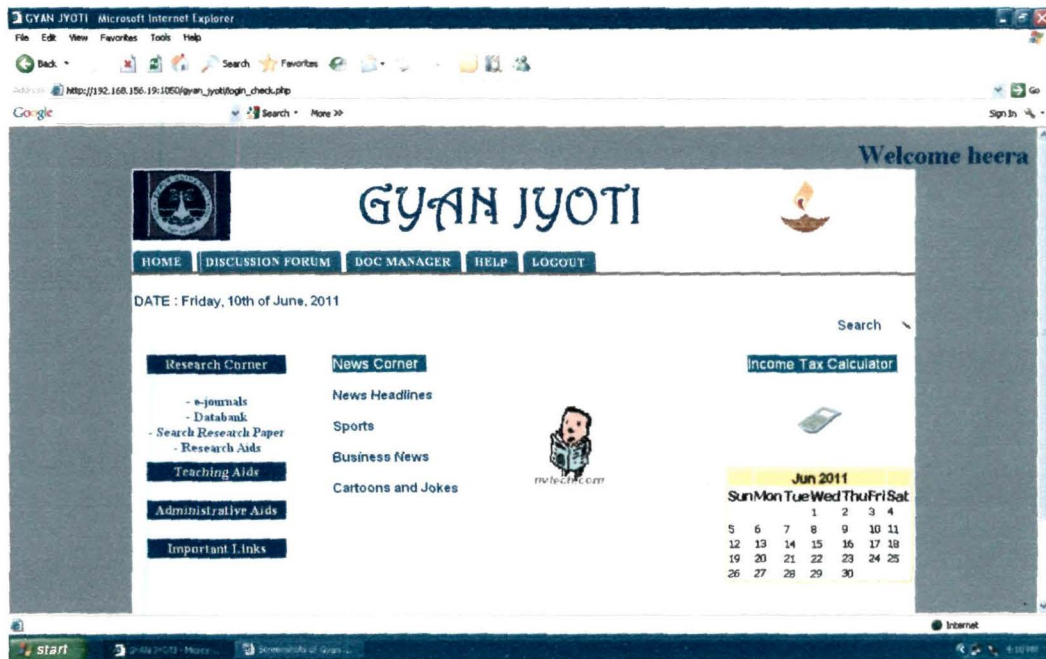


Figure VI.6: Options in Research Corner of Gyan Jyoti

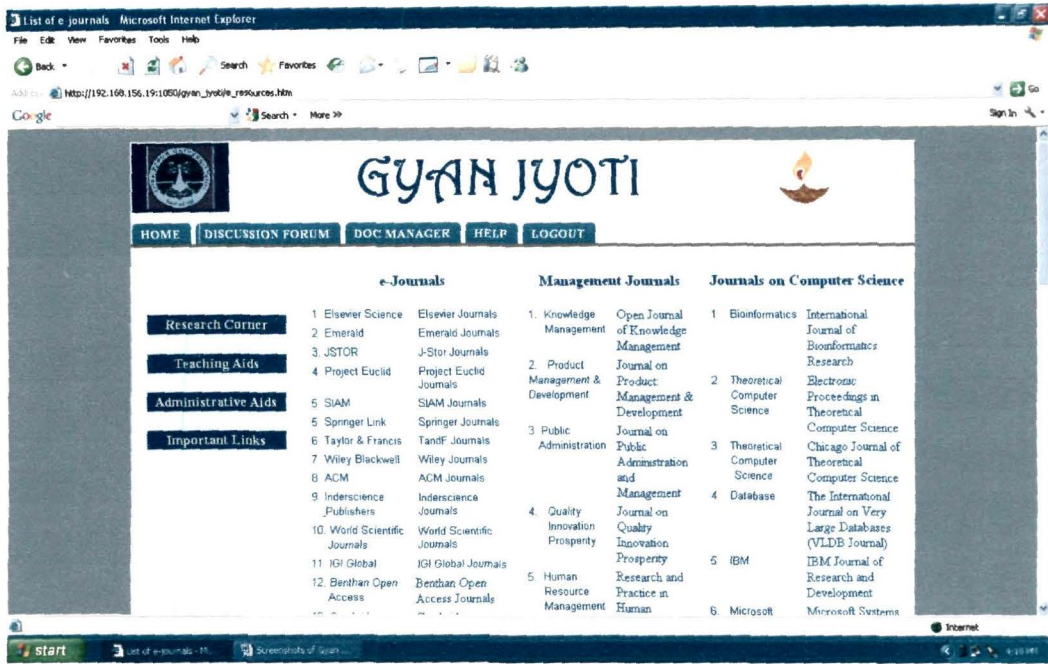


Figure VI.7: List of e-Journals for Management and Computer Science

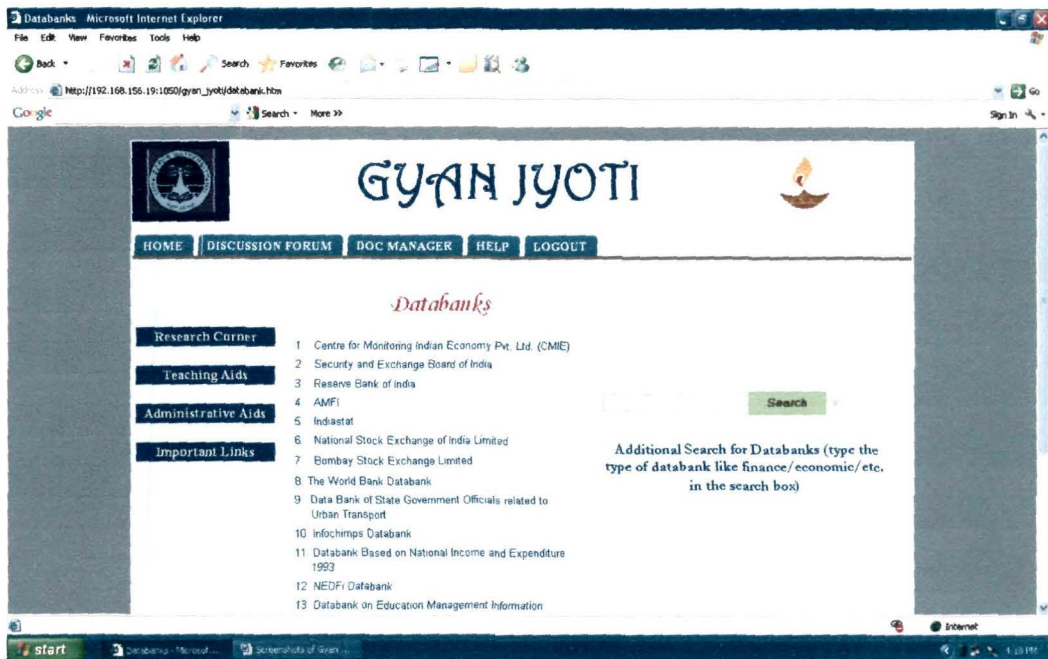


Figure VI.8: List of Databanks and Databank Search



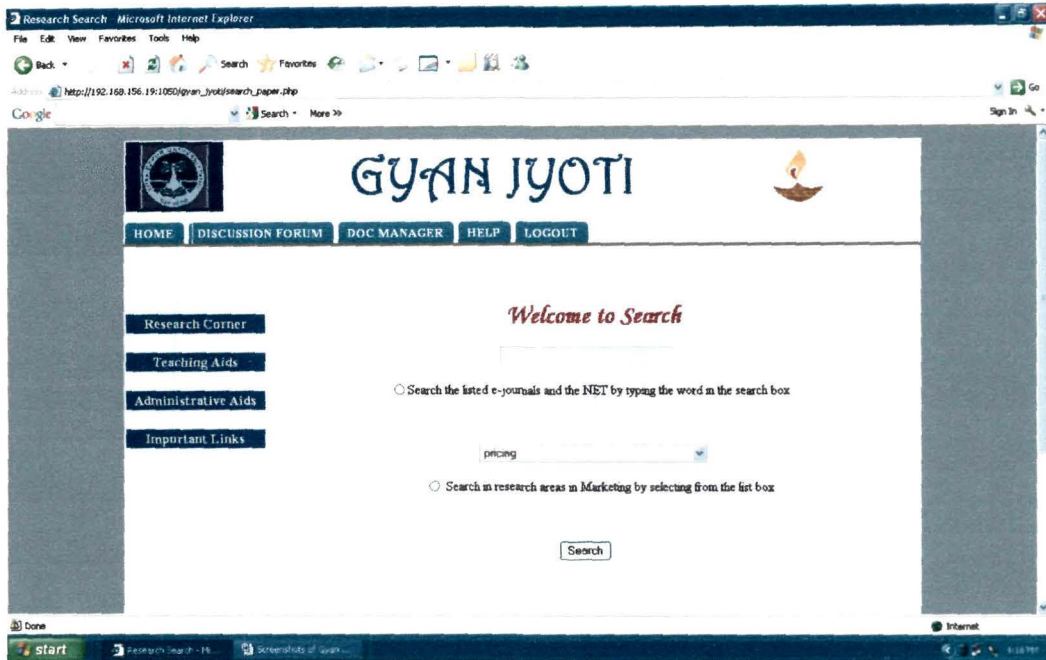


Figure VI.9: Research Paper Search of Gyan Jyoti

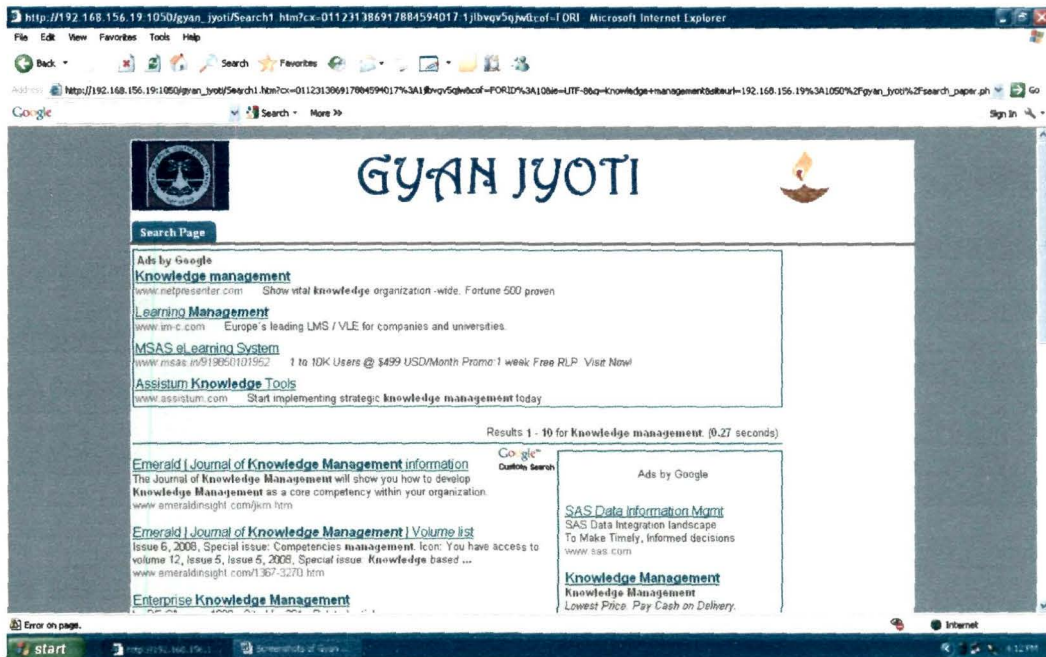


Figure VI.10: Search Results of the 1st option of Research Paper Search of Gyan Jyoti

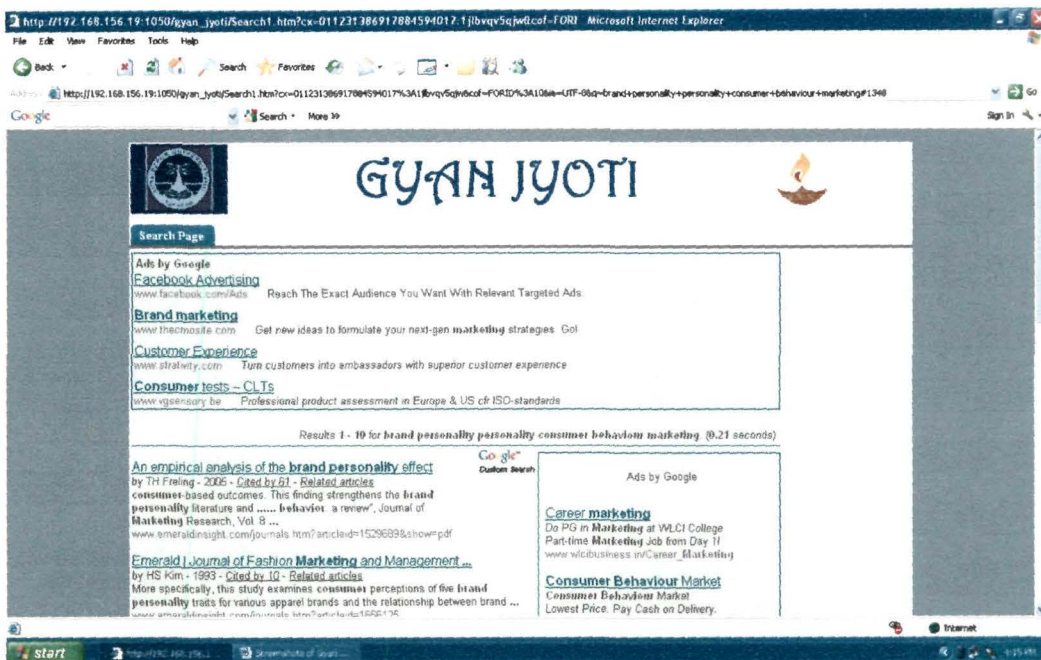


Figure VI.11: Search Results of the 2<sup>nd</sup> option of Research Paper Search of Gyan Jyoti

