REQUIREMENTS AND PROPOSED ARCHITECTURE FOR A KNOWLEDGE SHARING SYSTEM

by

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Abstract

Organizations have come to realize the importance of knowledge and the need to manage this strategic resource. Knowledge brings value to the organization when it is used to create capabilities. The challenge is to provide access to those knowledge resources. The thesis suggests a Knowledge Sharing System that can help access both the tacit and the explicit knowledge resources in an organization, by providing the user with the relevant meta-knowledge.

The thesis provides a summary of the current state of knowledge management: definitions, needs and challenges faced by organizations in managing their knowledge resources. The thesis includes the results of the case study analysis of more than 50 case studies on the knowledge management initiatives that have been undertaken by organizations.

The thesis then focuses on a specific aspect of knowledge management - knowledge sharing. It presents a conceptual model for knowledge sharing in organizations and defines three dimensions for knowledge sharing – Culture, Accessibility and Codification of knowledge. These dimensions are further broken down into sub-dimensions and have been analyzed in detail.

Finally, the thesis suggests the requirements and proposed architecture for a Knowledge Sharing System (KSS) that maintains meta-knowledge i.e. knowledge about knowledge resources. The KSS is based on the conceptual model for knowledge sharing. The thesis describes the requirements for the KSS and an architecture that can help meet those requirements.
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1. Introduction to the Thesis

1.1 Introduction

The new millennium is seeing the emergence of a Knowledge Society where an important differentiator between success and failure, for individuals, societies and corporations, is the knowledge they acquire and use. While E-Commerce is one visible usage of the Internet phenomenon, other internal innovation that is happening in many organizations is that of knowledge management. The ability that the Internet provides to seamlessly integrate the business processes of organizations with activities spread all over the globe is encouraging organizations to look at knowledge capture, archival, dissemination and usage as the logical method of improving customer response through institutionalized and technology-enabled processes. Through the deployment of data and knowledge capture, storage and mining tools on knowledge networks, the objective seems to be to capture every form of explicit and tacit information and knowledge and build ongoing corporate learning. Even industries as traditional as manufacturing are obtaining competitive advantage through technological know-how, product design skills, problem-solving expertise, personal creativity and the ability to innovate. Knowledge management is the discipline capturing these knowledge-based competencies and disseminating them for the benefit of the organization as a whole. A knowledge management initiative is best taken up if an organization finds value in building an institutional memory or a comprehensive knowledge base for the firm to enable better application, sharing and managing of knowledge across the various entities within and
outside the organization. The present wave of knowledge management derives from three related factors [23]:

- **Need** The knowledge environment is evolving more rapidly than ever before—so much data, information and knowledge, so many reports, email messages, Web pages, and databases, all of them more accessible than ever.

- **Recognition of the need** Upper management has come to recognize that knowledge is a primary asset, hence the formal, organized push to further capitalize on knowledge. In the current environment of value addition measurement at all levels, and drive towards shareholder value creation, the conscious capture, storage and archiving of knowledge can lead to the creation of invaluable intellectual property that has both tactical and long term strategic value for the organization.

- **We can do something about the need** Innovations in computing, networking, and circulation of knowledge within the workplace all are part of what makes knowledge management now a “doable” effort.

### 1.1.1 Organizations as Knowledge Systems

Recognition of multidimensionality of organizational knowledge is the foundation of the firm [Zack, 1998]. According to this view firms exist because it is difficult to generate, transfer and apply all the required types of knowledge via markets. Firms then are created as systems for generating, transferring and applying the knowledge required for development and delivery of products and/or services. The resource-based view of the firm postulates that a firm's profitability is not only a function of its markets and competitive position but also a function of its internal capabilities and know-how in combining its resources to deliver
products and services and to enhance organizational performance. Thus, organizations operate based on the capabilities and knowledge that they generate through an ongoing process of absorbing information from internal and external sources, converting it to knowledge, and acting upon that knowledge [1].