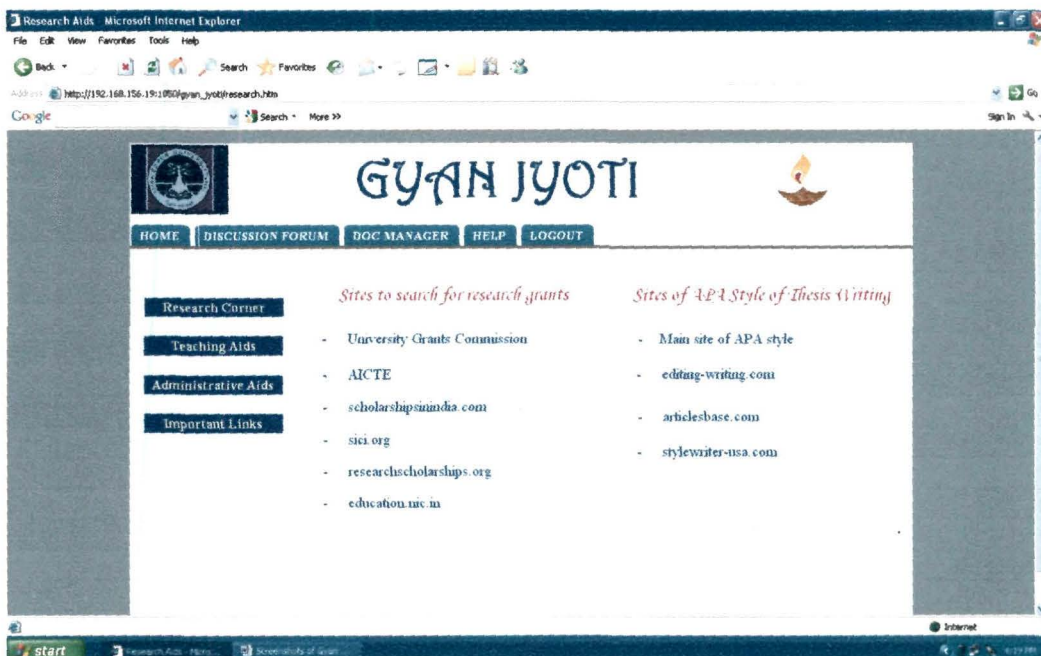


Figure VI.12: Links to Sites of Research Grants and APA style

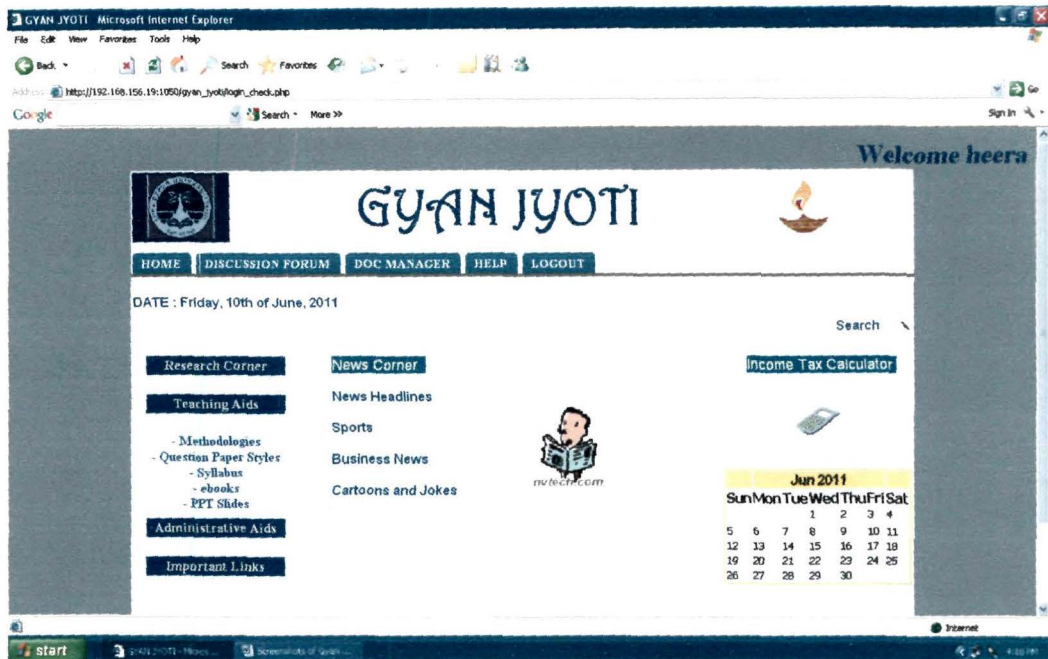


Figure VI.13: Options in Teaching Aids of Gyan Jyoti

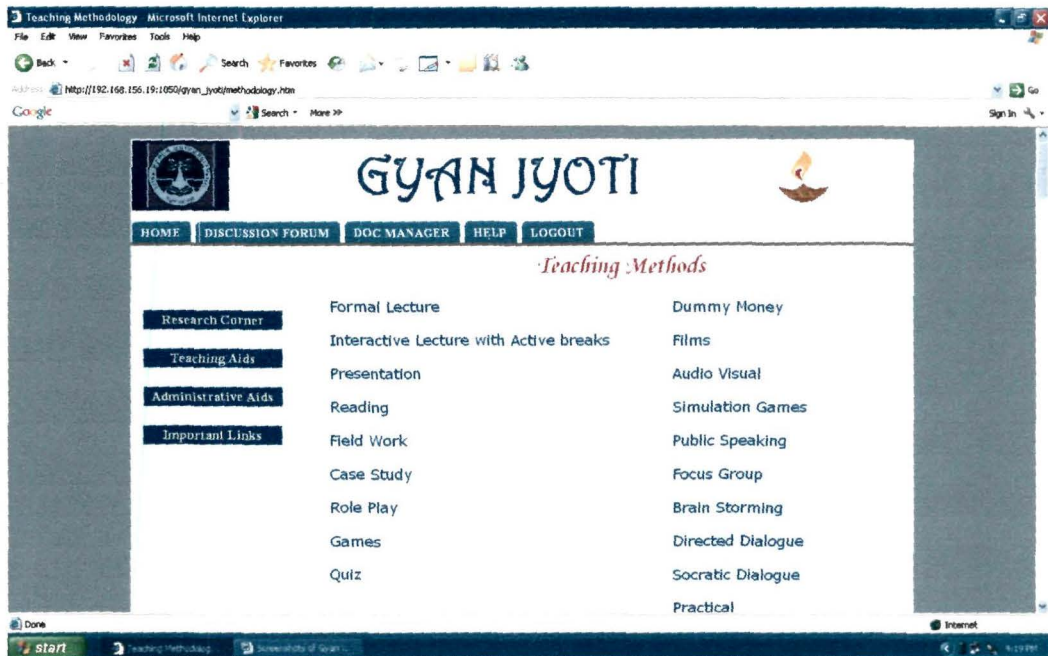
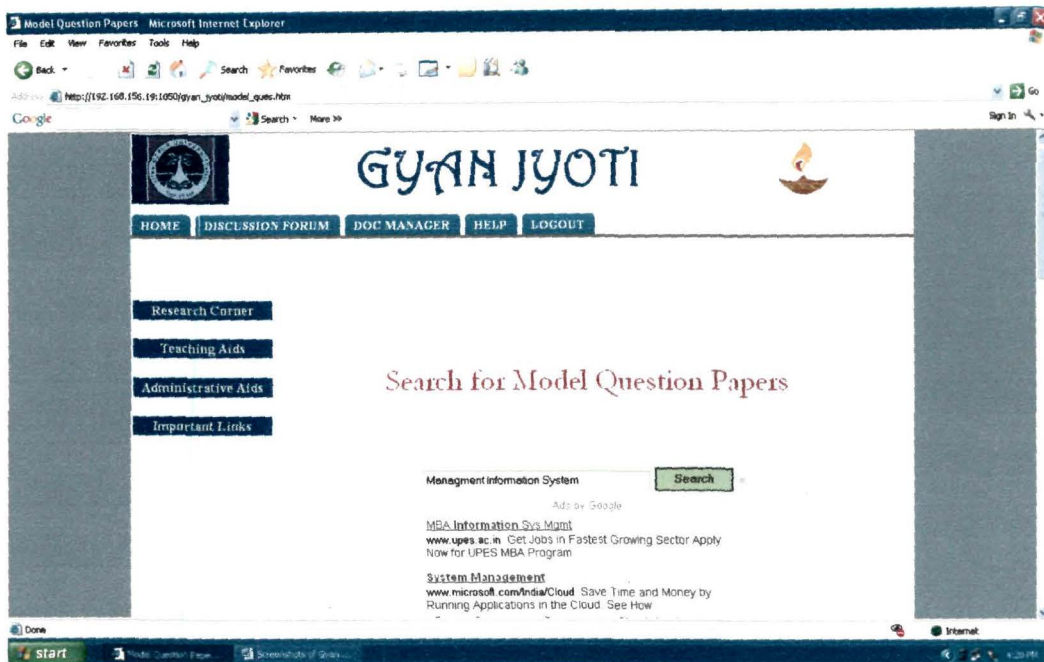
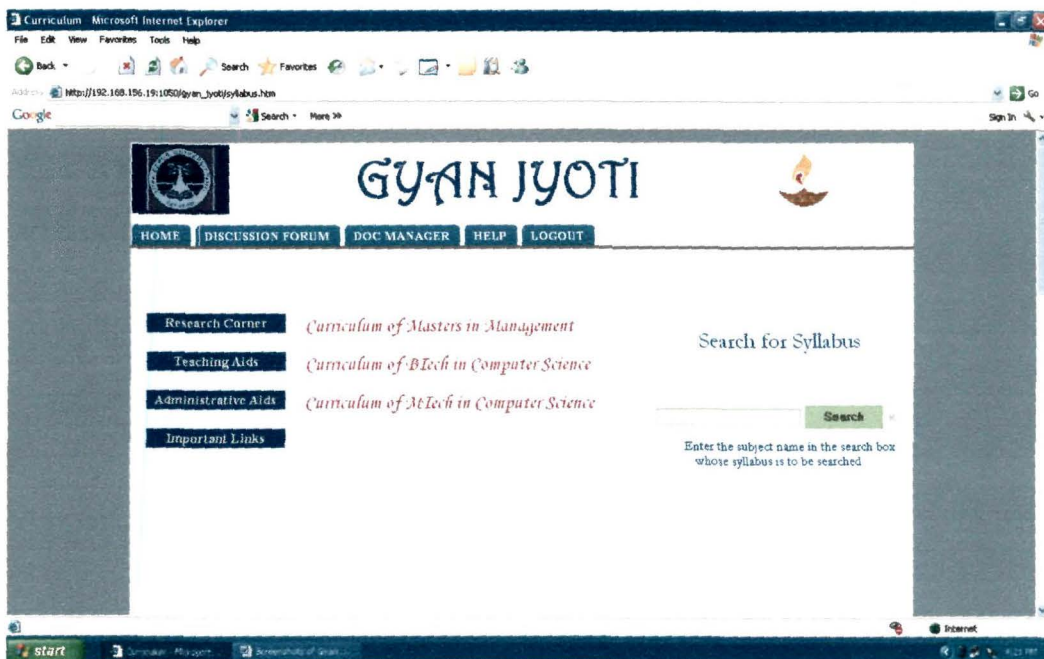


Figure VI.14: Teaching Methods



**Figure VI.15: Customized Google Search Results for Model Question Papers on Management Information System**



**Figure VI.16: Links to Course Structure of Management and Computer Science Courses**

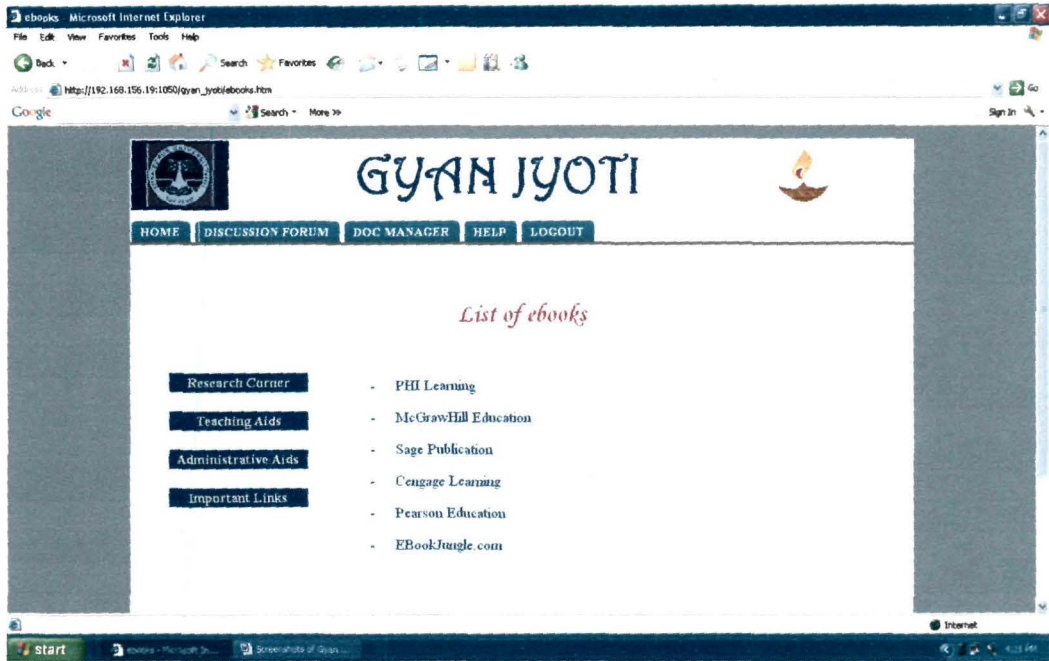


Figure VI.17: Links to ebooks

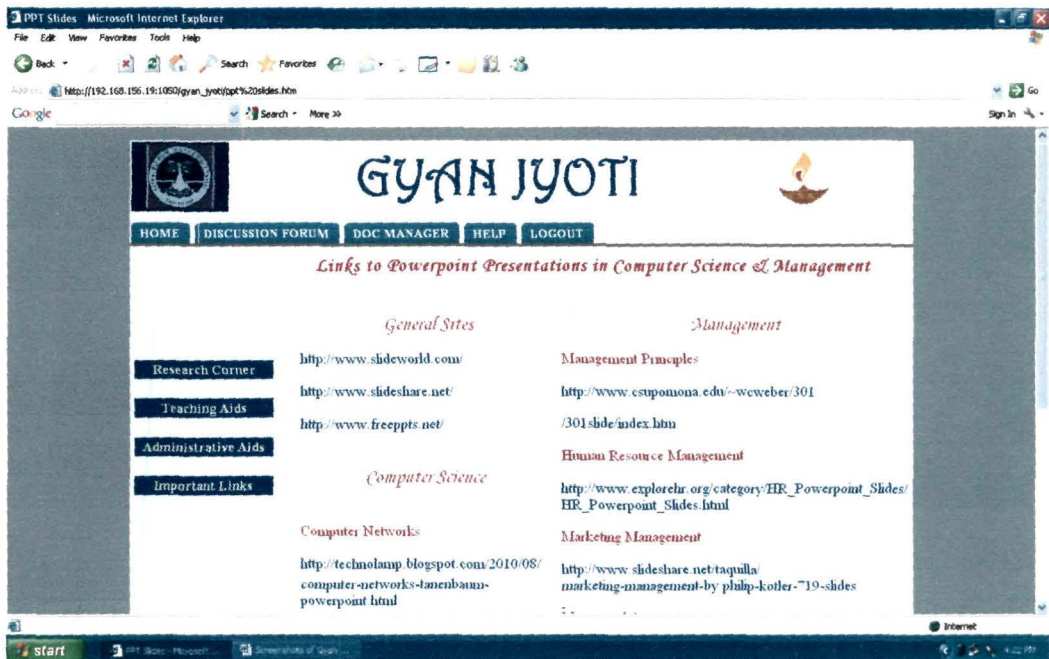


Figure VI.18: Links to Powerpoint presentations in Computer Science & Management

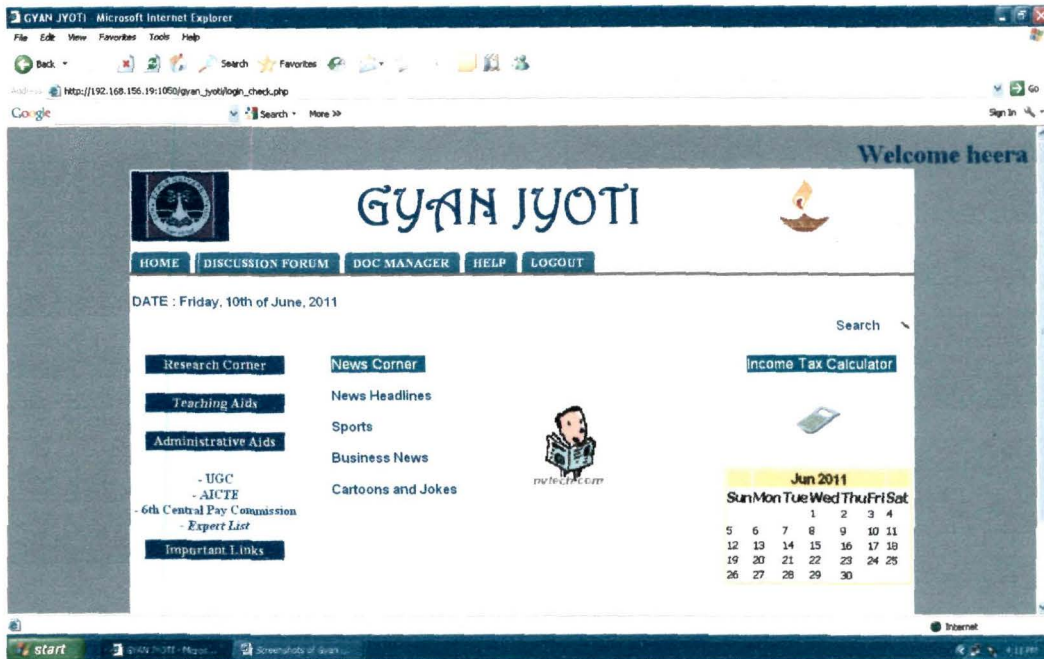


Figure VI.19: Options in Administrative Aids of Gyan Jyoti

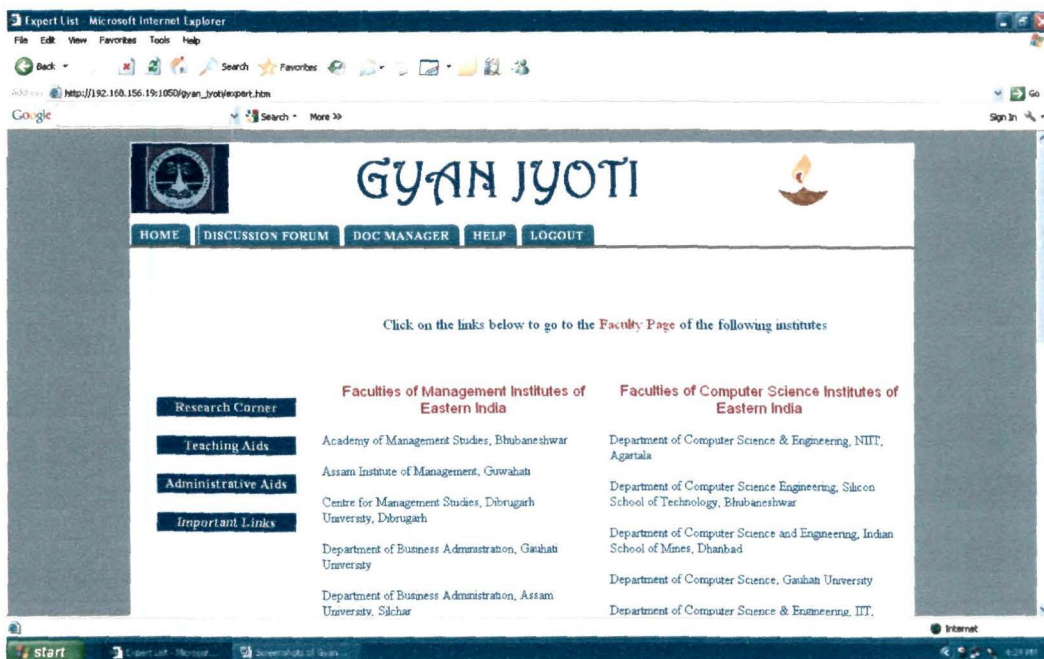
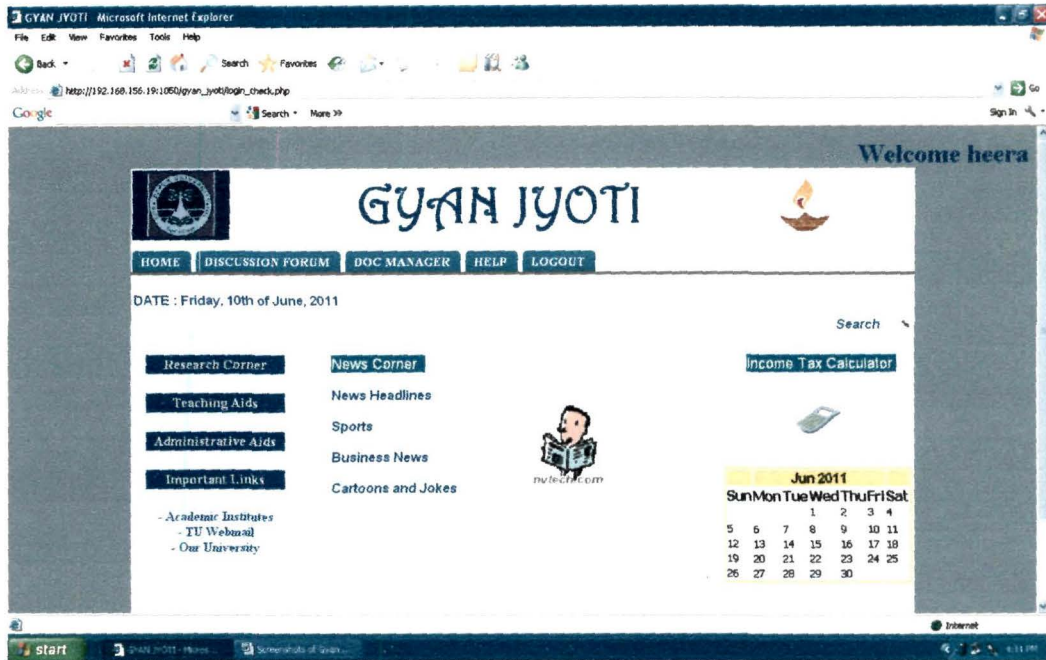
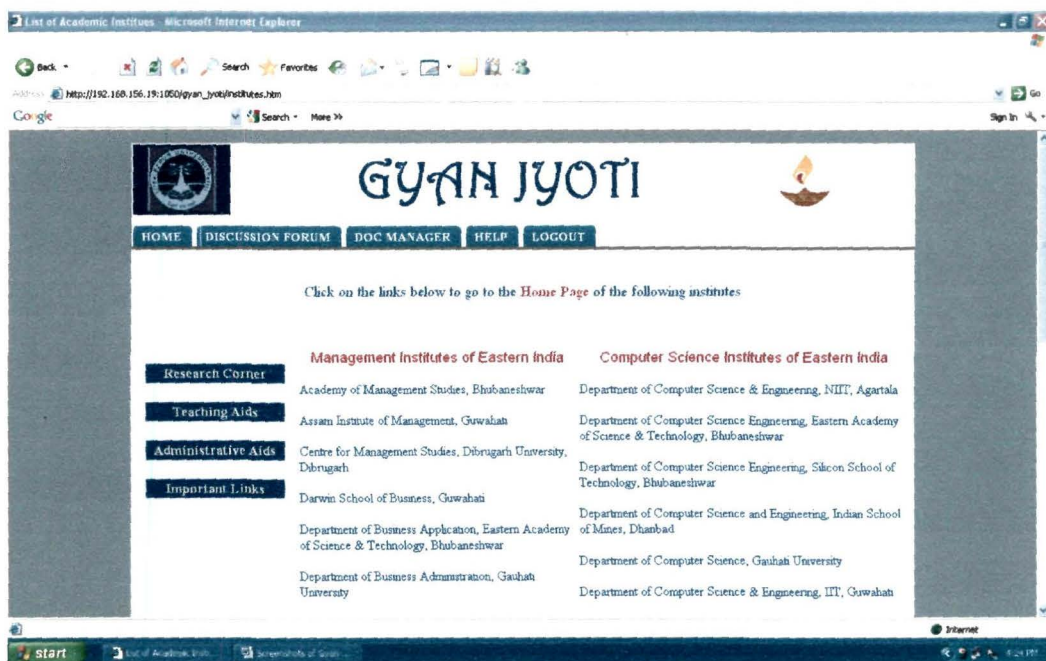


Figure 20: Links to Faculty page of Management and Computer Science Institutes of Eastern India