Organizations as Knowledge Systems may be analyzed in terms of three sets of knowledge activities focused on generation, codification and utilization of knowledge (Davenport and Prusak, 1997).

**Knowledge Generation:** Although knowledge generation is an ongoing process, in general, it is the least systematic of organizational knowledge management activities (Davenport and Prusak, 1997). The interplay between the individual and social knowledge is an important aspect of organizational knowledge creation, amplification and transfer [1]. Organizational knowledge is generated through R&D efforts in an organization, or through external sources, through competitive intelligence or on large scale through acquisitions. The acquisition of Lotus by IBM for $3.5 billion was to obtain the collaborative groupware expertise and knowledge possessed by the Lotus Institute.

Knowledge generation can be seen to broadly comprise [Natarajan, 2000,Pp 27-40):

- **Knowledge Acquisition:** Knowledge Acquisition is simply the process of acquiring knowledge that is available somewhere. For an organization this might entail capturing knowledge from existing knowledge. Or it might mean identifying external sources of either process/technology expertise or market intelligence so that this knowledge can be purchased.
• **Knowledge synthesis:** Knowledge synthesis is the process of putting either different kinds of information or people together to be able to come up with new patterns and ideas. This enables a new approach or understanding to evolve from already available pockets of information or expertise, merely on account of the fact that they are being made to interact differently or are being viewed in a different way.

• **Knowledge creation:** Some people subscribe to the interpretation that 'real' knowledge management solutions are those that help an organization create new knowledge. They argue that it can only be the artificial intelligence based expert system solutions and the like, which enable intelligent pattern detection and creation of new ideas that can be called knowledge solutions.

**Knowledge Codification:** Remembering what the organization has learnt and reusing its relevant knowledge is an important aspect of effective knowledge management. Like individuals, organizations may loose track of their knowledge and forget. Thus, organizations are trying to codify their knowledge in order to preserve and reuse it.

**Knowledge Utilization:** Knowledge generation and codification do not necessarily lead to improved performance and business value. Knowledge creates value when it is applied by organizations to create capabilities and to take effective action. Since knowledge is generated and codified throughout the organization, a key challenge in the application of organizational knowledge is transferring it from the source where it is generated or resides to where it is needed and used [1]. Knowledge transfer in organizations can be challenging due to a number of factors, including the type of knowledge, the reward system, and an inability to
locate and access the required knowledge. The knowledge management challenges are discussed further in Chapter 2 of the thesis.

1.1.2 Knowledge Management Systems (KMS)

Maryam Alavi defines knowledge management systems as IT-based systems developed to support and enhance the primary organizational knowledge management processes of knowledge generation, knowledge codification and knowledge transfer [1]. Knowledge Management Systems may be classified into the (i) the repository model and (ii) the network model [1]. The repository model aims at the codification of knowledge. The network model aims at using information and communication technologies to support the flow of knowledge in organizational settings and among networks of people.

The Repository Model of KMS: The repository model views knowledge as an object that can be collected, stored, organized, and disseminated. These systems focus on managing explicit knowledge with primary focus on the creation and storage/retrieval aspects of organizational knowledge management. Information management technologies like relational databases and document management systems play a dominant role in the development of these types of KMS. Corporate Intranets perhaps present the most prevalent technical infrastructure for development and management of knowledge repositories [1].