**Figure VI.21: Options in Important Links of Gyan Jyoti**



**Figure VI.22: Links to website of Management and Computer Science Institutes of Eastern India**

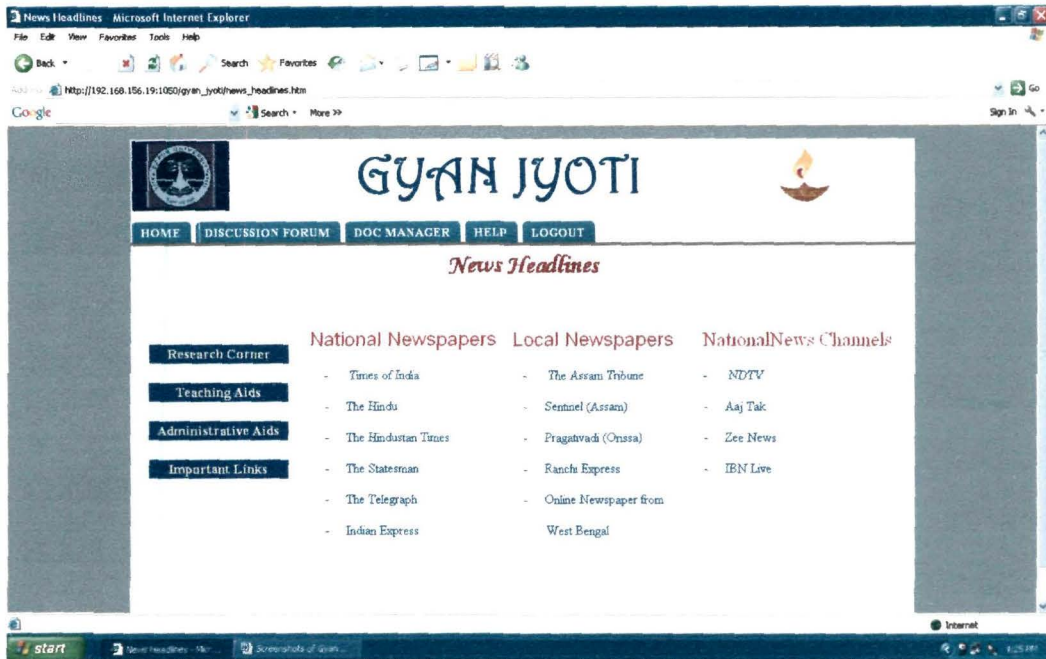


Figure VI.23: Links to News Headlines

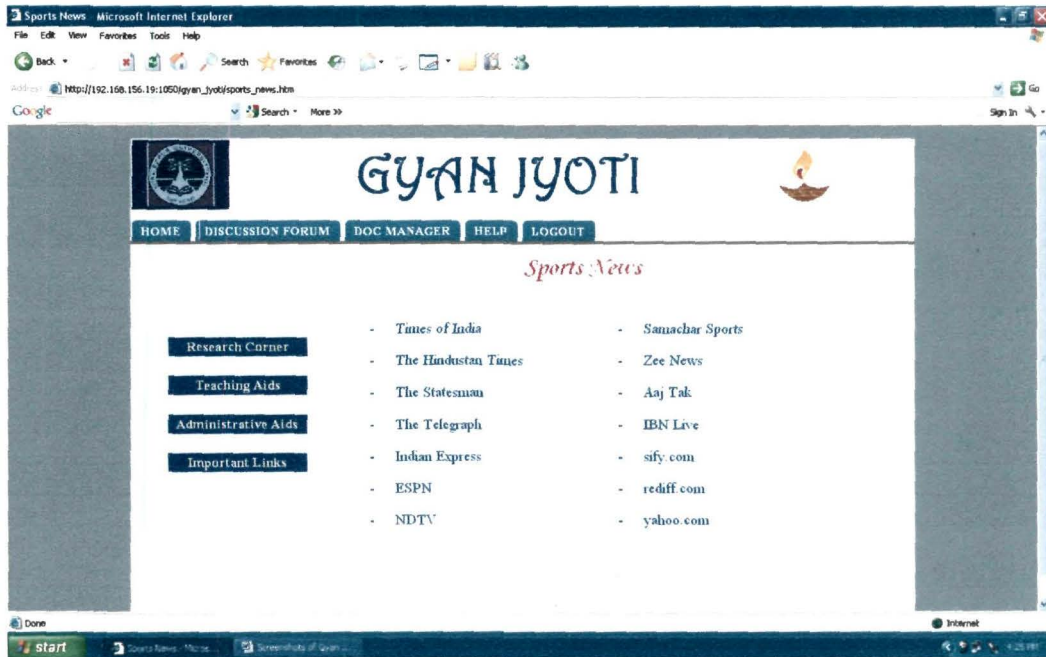


Figure VI.24: Links to Sports News



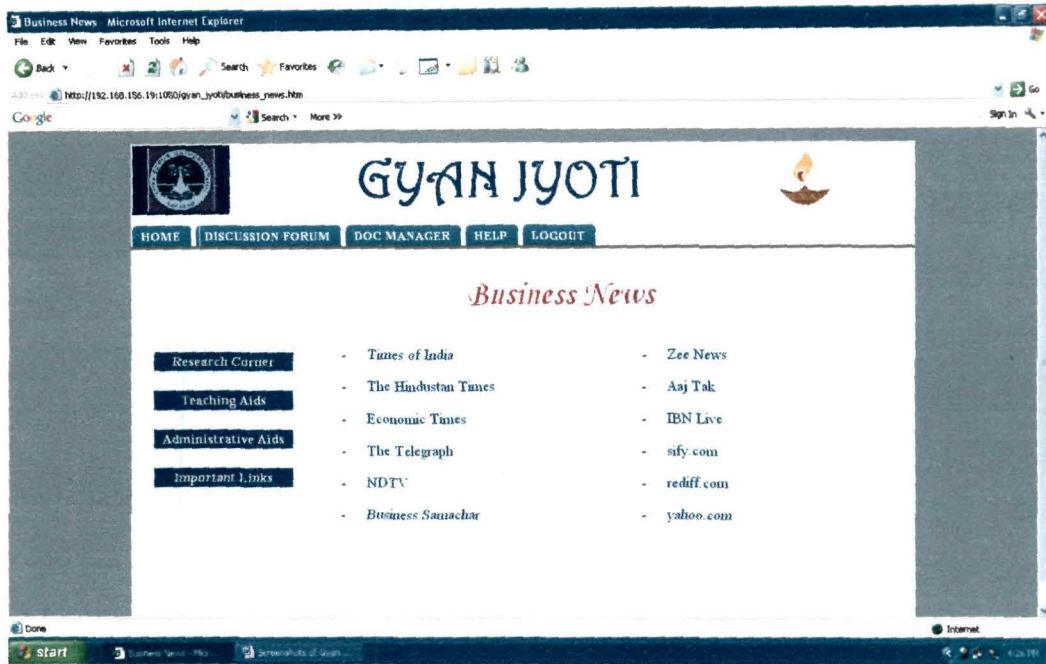


Figure VI.25: Links to Business News

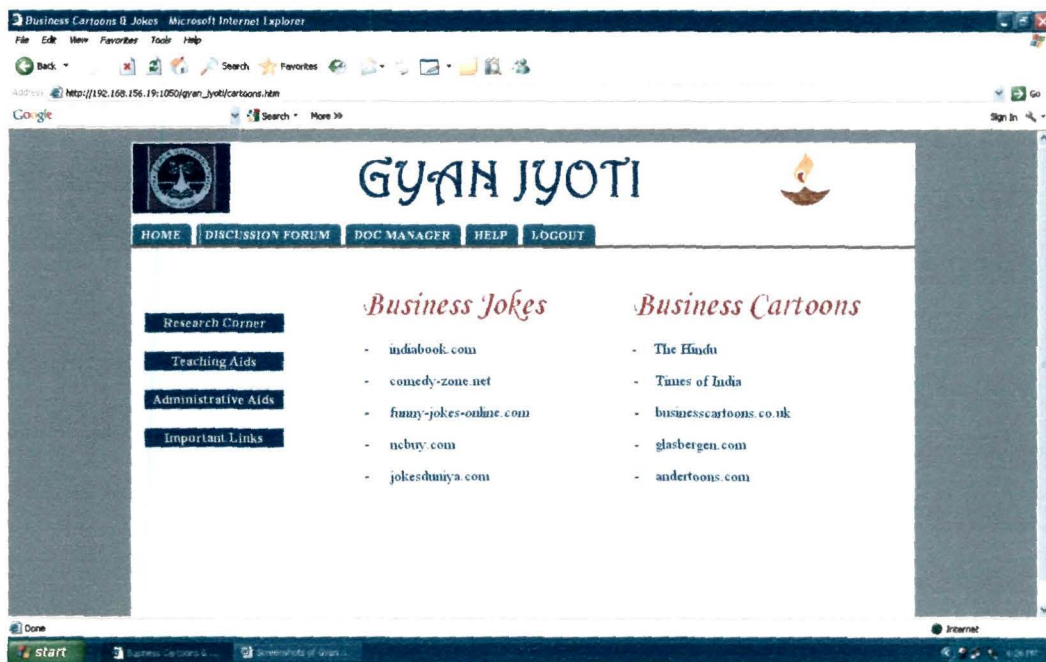


Figure VI.26: Links to Business Jokes and Cartoons

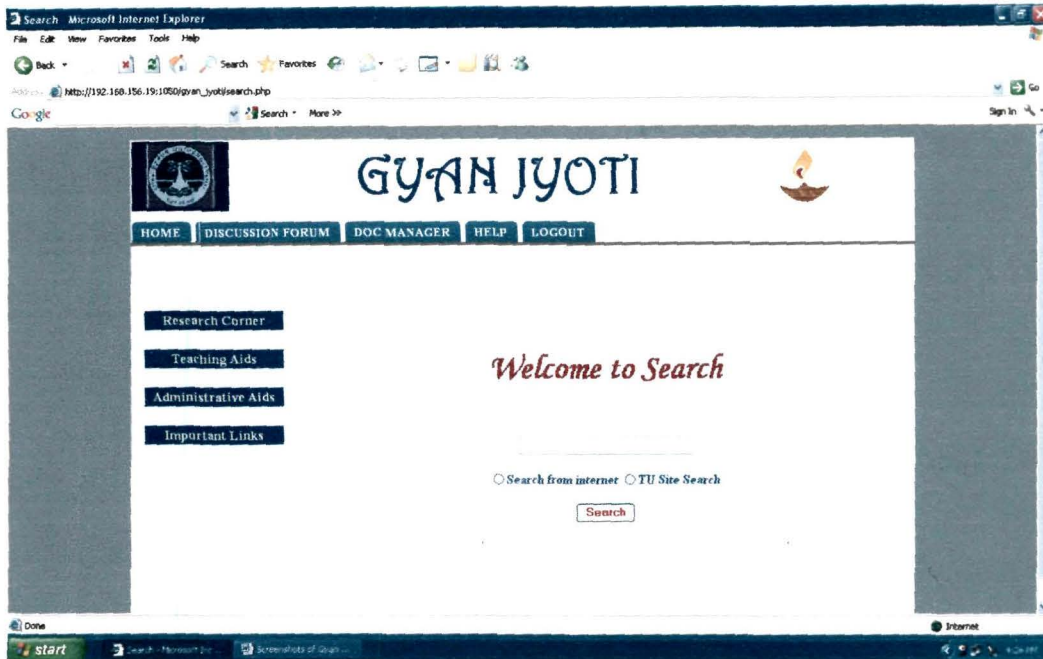


Figure VI.27: Google search and Tezpur Univeristy Site Search

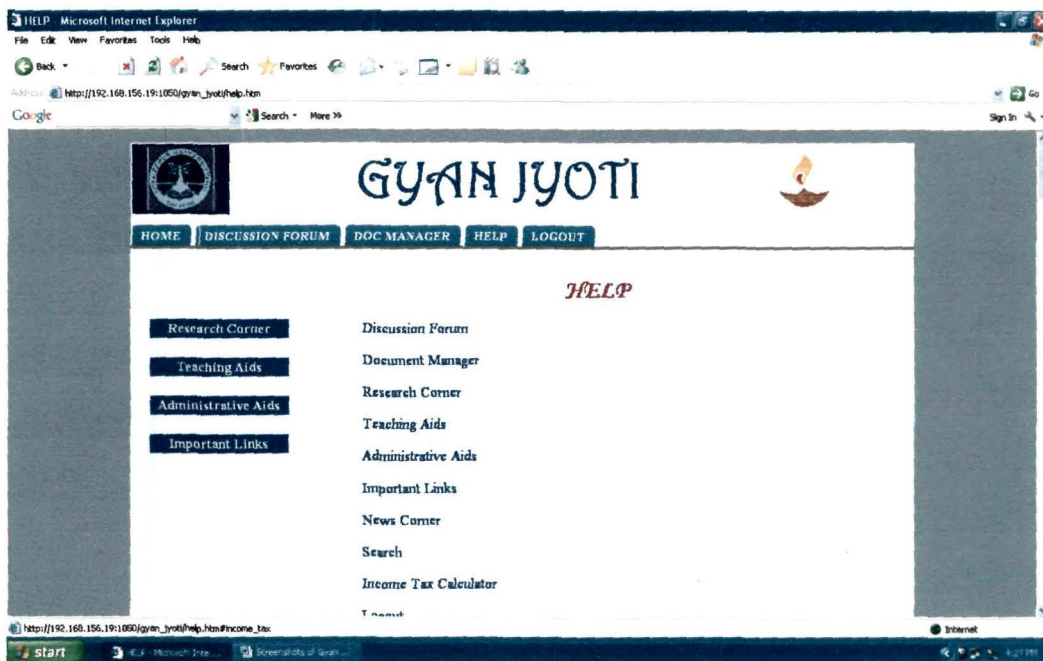
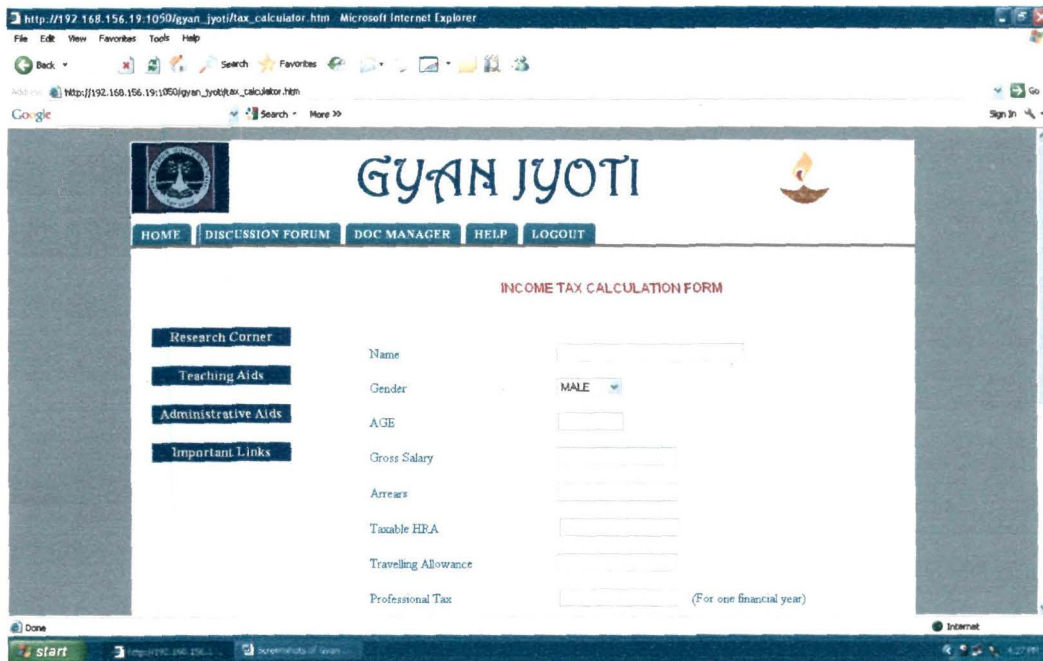
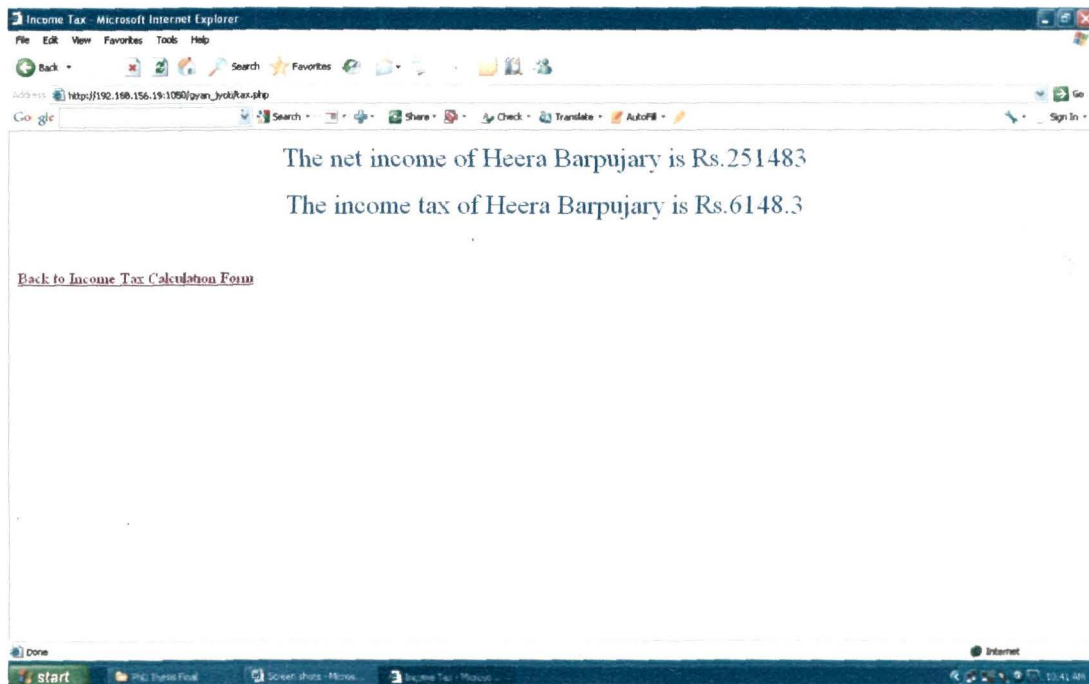


Figure VI.28: Help provided in Gyan Jyoti



**Figure VI.29: Income Tax Calculation Form**



**Figure VI.30: Calculated Income Tax Result**

## ANNEXURE VII

### Programming Codes of Gyan Jyoti

#### Program Listing 1: php Script to Create a New User Login

```
<?php
// contact to database
$conn = oci_connect("heera", "geeta1", "Oracle9i");

//Get data in local variable
$v_login=$_POST['login'];
$v_password=$_POST['password'];
$v_con_password=$_POST['con_password'];
if ($v_password==$v_con_password)
{
    $msg.="\n ".$_POST['title'];
    $name=$_POST['name'];
    $v_name=$msg. " " . $name;
    $v_gender.="\n".$_POST['gender'];
    $v_gender==$v_gender." ";
    $v_institute=$_POST['institute'];
    $v_address=$_POST['address'];
    $v_email=$_POST['email'];

//check for null values
if ($v_login=="" or $v_password=="" or $v_con_password=="" or $v_name=="" or
$v_gender=="" or $v_institute=="" or $v_email=="")
{
    header("location:login_reg_failure.php");
}
else
{
```

```

$query="insert into member(login,password,name,gender,institute,address,email)
values('$v_login','$v_password','$v_name','$v_gender','$v_institute','$v_address','$v_e
mail')";
$stat=oci_parse($conn,$query);
oci_execute($stat);
oci_close($conn);
header("location:login.htm");
}
}
else
{
echo "Password mismatch";
header("location:login_form.htm");
}
?>

```

### **Program Listing 2: Codes to Create Homepage of Gyan Jyoti**

```

<?php
$conn = oci_connect("heera", "geeta1", "Oracle9i");
$v_login=$_POST['login'];
$v_password=$_POST['password'];
if(!empty($v_login) && !empty($v_password))
{
$query=oci_parse($conn,"select login from member WHERE login='$v_login' and
password='$v_password'");
$result=oci_execute($query);
$r=oci_fetch_all($query,$conn);
if ($r==1)
{
session_start();
session_register("login", $v_login);
echo "<div align='right'><font color='blue' size='6pt'>
<b>Welcome ".$v_login." </b></font> </div>";

```

```
}  
else  
{  
    header("location:login_failure.php");  
}  
}  
else  
{  
    header("location:login_blank.php");  
}  
?>
```

<HTML>

<HEAD>

<TITLE>GYAN JYOTI</TITLE>

<style type="text/css">

#tabs {

float:left;

width:100%;

font-size:93%;

line-height:normal;

border-bottom:4px solid #666;

margin-bottom:0em; /\*margin between menu and rest of page\*/

overflow:hidden;

background-color:#FFFFFF;

}

#tabs ul {

margin:0;

padding:10px 10px 0 0px;

list-style:none;

background-color:#FFFFFF;

}

#tabs li {

display:inline;

```

        margin:0;
        padding:0;
    }
#tabs a {
    float:left;
    background:url("pics/left.png") no-repeat left top;
    margin:0;
    padding:0 0 0 6px;
    text-decoration:none;
}
#tabs a span {
    float:left;
    display:block;
    background:url("pics/right.png") no-repeat right top;
    padding:6px 15px 4px 6px;
    margin-right:2px;
    color:#FFF;
}
#tabs a span {
    float:none;
}
#tabs a:hover span {
}
#tabs a:hover {
    background-position:0% -42px;
}
#tabs a:hover span {
    background-position:100% -42px;
}
#glowtext{
    filter:glow(color=#FFFFFF,strength=3);
    width:100%;
}

```

```
.menutitle{
  cursor:pointer;
  margin-bottom: 5px;
  background-color:blue;
  color:#FFFFCC;
  width:170px;
  padding:2px;
  text-align:center;
  font-weight:bold;
  font-size:13pt;
  }
.submenu{
  margin-bottom: 0.5em;
  font-size:13pt;
  }
</style>
```

```
<script type="text/javascript">
var persistmenu="yes"
var persisttype="sitewide"
if (document.getElementById)
{
document.write('<style type="text/css">\n')
document.write('.submenu{display: none;}\n')
document.write('</style>\n')
}
}
```

```
function SwitchMenu(obj)
{
  if(document.getElementById)
  {
    var el = document.getElementById(obj);
    var ar = Document.getElementById("masterdiv").getElementsByTagName("span");
```



```

if(el.style.display != "block")
{
    for (var i=0; i<ar.length; i++)
    {
        if (ar[i].className=="submenu") //DynamicDrive.com change
        ar[i].style.display = "none";
    }
    el.style.display = "block";
}
else
{
    el.style.display = "none";
}
}
}
}

```

```

function get_cookie(Name)
{
    var search = Name + "="
    var returnvalue = "";
    if (document.cookie.length > 0)
    {
        offset = document.cookie.indexOf(search)
        if (offset != -1)
        {
            offset += search.length
            end = document.cookie.indexOf(";", offset);
            if (end == -1)
            end = document.cookie.length;
            returnvalue=unescape(document.cookie.substring(offset, end))
        }
    }
    return returnvalue;
}

```

```

function onloadfunction(){
if (persistmenu=="yes"){
var cookiename=(persisttype=="sitewide")? "switchmenu" :
window.location.pathname
var cookievalue=get_cookie(cookiename)
if (cookievalue!="")
document.getElementById(cookievalue).style.display="block"
}
}

function savemenustate( )
{
var inc=1, blockid=""
while (document.getElementById("sub"+inc))
{
if (document.getElementById("sub"+inc).style.display=="block")
{
blockid="sub"+inc
break
}
}
inc++
}
var cookiename=(persisttype=="sitewide")? "switchmenu" :
window.location.pathname
var cookievalue=(persisttype=="sitewide")? blockid+";path=/" : blockid
document.cookie=cookiename+"="+cookievalue
}

if (window.addEventListener)
window.addEventListener("load", onloadfunction, false)
else if (window.attachEvent)
window.attachEvent("onload", onloadfunction)
else if (document.getElementById)

```

```
window.onload=onloadfunction
if (persistmenu=="yes" && document.getElementById)
window.onunload=savemenustate
```

```
</script>
```

```
<script type="text/javascript">
function startTime()
{
var today=new Date();
var h=today.getHours();
var m=today.getMinutes();
var s=today.getSeconds();// add a zero in front of numbers<10
m=checkTime(m);
s=checkTime(s);
document.getElementById('txt').innerHTML=h+":"+m+":"+s;
t=setTimeout('startTime()',500);
}

```

```
function checkTime(i)
{
if (i<10)
{
i="0" + i;
}
return i;
}
</script>
```

```
<Script Language="JavaScript">
<!--
function nameDefined(ckie,nme)
{
var splitValues
```

```

var i
for (i=0;i<ckie.length;++i)
{
    splitValues=ckie[i].split("=")
    if (splitValues[0]==nme) return true
}
return false
}

function delBlanks(strng)
{
    var result=""
    var i
    var chrn
    for (i=0;i<strng.length;++i) {
        chrn=strng.charAt(i)
        if (chrn!=" ") result += chrn
    }
    return result
}

function getCookieValue(ckie,nme)
{
    var splitValues
    var i
    for(i=0;i<ckie.length;++i) {
        splitValues=ckie[i].split("=")
        if(splitValues[0]==nme) return splitValues[1]
    }
    return ""
}

function readCookie() {
    var cookie=document.cookie
    counter=0
    var chkdCookie=delBlanks(cookie) //are on the client computer

```

```

var nvpair=chkdCookie.split(";")
if(nameDefined(nvpair,"pageCount"))
counter=parseInt(getCookieValue(nvpair,"pageCount"))
++counter
var futdate = new Date()
var expdate = futdate.getTime()
expdate += 3600000 * 24 *30 //expires in 1 hour
futdate.setTime(expdate)

var newCookie="pageCount="+counter
newCookie += "; expires=" + futdate.toGMTString()
window.document.cookie=newCookie
}
// -->
</Script>
</HEAD>

<BODY bgcolor="#708090" link="#0000FF" vlink="#0000FF" alink="#0000FF" >
<center>
<table width="960px" height="75px" style="background-color:#FFFFFF">
<tr>
<td style="height: 55%; width=117px; background-color:#000080">
<p align="center">
<b>
<span style="font-size: 48pt; color: blue; font-family: Garamond" id="glowtext">
<center>
</center>
</span>
</b>
</td>

```

```

<td style="height: 55%; background-color:#FFFFFF" width="655">
  <p align="center"><b>
    <span style="font-size: 48pt; color: blue; " id="glowtext0">
      <font face="Harrington">GYAN JYOTI</font></span></b></td>
  <td style="height: 55%; background-color:#FFFFFF">
    <font face="Harrington">
      
    </font>
  </td>
</tr>
</table>
</center>
<center>
  <table border="0" style="width: 960px; height: 3>
    <tr>
      <td style=" colspan="3" bgcolor="#F0F8FF">
        <div id="tabs">
          <ul>
            <li><a href="chat_main.htm" target="_self"><span><b>DISCUSSION
FORUM</b></span></a></li>
            <li><a href="file_upload.php" target="_self"><span><b>DOC
MANAGER</b></span></a></li>
            <li><a href="help.htm" target="_self"><span><b>HELP</b></span></a></li>
            <li><a href="logout.php" target="_self"><span><b>LOGOUT</b></span></a></li>
          </ul>
        </div>
      </td>
    </tr>
    <tr>
      <td style="width: 100%; height: 30; background-color:#FFFFFF" colspan="5"
        align="right"><br/>
        <b><font face="Arial">
          <?php echo "<div align='left'><font color='blue' size='3pt'><b>DATE :</b>".
          ".date("l, dS \of F, Y")."</font></div>";?>

```

```

</font></b>
<span style="color: #0000ff; font-family: Arial"><strong><a href="search.php"
target="_self">
<span style="text-decoration: none">Search</span></a>&nbsp; </strong></span>
<a href="search.php" target="_blank">
</img></a><b><font face="Arial">
</font></b>
</tr>
<tr><td><font color='#FFFFCC' size='6pt'><div id="txt"></div></font><br/></td>
</tr>
<tr>
<td style="width: 211px; height: 420; background-color:#F0F8FF"
valign="top"><div id="masterdiv"><center><div class="menutitle"
onclick="SwitchMenu('sub1')">
<p>Research Corner</p>
</div><font color="#0000FF"><br />
</font>
<span class="submenu" id="sub1">
<strong><span style="color: #0000FF"><font size="3">- </font> </span></strong>
<font size="3"><a href="e_resources.htm" target="_self">
<strong><span style="text-decoration:none">e-journals</span></strong></a>
<font color="#0000FF"><br/>
</font>
<strong><span style="color: #0000FF">- </span></strong><a href="databank.htm"
target="_self"><strong>
<span style="text-decoration:none">
Databank</span></strong></a><font color="#0000FF"><br/>
</font>
<strong><span style="color: #0000FF">- </span></strong>
<a href="search_paper.php" target="_self">
<strong><span style="text-decoration:none">
Search Research Paper</span></strong></a><font color="#0000FF"><br/>
</strong>

```

```

</font>
<strong><span style="color: #0000FF">- </span></strong></font>
<a href="research.htm" target="_self"><strong>
<span style="text-decoration:none">
<font size="3">Research Aids</font></span></strong></a>
<font color="#0000FF"><br/>
</font>
</strong></span>
<div class="menutitle" onclick="SwitchMenu('sub2')" style="font-weight:
bold"><p>Teaching Aids</p></div><br />
<span class="submenu" id="sub2">
<a href="methodology.htm" target="_self"><strong>
<span style="text-decoration: none; "><font size="3">- Methodologies<br/> -
</font> </span>
</strong><font size="3"><a href="model_ques.htm" target="_blank"><strong>
<span style="text-decoration:none">Question Paper Styles</span></strong>
</a><font color="#0000FF"><br/></font>
strong<span style="color: #0000FF">
- </span></strong><a href="syllabus.htm" target="_blank"><strong>
<span style="text-decoration:none">
Syllabus</span></strong></a><font color="#0000FF"><br/></font>
<strong><span style="color: #0000FF">
- </span></strong><a href="ebooks.htm" target="_self"><strong>
<span style="text-decoration:none">ebooks</span>
</strong></a></font><strong>
<span style="color: #0000FF; text-decoration:none">
<font size="3">
</font> </span></strong></span>
</div><br /><span class="submenu" id="sub3" >
<strong><span style="color: #0000FF"><font size="3">- </font> </span></strong>
<font size="3"><a href="ugc.php" target="_blank">

```



```

<strong><span style="text-decoration:none">UGC</span></strong></a>
<font color="#0000FF"><br/></font>
<strong><span style="color: #0000FF">- </span></strong><a href="aicte.htm"
target="_blank"><strong>
<span style="text-decoration:none">AICTE</span></strong></a><font
color="#0000FF"><br/></font>
<strong><span style="color: #0000FF">- </span></strong>
<a href="http://india.gov.in/govt/paycommission.php" target="_blank"><strong>
<span style="text-decoration:none">6th Central Pay Commission</span>
</strong></a><font color="#0000FF"><br/></font>
<strong><span style="color: #0000FF">- </span></strong><a href="expert.htm"
target="_self"><strong>
<span style="text-decoration:none">Expert List</span></strong></a></font>
<font size="3" color="#0000FF"><br/></font>
</span>
<div class="menutitle" onclick="SwitchMenu('sub4')"><p>Important Links</p>
</div><br /><span class="submenu" id="sub4">
<strong><span style="color: #0000FF"><font size="3">- </font> </span></strong>
<font size="3"><a href="institutes.htm" target="_self"><strong>
<span style="text-decoration:none">Academic Institutes</span></strong></a>
<font color="#0000FF"><br/></font><strong><span style="color: #0000FF">-
</span></strong><a href="http://mail.tezu.ernet.in" target="_blank">
<strong>
<span style="text-decoration:none">TU Webmail</span></strong>
</a><font color="#0000FF"><br/></font>
<strong><span style="color: #0000FF">- </span></strong></font>
<a href="http://www.tezu.ernet.in" target="_blank"><strong>
<span style="text-decoration:none"><font size="3">Our University</font></span>
</strong></a></span><font color="#0000FF"><br /></font>
</div></center></td>
<td style="width: 35px; height: 3"></td>
<td style="width: 242px; " valign="top" bgcolor="#F0F8FF">
<p>
<span style="color: #FFFFCC; background-color:#0000FF" >

```

```

<font face="Arial" size="4"> News Corner</font></span>
<font face="Arial" size="4" color="#FFFFCC"><span style="background-color:
#0000FF">&nbsp; </span> </font></p>
<span style="color: blue; font-family: Arial">
<p><a href="news_headlines.htm" target="_self"><b>
<span style="text-decoration: none">News Headlines</span></b></a><b> </b>
<p><b><a href="sports_news.htm" target="_self">
<span style="text-decoration: none">Sports</span></a>
</b>
<p><b><a href="business_news.htm" target="_self">
<span style="text-decoration: none">Business News</span></a>
</b>
<p><b><a href="cartoons.htm" target="_self">
<span style="text-decoration: none">Cartoons and Jokes</span></a>
</b>
</span>
<p>&nbsp;</td>
<td style="width: 248px; height: 3" valign="top">
<p align="center">
</font><br/><br/><br/>
<br/><br/><br/><br/><br/><br/><br/>
&nbsp;<p align="center">
&nbsp;<p align="center">
<br/>
</td>
<td valign="top">
<p align="center"><font color='blue' size='4'>
&nbsp;<span style="background-color: #0000FF"><a href="tax_calculator.htm"
target="_self"><span style="text-decoration: none; "><font face="Arial"
color="#FFFFCC">Income Tax Calculator</font></span></a></span></font><font
face="Arial" color="#FFFFCC" size="4"><span style="background-color:
#0000FF">
</span>

```

```

</font><font size="6"><br/><br>
<a href="tax_calculator.htm">
</a></font>
<br/>
<br/>
<br/>

<?php
$m= date("m");
$d= date("d"); // Finds today's date
$y= date("Y"); // Finds today's year
$no_of_days = date('t',mktime(0,0,0,$m,1,$y)); // This is to calculate number of days
                                                in a month
$mn=date('M',mktime(0,0,0,$m,1,$y)); // Month is calculated to display at the top of
                                                the calendar
$yn=date('Y',mktime(0,0,0,$m,1,$y)); // Year is calculated to display at the top of the
                                                calendar
$j= date('w',mktime(0,0,0,$m,1,$y)); // This will calculate the week day of the first
                                                day of the month

for($k=1; $k<=$j; $k++)
{ // Adjustment of date starting
    $adj .="<td>&nbsp;</td>";
}
/// Starting of top line showing name of the days of the week
echo " <table border='1' bordercolor='#FFFF00' cellspacing='0' cellpadding='0'
align=center>
<tr><td>";
echo "<table cellspacing='0' cellpadding='0' align=center width='100' border='1'>
<td align=center bgcolor='#ffff00'><font size='3' face='Tahoma'>
&nbsp;</td><td colspan=5 align=center bgcolor='#ffff00'>
<font size='3' face='Arial'><b>$mn $yn</b>
</td><td align=center bgcolor='#ffff00'><font size='3' face='Tahoma'> &nbsp;</td></tr><tr>";

```

```

echo "<td><font size='3' face='Tahoma'><b>Sun</b></font></td><td>
<font size='3' face='Tahoma'><b>Mon</b></font></td>
<td><font size='3' face='Tahoma'><b>Tue</b></font></td><td>
<font size='3' face='Tahoma'><b>Wed</b></font></td>
<td><font size='3' face='Tahoma'><b>Thu</b></font></td><td>
<font size='3' face='Tahoma'><b>Fri</b></font></td>
<td><font size='3' face='Tahoma'><b>Sat</b></font></td></tr><tr>";
for($i=1;$i<=$no_of_days;$i++)
{
echo $adj."<td valign=top ><font size='2' face='Tahoma'>$i<br>";
echo " </font></td>";
$adj="";
$j ++;
if($j==7){echo "</tr><tr>";
$j=0;}
}
echo "</tr></table></td></tr></table>";
?>
</td>
</tr>
</tr>
</table>
</center>
</div>
</BODY>
</HTML>

```

### Program Listing 3: php script of the Ontology Driven Search

```
<? php
$key1=$_POST['search_onto'];
$doc = new DOMDocument();
$doc->load('marketing.xml');
$classes=$doc->getElementsByTagName("class");
foreach( $classes as $class )
{
    $names = $class->getElementsByTagName("name");
    $name = $names->item(0)->nodeValue;
    $superclass = $class->getElementsByTagName("superclass");
    $super=$superclass->item(0)->nodeValue;
    if ($name==$key1)
    {
        $names = $class->getElementsByTagName("name");
        $name = $names->item(0)->nodeValue;
        $superclass = $class->getElementsByTagName("superclass");
        $super=$superclass->item(0)->nodeValue;
        if($name=="THING")
        {
            $name=" ";
        }
        if($super=="THING")
        {
            $super=" ";
        }
        $search1=$name;
        $search2=$super;
        $search=$search1." ". $search2;
    }
}
$r="marketing";
```

```

while($search2!=$r)
{
    $classes=$doc->getElementsByTagName("class");
    foreach( $classes as $class )
    {
        $names = $class->getElementsByTagName("name");
        $name = $names->item(0)->nodeValue;
        $superclass = $class->getElementsByTagName("superclass");
        $super=$superclass->item(0)->nodeValue;
        if($name==$search2)
        {
            $names = $class->getElementsByTagName("name");
            $name = $names->item(0)->nodeValue;
            $superclass = $class->getElementsByTagName("superclass");
            $super=$superclass->item(0)->nodeValue;
            if ($name=="THING")
            {
                $name=" ";
            }
            if ($super=="THING")
            {
                $super=" ";
            }
            $search3= $super;
            $search=$search." ".$search3;
            $search2=$search3;
        }
    }
}
}
?>

```







## Program Listing 6: php script to Conduct and Store a Discussion Session

```
<?php
$chat_file_ok = "msg.txt";
$chat_length = 100;
$max_single_msg_length = 10000;
$max_file_size = $chat_length * $max_single_msg_length;
$file_size = filesize($chat_file);
if ($file_size > $max_file_size) {
    // reads file and stores each line $lines' array elements
    $lines = file($chat_file_ok);
    //get number of lines
    $a = count($lines);
    $u = $a - $chat_length;
    for($i = $a; $i >= $u ;$i--)
    {
        $msg_old = $lines[$i] . $msg_old;
    }
    $deleted = unlink($chat_file_ok);
    $fp = fopen($chat_file_ok, "w+");
    $fw = fwrite($fp, $msg_old);
    fclose($fp);
}
if(!isset($_POST["Say"]))
{
    $nick=$_POST['nick'];
    $chat=$_POST['chat'];
    $msg = str_replace("\n", " ", $chat);
}
$msg = str_replace ("\n", " ", $chat);
$msg = str_replace ("<", " ", $msg);
$msg = str_replace (">", " ", $msg);
$msg = stripslashes ($msg);
```

```

if ($msg != "")
{
    $col= "\n"._POST['col'];
    $color=str_replace("\n", " ", $col);
    $fp = fopen($chat_file_ok, "a+");
    $fw = fwrite($fp, "\n<font color=$color> <b>$nick:</b> $msg </font><br>");
    fclose($fp);
}
if(!isset($_POST["Say"]))
{
    $nick=$_POST['nick'];
    $chat=$_POST['chat'];
    $conn = oci_connect("heera", "geeta1", "Oracle9i");
    if (!empty($chat))
    {
        $add = "insert into chatscript(id,nickname,chat) values(t1.nextval, '$nick', '$chat)";
        $stat=oci_parse($conn,$add);
        oci_execute($stat);
    }
    oci_close($conn);
}
?>

```

**Program Listing 7: php script to display chat script in the screen**

```

<?php
print '<meta http-equiv="refresh"
content="10;URL="http://localhost:1/KMS/chat1/chat_window.php">';
$chat_file_ok = "msg.txt";
$chat_length = 10;
$lines = file($chat_file_ok);
$a = count($lines);
$u = $a - $chat_length + $chat_length;

```

```

/*    reads the array in reverse order and outputs to chat */
for ($i = $a; $i >= $a - 18 ;$i--)
{
    echo $lines[$i] . """;
}
?>

```

### Program Listing 8: php script to search stored chat scripts from database

```

<?php
$searching=$_POST['searching'];
$find=$_POST['find'];
$field=$_POST['field'];
if ($searching == "yes")
{
    echo "<font color='blue' size='3pt'><b>Results</b></font><p>";
    if ($find == "")
    {
        echo "<p>You forgot to enter a search term";
        exit;
    }
    $conn=oci_connect("heera", "geeta1", "Oracle9i");
    $find = strip_tags($find);
    $find = trim ($find);
    $data = oci_parse($conn,"select nickname,chat from chatscript where $field like
        '%$find%'");
    oci_execute($data);
    while($result = oci_fetch_array( $data ))
    {
        echo $result[0]; echo " ";
        echo $result[1]; echo "<br>";
        echo "<br>";
    }
}

```

```

$anymatches=oci_num_rows($data);
    if ($anymatches == 0)
    {
        echo "Sorry, but we can not find an entry to match your query<br><br>";
    }
    echo "<b>Searched For:</b> " . $find;
}
?>

```

### Program Listing 9: php script to calculate income tax

```

<?php
$name=$_POST['name'];
$v_gender.="\\n".$_POST['gender'];
$gender=="$v_gender." ";
$age=intval($_POST['age']);
$gross_salary= floatval($_POST['gross']);
$arrear=floatval($_POST['arrear']);
$house_rent=floatval($_POST['HRA']);
$TA=floatval($_POST['TA']);
$remote= floatval($_POST['RA']);
$PT=floatval($_POST['PT']);
$house_loan=floatval($_POST['house_loan']);
$other_income=floatval($_POST['other_income']);
$total_savings=floatval($_POST['savings']);
$donation=floatval($_POST['donation']);
$infra_bond=floatval($_POST['infra_bond']);
$relief=floatval($_POST['relief']);
if ($total_savings>100000)
    $total_savings=100000;
else
    $total_savings=$total_savings;

```

```

if ($infra_bond>20000)
    $infra_bond=20000;
else
    $infra_bond=$infra_bond;
$a=$gross_salary+$arrear;
$b=$a-$house_rent-$remote-$PT - $TA;
$c=$b+$other_income;
$f=$c-$house_loan-$donation;
$d=$f-$total_savings-$infra_bond-$relief;
echo "<center><font color='blue' size='6pt'>The net income of ".$name." is
Rs.". $d."</font></center><br/>";
$tax=0;
if ($age>=80)
{
    if($d<=500000)
    {
        echo "<center><font color='blue' size='6pt'>No tax required for ".$name."
</font></center>";
    }
    elseif ($d<800000)
    {
        $tax=0.20*($d-500000);
        echo "<center><font color='blue' size='6pt'>The income tax of ".$name."
is Rs.". $tax."</font></center>";
    }
    else
    {
        $tax=60000+(0.30*($d-800000));
        echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
Rs.". $tax."</font></center>";
    }
}
}

```

```

elseif (($age>=60)&&($age<80))
{
    if($d<250000)
    {
        echo "<center><font color='blue' size='6pt'>No tax required for
        ".$name."</font></center>";
    }
    elseif($d<500000)
    {
        $tax=0.10*($d-250000);
        echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
        Rs.". $tax."</font></center>";
    }
    elseif($d<800000)
    {
        $tax=26000+(0.20*($d-500000));
        echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
        Rs.". $tax."</font></center>";
    }
    else
    {
        $tax=86000+(0.30*($d-800000));
        echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
        Rs.". $tax."</font></center>";
    }
}
else
{
    if($gender=="MALE")
    {
        if($d<180000)
        {
            echo "<center><font color='blue' size='6pt'>No tax required for
            ".$name."</font></center>";
        }
    }
}

```

```

}
elseif($d<500000)
{
    $tax=0.10*($d-180000);
    echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
    Rs.". $tax."</font></center>";
}
elseif($d<800000)
{
    $tax=34000+0.20*($d-500000);
    echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
    Rs.". $tax."</font></center>";
}
else
{
    $tax=94000+(0.30*($d-800000));
    echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
    Rs.". $tax."</font></center>";
}
}
else
{
    if($d<190000)
    {
        echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is Rs.".
        $tax."</font></center>";
    }
    elseif($d<500000)
    {
        $tax=0.10*($d-190000);
        echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
        Rs.". $tax."</font></center>";
    }
}

```

```
elseif($d<800000)
{
    $tax=31000+0.20*($d-500000);
    echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
    Rs.". $tax."</font></center>";
}
else
{
    $tax=91000+(0.30*($d-800000));
    echo "<center><font color='blue' size='6pt'>The income tax of ".$name." is
    Rs.". $tax."</font></center>";
}
}
}
?>
```



## ANNEXURE VIII

Dear Sir / Madam,

A Knowledge Management Portal for academicians has been developed and is available at [http://agnee.tezu.ernet.in:8000/gyan\\_jyoti/login.htm](http://agnee.tezu.ernet.in:8000/gyan_jyoti/login.htm) . Kindly open this link by clicking on it or by copying the link in the address bar of a browser, and browse the different components of the portal. After viewing the portal, kindly fill up the feedback form given below.

The feedback form aims at identifying the loopholes of the portal. It is purely for research use only. We look forward for your help and co-operation and assure that your response will be kept confidential.

### FEEDBACK FORM

*Tick wherever applicable.*

1. Are you able to create a new user login easily?

a. Yes            b. No

If No, What problem did you face? -----

2. Can you enter the main page of Knowledge portal without entering login and password?

a. Yes            b. No

3. If the portal suddenly quits, do you have to enter login and password again to enter the main page of the portal?

a. Yes            b. No            c. Can't say

4. Please give your opinion on the following features.

Features	Strongly Agree	Agree	Can't Say	Disagree	Strongly Disagree
a. Document Manager is a useful component for carrying out my type of work.					
b. Provision for File uploading is a useful feature.					
c. Provision for Browsing of uploaded files is a useful feature.					
d. Discussion forum is a useful component for carrying out my type of work.					