The Network Model of KMS: In the network model of KMS, knowledge remains with the individual who has developed and possesses it and is transferred mainly through person-to-person contacts. This is in contrast to the repository model that involves person-to-repository and repository-to-person modes of knowledge transfer. This model supports organizational knowledge management processes that involve social interactions and direct
communication and contact among individuals. This model as suggested by Maryam Alavi [1] is based on the premise that knowledge generation and knowledge application are fundamentally social processes that occur most efficiently through direct interactions among members of communities of practice. The knowledge repositories based on this model contain pointers to the knowledge source (i.e., people), not the knowledge itself. Corporate yellow pages and knowledge maps are very useful in locating tacit knowledge and expertise embedded in the minds of knowledge workers. The major challenges for such an initiative include: determining the level of know-how of organizational members, keeping the knowledge links current, determining whom to include in the corporate yellow pages, and motivating the individuals with the required knowledge to spend the time and effort to share their knowledge with those who need that knowledge. Teltech (www.teltech.com) provides a very good example where the company is in the business of providing the customer with links to knowledgeable people through its web site. Teltech.com provides access to skilled research analysts and a directory of industry experts. Teltech.com also contains a directory of high-value websites and access to a wide variety of science, technical, and business documents. It provides a variety of features, including articles and live discussions with its experts. The user selects the specific area of knowledge for which the expertise is sought and Teltech, through its network of experts help match experts to the customers. Teltech rates these experts according to some relevant criterion.

1.2 Objectives of Research

Knowledge creates value when it is applied by organizations to create capabilities and to take effective action. To make this happen, people in the organization should have easy access to
the knowledge. The focus of this research is on Knowledge Sharing aspect of Knowledge Management, intended to support better use of the organizational knowledge resources.

The main objective of the research is: Propose a Knowledge Sharing System (KSS), which manages information about knowledge resources. The KSS does this by managing the meta-knowledge (knowledge about knowledge resources). Often, the important and useful information is too complex to put in explicit form; too much tacit knowledge is required to make a process work. Thus, a possible solution might be to have a directory and "pointer" system that can supplement the search for knowledge resources. Unlike the network model proposed by Maryam Alavi (section 1.1.2) where the system has links to the contributors or holders of some knowledge resource (i.e., people), my proposed system is a directory to all the tangible and intangible resources which might range from the knowledge possessed by individuals, communities, to the information stored on floppy disks or in journals or books. It needs to be emphasized that organizations possess very substantial amount of knowledge, and hence the scope and nature of the information to be captured has to be determined before the system is designed.

For example: The user searching the KSS for the Management Information Systems (MIS) division at University of British Columbia (UBC), for "Business Modelling Methods" would find:

- Links to the archive for courses offered in the past or being offered on the topic by the MIS division and information about where to look or whom to contact to access those resources.
- Graduate theses on the topic. The KSS will mention the location for the resource (main library) and information about the originator (graduate student), hence enabling the user to contact the originator if need be.

- Research papers written by the faculty on 'Business Modelling Methods', faculty profile and how to access the knowledge resource (research papers).

- Presentations done on the same topic during the weekly MIS workshops, information about the speaker and maybe some comments from the audience.

- Books available on the topic in the library.

Also, the type of knowledge resource (tacit/explicit) which may further translate to medium of storage, the location, contact information about the person sought, a short description and other relevant information to improve accessibility to the knowledge resource. Advanced 'search' capabilities enable the user to perform searches based on meta-knowledge parameters (e.g. only the papers and thesis (type: explicit) done on the topic of 'Business Modelling Methods' in the last four years and involving a certain faculty member).

This KSS can be compared to 'yellow pages' for the organizational knowledge resources. It is based on providing only meta-knowledge. It is left to the user to decide if it's worth accessing the knowledge resource.

The detailed requirements and proposed architecture for KSS has been described in chapter 4 of the thesis. Before I could propose an architecture and outline the requirements for a KSS, I decided to equip myself with the knowledge about the present state of knowledge management—what do organizations and people mean when they use this term, how is it being conducted and what are the requirements and barriers to it. Once I had a reasonable
understanding of the present developments in the field (KM), I decided to focus on a specific aspect of it- Knowledge Sharing.

1.3 Outline of the Thesis

In short the objectives were to:

Suggest the requirements and propose an architecture for a Knowledge Sharing System which manages meta-knowledge about both the tacit and the explicit knowledge resources. This objective will be achieved after the following objectives are accomplished:

- Study of the present state of knowledge management
- To focus on knowledge sharing aspect of knowledge management. This eventually lead to proposing a conceptual model for knowledge sharing that forms the basis for determining the requirements for the KSS and proposing an architecture that could meet those requirements.