Features	Strongly Agree	Agree	Can't Say	Disagree	Strongly Disagree
e. Provision for Starting a discussion is a useful feature.					
f. Provision for Searching a discussion is a useful feature.					
g. Search facility for research papers is a useful component.					
h. Relevant research paper is obtained in search results.					
i. Options given in Research Corner are useful for research work.					
j. Options given in Teaching Aids are useful for teaching.					
k. Options given in Administrative aids are useful for administrative work.					
l. Options given under Important Links are useful.					
m. Income tax calculator is a useful component.					
n. News items under News Corner are an attractive feature of the Knowledge portal.					
o. The knowledge portal is easy to operate.					

5. Please give your opinion on the effectiveness of the following features.

Features	Agree	Can't Say	Disagree
a. File uploading can be done without much delay.			
b. Browsing of uploaded files can be viewed without much delay.			
c. Starting a discussion can be done without much delay.			
d. Searching a discussion can be done without much delay			
e. Searching research paper does not take much time.			
f. Searching model question paper takes less time.			
g. Databanks can be searched without much delay.			
h. Syllabus can be searched within a short time.			
i. Help provision in the Knowledge portal is helpful.			

**Note:** If you happen to disagree with any of the above statements, please mention the reason in Q 6 against that feature.

6. Write down the additions that you want to incorporate in the following components.

Component Name	Additions
Document Manager	
File Uploading	
Browsing of Upload files	
Discussion Forum	
Starting a Discussion	
Searching a Discussion	
Research Corner	
Teaching Aids	
Administrative Aids	
Important Links	
News Corner	
Income Tax Calculator	
Help	
Any other feature that you feel would add value to the portal	

7. As a whole the portal will be useful for academicians.

a. Agree      b. Disagree      c. Can't Say

If you Disagree, please mention why?

8. On a scale of 1-5, what rating you will give to this Knowledge Management portal.

(1 is the lowest and 5 is the highest score).

Name:

Designation:

Department:

Organization:

If you hold additional responsibilities, please tick mark in the options given below.

a. Head of the Department       b. Placement Co-ordinator

c. Examination Co-ordinator       d. Laboratory Supervisor

e. Others, Please mention

# ANNEXURE IX

## Information on the Contents of the CD attached with the Thesis

For the study, a prototype of the Knowledge Management System for Academics was developed. Oracle 9i Server version was used as the database and Zend Server software was used as a Web Server for this prototype. Zend Server supports php script, which was used to connect the database with the Web Pages.

While transferring the prototype in a CD, problems were encountered while transferring the database. Hence, in the CD instead of Oracle 9i, XML was used to store the data.

Since, the prototype is server based, therefore, in order to run the prototype, certain guidelines has to be followed.

### Guidelines:

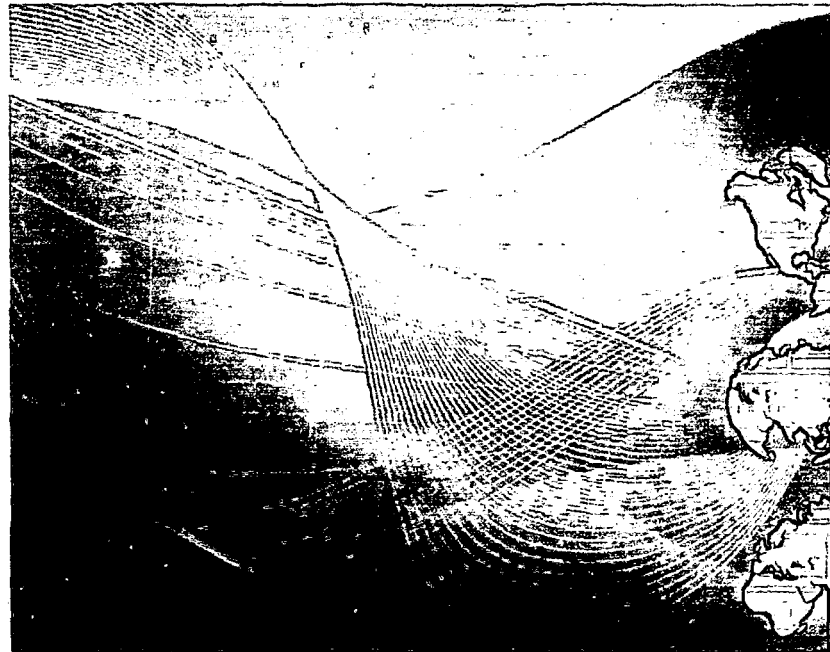
1. Install the Zend Server software in your PC (loaded with Windows based OS, preferably Windows XP) by clicking “**ZendCoreForOracle-2.5.0-Windows-x86 Setup.exe**” file and following the instructions given below.
  - a. First, a Welcome screen appears. Click next.
  - b. Next, the License Agreement screen appears. Select the “**I accept the terms of the license agreement**” option and click next.
  - c. Next, the Setup type screen appears. Select the “**Complete**” option (selected by default) and click next.
  - d. Now, the Choose Destination Location screen appears. Click next.
  - e. Now, the Web Server Selection screen appears. Select the “**Install Zend Core’s bundled apache 2.2.4**” option and click next.
  - f. Now, the Apache port number screen appears. Type “**1050**” in the textbox given against port and click next.
  - g. Now the Extension association screen appears. Select the first option i.e. “**.php**” (selected by default) and click next.

- h. Now the Administrator password screen appears. Type the same password in the both the boxes (password must start with alphabets and can include both alphabet and numbers) and click next.
        - i. Now the Zend Network Subscription screen appears. Select “No” (selected by default) and click next.
        - j. Now the Proxy Configuration screen appears. Select “No” (selected by default) and click next.
        - k. Now the Ready to Install the Program screen appears. Click the “Install” button. The installation starts. Click “OK” to all other options between installations until the Installation Complete wizard appears. Click Finish button. This completes your installation.
2. Copy the folder named “gyan\_jyoti” from the CD inside the “htdocs” folder of your PC, which is located in “C:\Program Files\Zend\Apache2\”.
3. Now open a browser (preferably Internet Explorer 6.0 or higher). Type in “[http://localhost:1050/gyan\\_jyoti/login.htm](http://localhost:1050/gyan_jyoti/login.htm)” in the address bar and browse. The login screen of the prototype named “Gyan Jyoti” will appear. You can create a new user login by clicking the “Sign In” link and submitting the login form or you can enter the login as “guest” and password as “guest” and click login to enter the homepage of “Gyan Jyoti”. To know about the use of the components in the homepage, “HELP” is provided in the homepage.

## ANNEXURE X

Paper presented at 3<sup>rd</sup> PIMR International Conference on  
Transcending Horizons through Innovation Global Practices, 2009

Transcending horizons *through*  
**INNOVATIVE  
GLOBAL PRACTICES**



Editors

Alok Bansal

Yogeshwari Phatak

I C Gupta

Rajendra Jain

## Designing A Knowledge Management Portal for Academics

Heera Barpujary\*  
Chandana Goswami\*\*

*To compete in the emerging knowledge-centric economy, organizations around the world have undertaken various initiatives to manage their most important yet volatile asset- knowledge and that is how the term Knowledge Management (KM) came into existence. In order to implement this concept in an organization, Knowledge Management Systems (KMS) are designed, so that there can be proper utilization of this asset for improved organizational performance. Since, the primary objectives of academics are research activities and dissemination of knowledge, therefore an efficient mechanism for managing knowledge is essential for enhancing the performance of academicians. In order to enable a KMS to be accessed by academics from any place, a Web-based KMS has to be designed. This paper aims at identifying user requirements for designing a KMS for academics. A survey method is adopted to find the knowledge requirements of academicians.*

*Keywords: Knowledge Management, Portal, and Academics.*

### INTRODUCTION

Knowledge is power was coined by Francis Bacon way back in the sixteenth century (Skyrme, 1999). According to Davenport and Prusak (1998), knowledge is defined as a "fluid mixture of experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information". It is perceived by Alavi and Leidner (1999) as a "justified personal belief that increases an individual's capacity to take action". In organisations, knowledge is embedded in documents, in organisational routines, in processes, practices, and norms. To compete in the emerging knowledge-centric economy, organizations around the world have undertaken various initiatives to manage their most important yet volatile asset - 'knowledge'.

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Knowledge Management is a systematic process of retaining, organizing, sharing and updating knowledge that is critical to individual performance and organizational competitiveness. In order to implement this concept in an organization, Knowledge Management Systems (KMS) are designed, so that there can be proper utilization of this asset for improved organizational performance. KMS is a complex aggregate of organisational infrastructure, information flow and supporting software for systematically dealing with the organisation's knowledge. Since, KMS offer a platform for sharing knowledge; they need to be designed using a technology which is user friendly and widely used. In this Internet age, Web technology is the tool that meets these requirements and can be used to design KMS. Like other organisations, academicians can also enhance their performance, if they get a platform to share their knowledge. In order to develop a successful system, it is very essential to know the requirements of the users. This paper aims at identifying user requirements for designing a KMS for academics.

### **KNOWLEDGE MANAGEMENT IN ACADEMICS**

Few studies attempted to design KMS for academics, and they are discussed in Table I in ANNEXURE III. The fact that limited research papers on application of KM in academics are available highlight that this is still an untouched area. Kidwell et. Al. (2000) identified the academic processes where KM will work. Wang et. al. (2003) talked of a knowledge repository. Breiter (2004) emphasised on the use of participatory approach in developing a user oriented system. Liao (2004) discussed the use of KM in academics but for administrative support. Abdullah et. al., (2005) proposed a framework keeping in mind stakeholder requirements. Zhang et. al. (2005) developed a KM framework for teaching a particular course. Edma (2005) developed a system for schools while Numprasertchai and Poovarawan (2006) tried to understand how ICT based KMS enhanced university competitiveness.

### **RATIONALE BEHIND THE STUDY**

From the studies made so far, it has been observed that, KMS for academics were designed by using case-based reasoning method, empirical method, interview method, applying software development life cycle and by applying Information and Communication Technologies. Other than a couple of studies, it was seen that a user requirement study was not given much importance in designing a KMS. So, this study aims at designing a KM portal by using survey method for user requirement study.

### **METHODOLOGY**

**Data Collection:** The study chiefly utilizes primary data to fulfil the stated objectives. This is done through a sample survey of academicians, where attempt is made to gather information regarding their job requirements. Details regarding data collection sampling procedure, sample size and study location have been provided in the following sections.

**Sample:** The population for the survey, from which the samples were drawn, were academicians from Computer Science or Management disciplines, and who worked in an academic institute in Eastern India. For the purpose of this research, elements are individuals who fulfil the following criteria:



- (a) The individual must be an academician.
- (b) The academicians must be from Computer Science or Management Discipline.
- (c) The academicians must be working in a Computer Science or Management Institute in Eastern India.
- (d) Eastern India comprises of Assam, Arunachal Pradesh, Jharkand, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Sikkim, Tripura and West Bengal.

The sampling unit for this study is defined as the individual academician. The survey has been conducted in Eastern India. The data was collected during the period July 2007 through September 2008.

Judgement sampling procedure is used for the study. The basis of judgment in selecting the academic institutes is that the institution is located in Eastern India and has Intranet and Internet connections. The basis of judgment in selecting the respondent was that the respondent should be an academician, teaching higher-level Management and Computer courses in Eastern India, and should have computer operating and browsing knowledge. Therefore, the questionnaire was sent to those academicians who had email accounts. The reason behind selecting these two disciplines is that both are very popular, industry oriented and the people in these two disciplines are Internet savvy. Also, there are a number of institutions (both public and private) offering these courses. [See Annexure 1]. The respondents were selected from Eastern India due to convenience in accessibility and with the intention of confining it geographically. Sample selection was restricted to academic institutions offering Management and Computer Science courses in Eastern India. The reason for restricting is as follows.

Elaborating on implementing of KMS in educational institutions, Thorn (2001) had stated that a wide open area of study makes it difficult to understand the implication of KM for an educational setting. From the above statement it can be concluded that a common KMS for all branches of education becomes difficult. Hence the study focused on only two disciplines. The data collection instrument employed in the study is a questionnaire sent through email. A total of 120 questionnaires were distributed among the academicians. Out of which, 56 usable questionnaires were obtained at the end of the survey period. Profiles of the respondents have been provided in Table II in Annexure III. The institutes and their locations from which data has been obtained are listed in Annexure 1.

**Tools for Data Collection:** The data collection instrument employed in the study is a questionnaire distributed through email. The questionnaire was designed based on Kidwell et.al., (2000) identified processes of academics. The questions formulated, tried to find out the requirements of academicians teaching in graduate and postgraduate programs in Management and Computer Science institutions in Eastern India. The detailed questionnaire design for the study is given in Annexure II. All the questions were in nominal scale except Q.No. 7, which was an open-ended question.

**RESULTS AND DISCUSSIONS**

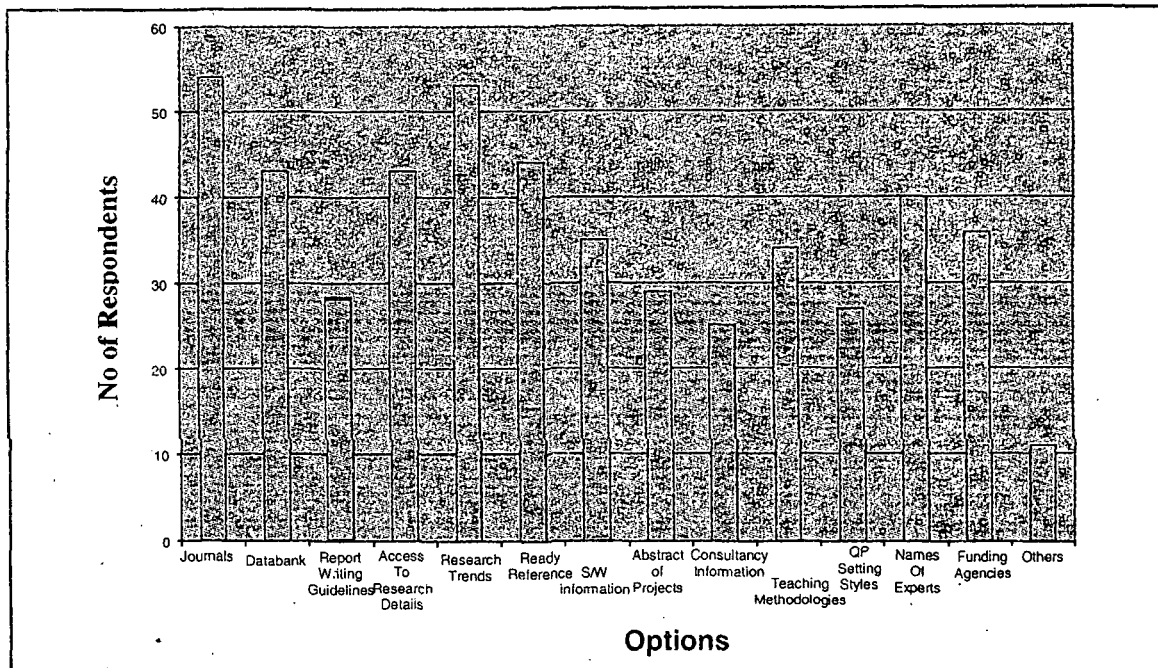


Figure 1: Teaching and Research Requirements (Refer to Annexure, Table 3)

As far as teaching and research requirements are concerned the survey result showed that access to Journals (96 percent) and Recent trends in a Research area (95 percent) were the two important requirements of the respondents Databank (77 percent), access to Research details (77 percent) and Ready reference of a topic (79 percent) were the other important requirements.

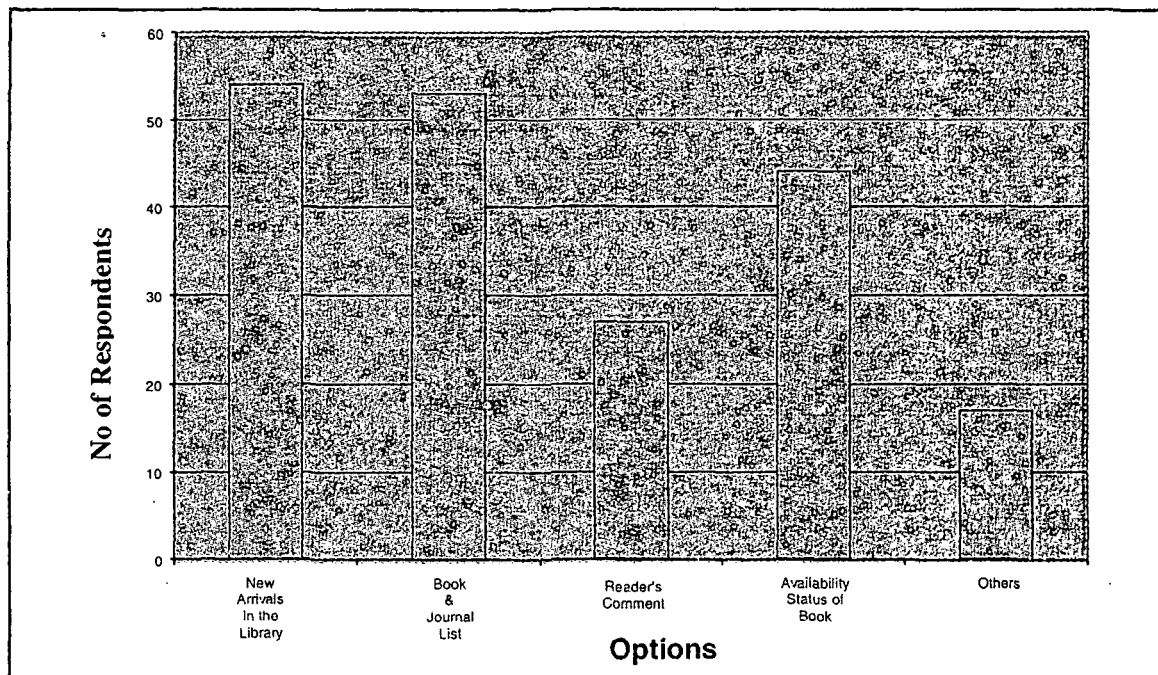


Figure-2 : Information from Library (Refer to Annexure, Table 4)

The respondents wanted to have information about new arrivals in the library (96 percent), list of books and journals (95 percent), followed by the availability status of a book (76 percent).

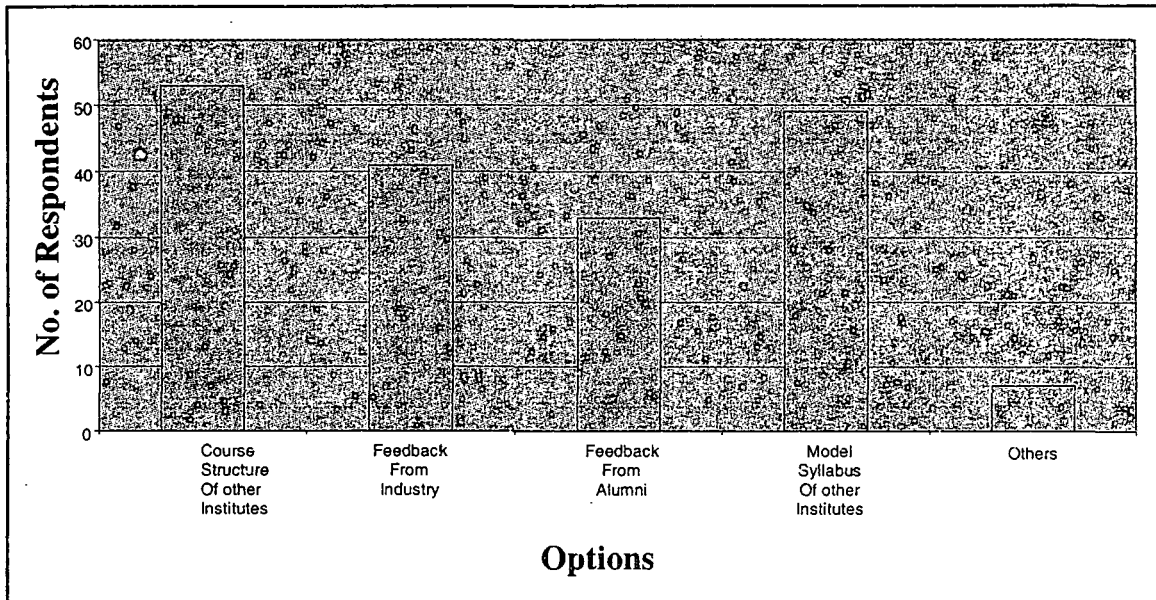


Figure 3: Curriculum Requirements (Refer to Annexure, Table 5)

The survey result showed that for revising and designing a curriculum, respondents sought for Course structure of other institutes (95 percent) and Model syllabus of other institutes (87.5 percent). Feedback from Industry (73 percent) was also perceived to be important in revising and designing a curriculum.

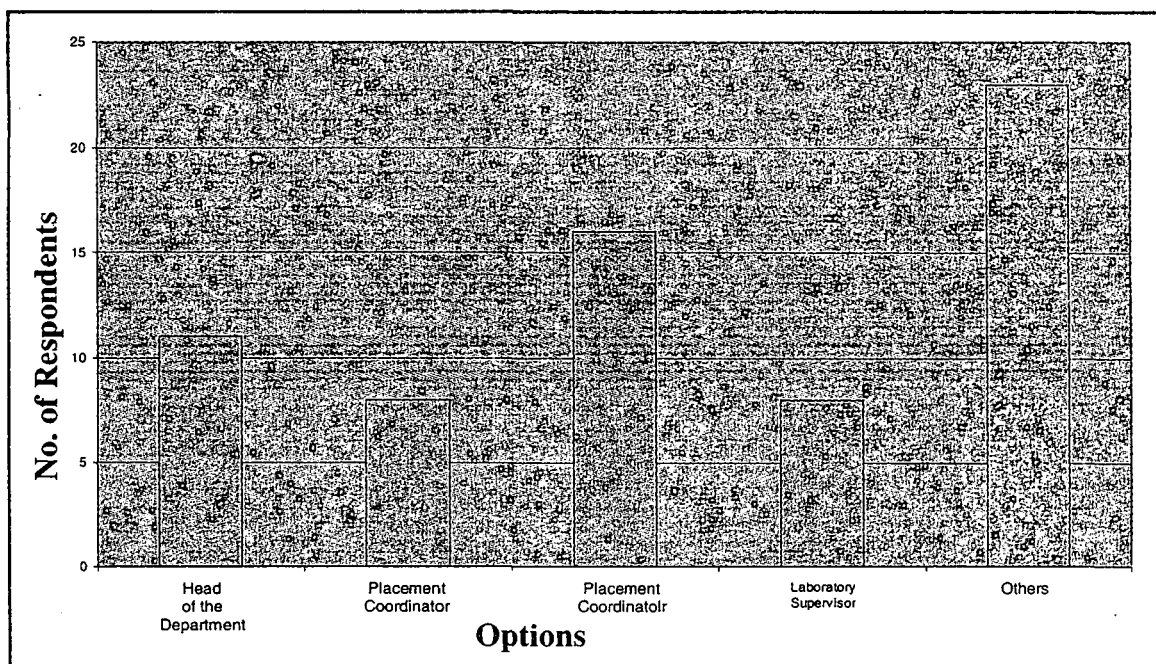


Figure 4: Type of Administrative Work (Refer to Annexure, Table 6)

The survey result showed that, 28.6 percent acted also as a Placement coordinator, 19.6 percent as Head of the Department, 14 percent perform the duties of a Examination coordination, 14 percent as Laboratory Supervisor and 41 percent of the respondents do other administrative work like Course Co-ordinator, Webmaster, Procurement In-charge, etc.

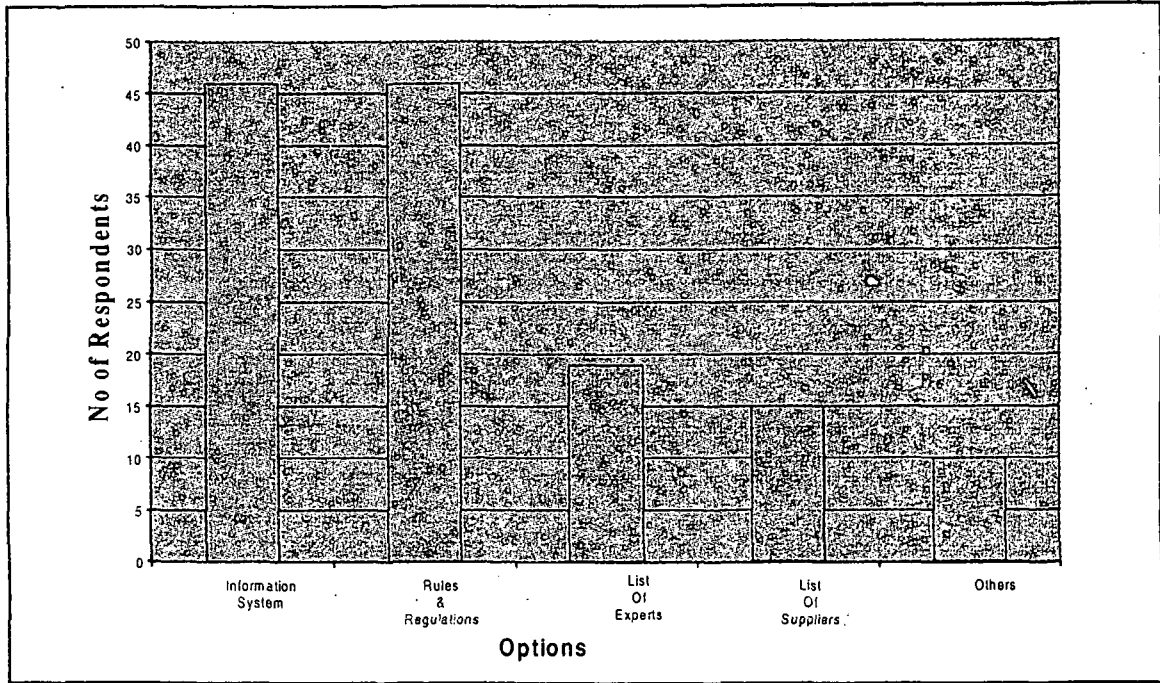


Figure 5: Aids for Administrative Work (Refer to Annexure, Table 7)

The survey results showed that existence of an Information System (82 percent) and easy access to Rules and Regulations (82 percent) would facilitate the respondents in performing their administrative work.

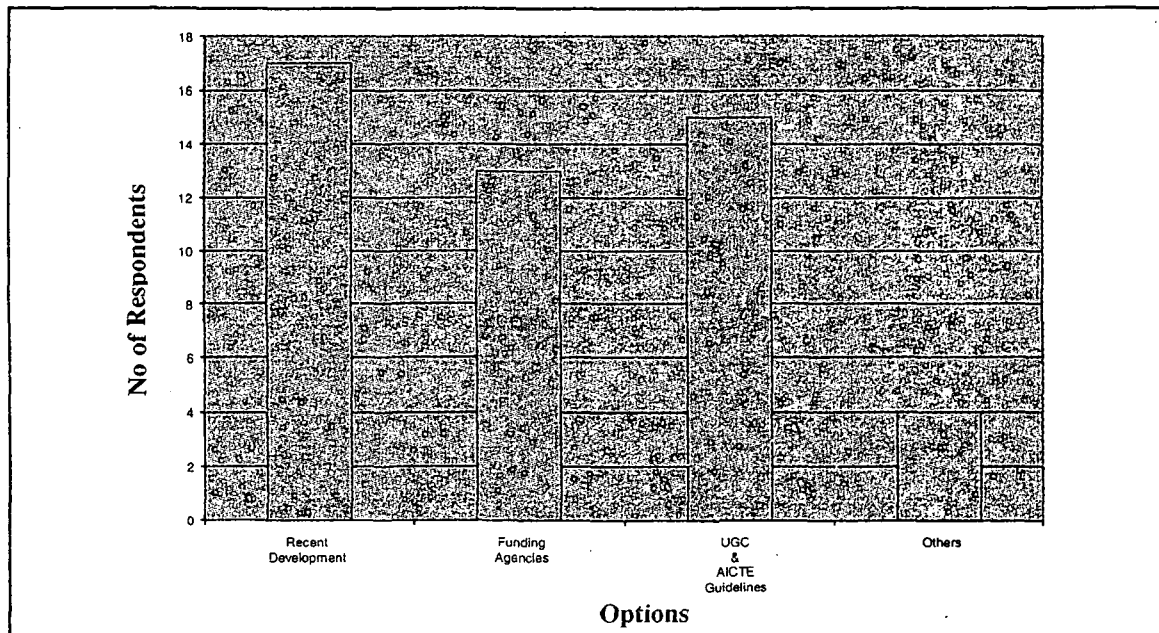


Figure 6: Aids for Strategic Planning (Refer to Annexure, Table 9)

35.7 percent of the respondents were involved in Strategic Planning. According to them, Recent Developments in the domain area (85 percent), UGC & AICTE guidelines (75 percent) and information about funding agencies (65 percent) were some of the important information required for Strategic Planning. In response to the open ended question regarding their frequently required information, the respondents stated the following. Availability of new journals, New funding for projects, International Agencies and their guidelines, Name of Guests and Visiting faculties, MHRD Rules/Guidelines, Project and consulting requirements, Changes in educational curriculum and recent trends in corporate sector, State-of-the-art hardware and software platforms available, Student Details, Alumni details, Faculty details, Technology changes and product information and Research & Development works abroad.

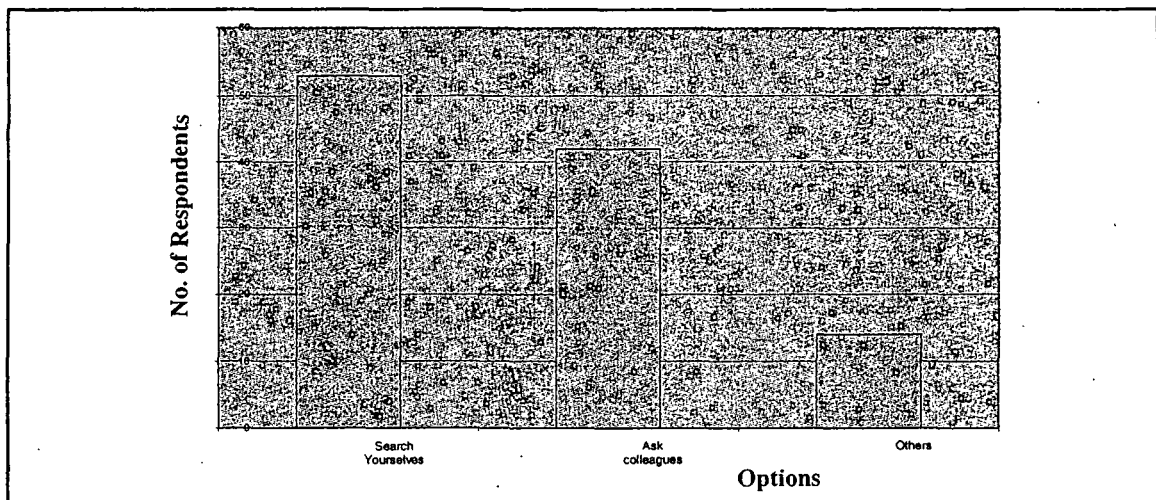


Figure 7: Sources of Information (Refer to Annexure, Table 11)

The survey results showed that 94.6 percent of the respondents search information on their own, 75 percent get information from their colleagues and 25 percent searched information from the Internet.

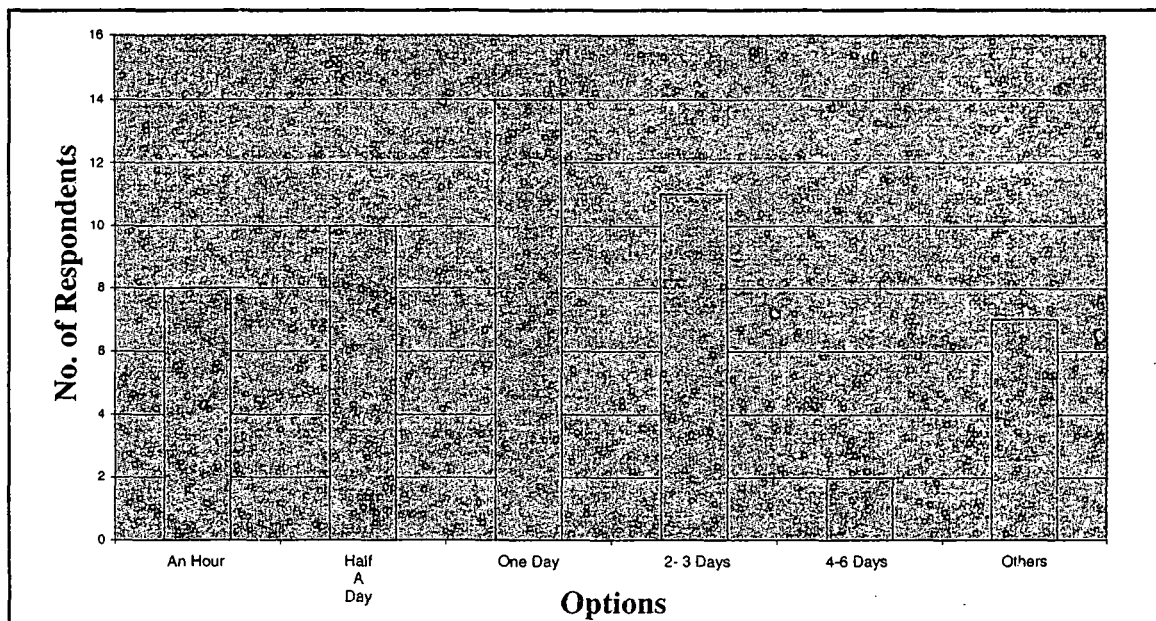


Figure 8: Time Spent for Searching (Refer to Annexure, Table 11)

14 percent of the respondents spent an hour a week, 17.8 percent spent half a day, 25 percent spent a day, 19.6 percent spent between 2 to 3 days, 3 percent spent between 4 to 6 days per week searching for information while 12.5 percent told that it depends on the information to be searched.

Almost 45 percent of the respondents spent on an average about 2 days per week in search of information.

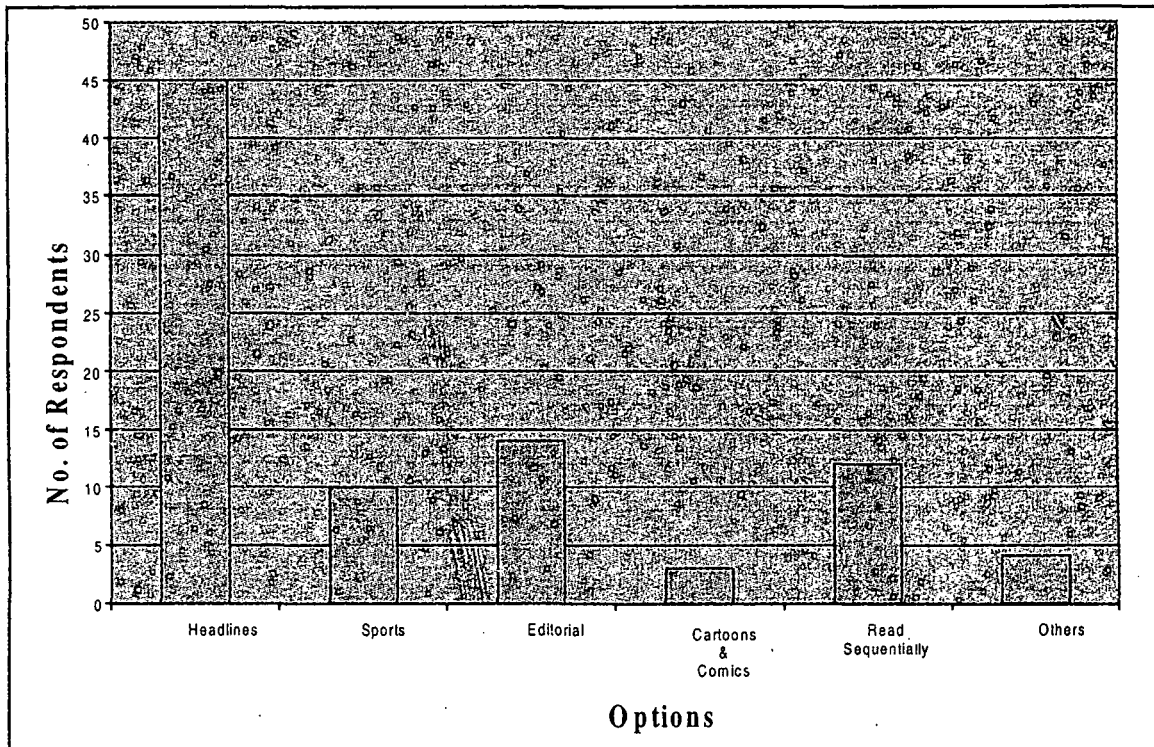


Figure 9: Reading Pattern of Newspapers (Refer to Annexure, Table 12)

On being asked about the reading pattern of newspapers, the respondents preferred to go through the Headlines (80 percent), followed by the Editorial (25 percent) and Sequential Reading (21.4 percent).

Therefore, from the above survey results we can derive the following inferences.

1. Respondents are research oriented and have high need for journal information and the recent trends in a particular research area.
2. Respondents require summarized information. The survey results showed that 79 percent of the respondents preferred to get a ready reference list of all publications in a particular topic.
3. Respondents mostly like to work alone. This can be inferred from the survey results, which showed that 95 percent of the respondents searched information on their own.
4. Most of the respondents are receptive. This can be inferred from the survey results, which showed that 61 percent of the respondents wanted to know about the different teaching methodologies. Also survey results showed that 71 percent of the respondents wanted to know the names of experts in a particular area. The fact that the editorial

section is the second preference in reading a newspaper indicates the need for current/ expert opinion.

5. Respondents want easy access to information. This can be inferred from the survey results, which showed that 77 percent of the respondents want to get access to databank. However they will prioritize what they would like to follow up. This has been inferred from the reading pattern where majority said they preferred to go through headlines of the newspaper instead of sequential reading.
6. Respondents like to keep themselves up-to-date. This can be inferred from the survey results, which showed that 95 percent of the respondents wanted to know about the recent trends in a particular area.
7. Respondents play multiple roles in their work place. This can be inferred from the survey results, which showed that apart from being a teacher and a researcher, they also played roles of the Head of the Department, Placement Co-ordinators, Examination Co-ordinators, Laboratory Supervisor, Course Co-ordinator, Webmaster, Procurement In-charge, etc.
8. Respondents are techno-savvy. This can be inferred from the survey results, which showed that 82 percent of the respondents felt the need for an information system to aid them in their administrative work.

## **DESIGN OF THE KNOWLEDGE MANAGEMENT PORTAL**

Abdullah et.al. (2005) identified Knowledge Portal, Electronic Document Management System (EDMS), Information Retrieval Engine and Data Warehouses and Data Mining Tools, as the most commonly used areas of functionality of the KMS Model. Out of these areas, Knowledge Portal is the user's first point of entry to a KMS. Therefore, a good design of a Knowledge Portal attributes to the success of a KMS. For the purpose of identifying the components of Knowledge Portal, the portals of BSNL, Wipro and ICICI were studied. From the study, the components of a Knowledge portal were identified as Authorization, Document Manager, Discussion Board, Chat, News, Bulletin Board, Mail, Search and Miscellaneous.

From the survey, the important features of a KM portal for academics have been identified and presented in a tabular form (See Table 13, ANNEXURE III). From the primary responses, it has been seen that an academician is involved with different activities as mentioned in the first column of Table 13. To facilitate these activities, keeping in mind the respondent requirements, list of items to be included in the main web page and the subsequent inner pages have been provided in the second and third column of Table 13. The links to the important items identified from the respondent requirements are placed in the main page because it serves as the index to the information content of the Knowledge portal. Moreover the main page must not look cluttered to have an aesthetic appeal. The details are given in the inner pages. It has been found that the parameters presented in Table 13, mostly fall under Document Manager, Search and Miscellaneous components of a KM portal. Therefore, these are important components needed to be kept in mind while designing a KM portal for academics.

## CONCLUSION

Use of technology for enhancing the capabilities of an organisation has been gaining momentum. An academician, who plays multiple roles, has an urgent need of a platform that will aid in carrying out all roles efficiently. The implication of this study is that it has identified the different roles and their requirements. The results of Table 13 in ANNEXURE III will be relevant for the actual design of a system, which by itself is a major task. It is expected that a KMS that will keep the above parameters in mind will find a higher degree of acceptability. Further, the development of a KMS will facilitate knowledge storing and dissemination and ultimately contribute to enhancement of capabilities of academician, resulting in organizational effectiveness.

However, the study has some limitations. First, as the study was restricted to Eastern India, the needs of other region were not taken into consideration. Secondly, the study focussed only on two disciplines i.e. Management and Computer Science, so the requirements identified for the KMS cannot be generalised. Lastly, as the survey was conducted with a time constraint, the requirements from a limited number of academicians were gathered.

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**Annexure**

**Table-1 :A Review of Kms for Academics**

<b>Author</b>	<b>Focus of the work</b>
Kidwell et.al., 2000	Identified five KM processes of Higher Education: <ul style="list-style-type: none"> <li>• Research</li> <li>• Curriculum Development</li> <li>• Student and Alumni Services</li> <li>• Administrative Services</li> <li>• Strategic Planning</li> </ul>
Wang, Means & Wedman, 2003	<ul style="list-style-type: none"> <li>• Knowledge repository to support knowledge creation and diffusion in the education domain.</li> <li>• Reports on an on-going project named KITE (Knowledge Innovation for technology in education) and discusses their experiences in implementation this project using Case-Based-Reasoning.</li> </ul>
Breiter, 2004	<ul style="list-style-type: none"> <li>• KM requirements for school done using participatory design process.</li> <li>• Empirical findings during the process of requirement analysis are documented, focussing on key organizational aspects in schools.</li> <li>• Based on empirical evidence, it is suggested that participatory design can be used not only as a method of user-oriented system development but also as a catalyst for reflecting the new role of technology for teaching and learning within an organizational change process.</li> </ul>

<b>Author</b>	<b>Focus of the work</b>
Liao, 2004	<ul style="list-style-type: none"> <li>• Explored the application of KM techniques in educational institutions – particularly in support of administrative systems.</li> <li>• Discussed the model of a Professional Development Centre.</li> </ul>
Abdullah et. al., 2005	<ul style="list-style-type: none"> <li>• Analysed KM concepts, system and architecture</li> <li>• Proposed a framework of KM system implementation in a collaborative environment (for Higher Learning Institutions) by interviewing members involved in the KMS development.</li> <li>• Discussed issues involved in KM that will help organizations to increase productivity and quality as well as to achieve return on investment (ROI).</li> </ul>
Zhang, Kaschek & Kinshuk, 2005	<ul style="list-style-type: none"> <li>• Developed an educational KM framework for teaching database and then implemented and evaluated a web-based KM system using software development life cycle.</li> <li>• Found that application of KM in teaching database normalization encouraged both teaching and learning outcomes.</li> </ul>

<b>Author</b>	<b>Focus of the work</b>
Edman, 2005	<ul style="list-style-type: none"> <li>• Discussed the need for knowledge management from the perspectives of students, teachers and parents.                             <ul style="list-style-type: none"> <li>○ Developed Knowledge-based systems for schools using interview method.</li> <li>○ These systems can be classified as support for</li> <li>○ Student's learning</li> <li>○ Students and teachers well being</li> <li>○ Teacher's decision making.</li> </ul> </li> </ul>
Numprasertchai & Poovarawan, 2006	<ul style="list-style-type: none"> <li>• Discussed an ICT (Information and Communication Technologies) based KMS implemented in Kasetsart University of Thailand.</li> <li>• Investigated how ICT based KMS enhances university competitiveness.</li> </ul>

**Table-2 : Profile of the Respondents**

Discipline State	Computer Science	Management	Total
Assam	3	3	6
West Bengal	10	4	14
Sikkim	3	0	3
Orissa	8	18	26
Jharkhand	3	4	7
<b>Total</b>	<b>27</b>	<b>29</b>	<b>56</b>

**Table-3: Teaching and Research Requirements**

Options	No. of Responses
Journals	54
Databank	43
Report writing guidelines	28
Access to research details	43
Recent trends in a research area	53
Ready Reference for a topic	44
Software information	35
Abstract of Projects	29
Consultancy information	25
Teaching methodologies	34
Question Paper setting styles	27
Names of Experts in a particular subject	40
Funding agencies & their guidelines	36
Others	Conferences and Seminars, Prospective collaborative organizations/ institutes and their ways of collaboration, Methods/Ways of answering questions from question papers

**Table-4: Information From Library**

Options	No. of Responses
New arrivals in the library	54
List of Books and Journals available	53
Reader's comments about books	27
Availability status of a book	44
Others	Online Journals

**Table-5 : Curriculum Requirements**

Options	No. of Responses
Course structures of other institutes	53
Feedback from Recruiters / Industry	41
Feedback from Alumni	33
Model syllabus of other institutes	49
Others	Record of feedback when it was last offered, Utility of the course in day to day life in view of learning and earning, Recent Trends, Feedback From Senior faculty

**Table-6 : Type of Administrative Work**

Options	No. of Responses
Head of the Department	11
Placement Co-ordinator	8
Examination Co-ordinator	16
Laboratory Supervisor	8
Others	Web Master, Warden of Hostel, Knowledge center coordinator, Member of outside academic committee, Advisor of B.Tech Students, Summer training guide and student activity group member, Course co-ordinator

**Table-7 : Aids for Administrative Work**

Options	No. of Responses
Information system to aid your work	46
Rules & Regulations of the Institute	46
List of Experts	19
List of Suppliers	15
Others	Man Management, Co-operation from colleagues

**Table-8 : Respondents Involved In Strategic Planning**

Options	No. of Responses
Yes	20
No	36

**Table-9 : Aids for Strategic Planning**

Options	No. of Responses
Recent developments in that programme	13
Funding Agencies	13
UGC & AICTE guidelines	15
Others	Outside world news, DST, DBT

**Table-10 : Sources of Information**

Options	No. of Responses
Search on my own	53
Ask colleagues / friends	42
Others	Searching Internet

**Table-5 : Curriculum Requirements**

Options	No. of Responses
Course structures of other institutes	53
Feedback from Recruiters / Industry	41
Feedback from Alumni	33
Model syllabus of other institutes	49
Others	Record of feedback when it was last offered, Utility of the course in day to day life in view of learning and earning, Recent Trends, Feedback From Senior faculty

**Table-6 : Type of Administrative Work**

Options	No. of Responses
Head of the Department	11
Placement Co-ordinator	8
Examination Co-ordinator	16
Laboratory Supervisor	8
Others	Web Master, Warden of Hostel, Knowledge center coordinator, Member of outside academic committee, Advisor of B.Tech Students, Summer training guide and student activity group member, Course co-ordinator

**Table-7 : Aids for Administrative Work**

Options	No. of Responses
Information system to aid your work	46
Rules & Regulations of the Institute	46
List of Experts	19
List of Suppliers	15
Others	Man Management, Co-operation from colleagues

**Table-8 : Respondents Involved In Strategic Planning**

Options	No. of Responses
Yes	20
No	36

**Table-9 : Aids for Strategic Planning**

Options	No. of Responses
Recent developments in that programme	13
Funding Agencies	13
UGC & AICTE guidelines	15
Others	Outside world news, DST, DBT

**Table-10 : Sources of Information**

Options	No. of Responses
Search on my own	53
Ask colleagues / friends	42
Others	Searching Internet

Table-11 : Time Spent For Searching

Options	No. of Responses
An hour	8
Half a day	10
One full day	14
2-3 days	11
4-6 days	2
Others	Depends on information

Table-12 : Reading Pattern of Newspapers

Headlines	45
Sports section	10
Editorial	14
Cartoons/Comics	3
Read Sequentially	12
Others	Business News

Table-13 : Components of the Km Portal

Activities Identified for Academics	Items to be added in the Main Page of the Website	Items to be added in the Inner Pages of the Website
Teaching & Research	<ul style="list-style-type: none"> <li>• Link to Online Journals</li> <li>• Link to Databanks</li> <li>• Link to Reference list of a particular topic</li> <li>• Link to Current trends of a particular topic</li> <li>• Link to Teaching Techniques</li> <li>• Link to software</li> </ul>	<ul style="list-style-type: none"> <li>• Research Details</li> <li>• Teaching Methodologies of a subject</li> <li>• Question Paper Setting Styles</li> <li>• Consultancy information</li> <li>• List of Experts of a subject</li> <li>• List of Funding Agencies</li> <li>• List of software available for a subject</li> </ul>
Library	<ul style="list-style-type: none"> <li>• Link to Library</li> <li>• List of new arrivals in the Library</li> </ul>	<ul style="list-style-type: none"> <li>• List of Books and Journals available in the Library</li> <li>• Book searching facility</li> </ul>
Activities Identified for Academics	Items to be added in the Main Page of the Website	Items to be added in the Inner Pages of the Website
Curriculum Development	<ul style="list-style-type: none"> <li>• Link to list of other academic institutes</li> </ul>	<ul style="list-style-type: none"> <li>• List of other academic institutes</li> <li>• Model syllabus provided by regulatory bodies</li> <li>• Syllabus of other institutes</li> </ul>
Administrative Work	<ul style="list-style-type: none"> <li>• Link to list of Information System needed for administrative work</li> <li>• Link to Rules &amp; Regulations of the Institute</li> <li>• Link to list of Suppliers</li> </ul>	<ul style="list-style-type: none"> <li>• Rules &amp; Regulations of the Institute</li> <li>• List of available Information System</li> <li>• List of Suppliers</li> <li>• Recruiters</li> <li>• Alumni database</li> </ul>
Strategic Planning	<ul style="list-style-type: none"> <li>• Link to UGC guidelines</li> <li>• Link to AICTE guidelines</li> </ul>	<ul style="list-style-type: none"> <li>• UGC guidelines</li> <li>• AICTE guidelines</li> </ul>

Contd...

News	<ul style="list-style-type: none"><li>• News Headlines</li></ul>	<ul style="list-style-type: none"><li>• News Details</li></ul>
Miscellaneous	<ul style="list-style-type: none"><li>• Discussion Forum</li><li>• Message Board</li><li>• Link to Important Meetings</li><li>• Link to official mail website</li><li>• General Search Facility</li></ul>	<ul style="list-style-type: none"><li>• Details of Important Meetings</li><li>• Details of Important Documents</li></ul>