The thesis is organized as follows:

Chapter 2 of the thesis deals with the topic of Knowledge Management - defining knowledge management, the need to manage knowledge, the challenges faced by organizations in managing their intellectual resources, and the result of the case study analysis of more than 50 case studies on the knowledge management initiatives undertaken by the organizations. I have also included a section on the knowledge management tools currently being used by the organizations to enable better codification and dissemination of their knowledge resources.
Chapter 3 of the thesis is the result of my research on 'knowledge sharing'. This research helped me come up with the three dimensions of knowledge sharing - culture, codification and accessibility to the knowledge resources. Each dimension is further analyzed by defining the specific factors that need to be considered to perform well on each of the three success factors.

Chapter 4 of the thesis uses the conceptual model for successful knowledge sharing initiatives to outline the requirements for the Knowledge Sharing System and the architectural components that can help meet those requirements. The architecture introduces the use of ontologies to enable better knowledge sharing.
2. Knowledge Management

2.1 Findings on Knowledge Management

2.1.1 Introduction

People in organizations have always sought, used and valued knowledge, at least implicitly. Companies hire for experience more often than for intelligence or education because they understand the value of knowledge that has been developed and proven over time. Managers making difficult decisions are much more likely to go to people they respect and avail themselves of their knowledge than they are to look for information in databases. Explicitly recognizing knowledge as a corporate asset is new. The need to make the most of organizational knowledge and to get as much value as possible from it is greater now than in the past [Davenport, 1998, Pp 12-19].

- **The Changing Global Economy:** Due to the increasing global competition companies now require quality, value, service, innovation and speed to market for business success and these factors will be even more critical in the future. Increasingly companies will differentiate themselves on the basis of what they know. A business firm that thrives would be the one that knows how to do new things well and quickly.

- **Product and Service Convergence:** Increasingly, knowledge and related intangibles not only make businesses function, but are part or all of "products" firms offer. Old distinctions between objects, services, and ideas are breaking down. Not surprisingly,
distinctions between manufacturing and servicing firms are disappearing too. These changes and pressures make knowledge vital to organizations. The intangibles that add value to the products and services are knowledge based: technical know-how, product design, marketing presentation, understanding the customer, personal creativity, and innovation.

- **Sustainable Competitive Advantage:** Technology disappears as a sustainable competitive advantage because the same technology is available to everyone and hence it cannot provide a long-term edge to anyone. Knowledge by contrast can provide a sustainable advantage. Eventually competitors can always match the quality and price of a market leader's current product or service. By the time that happens, though, the knowledge-rich, knowledge-managing company will have moved on to a new level of quality, creativity or efficiency. The potential for new ideas generating from the stock of knowledge in any firm is limitless - particularly if the people are given a chance to think, to learn and to talk with one another.

- **Corporate size and Knowledge Management:** At a time when firms need to "know what they know" and must use that knowledge effectively, the size and geographic dispersion of many of them make it difficult to locate existing knowledge and to get it to where it is needed. The mere existence of knowledge somewhere in an organization is of little benefit, it becomes a valuable corporate asset only if it is accessible, and its value increases with the level of accessibility. Hence organizations are increasingly employing technology to solve the problem of global knowledge transfer.
Computer Networks and Knowledge Exchange: The low cost of computers and networks has created a potential infrastructure for knowledge exchange and opened up important knowledge management opportunities. Through e-mail, groupware, the Internet, and Intranets, computers and networks can point to people with knowledge and connect people who need to share knowledge over a distance.

2.1.2 Defining Data, Information and Knowledge

Understanding what data, information and knowledge are and how to get from one to another is essential to doing knowledge work successfully.

• Data

Data is a set of discreet, objective facts about events [15]. In an organizational context, data is most usefully defined as structured records of transactions. Quantitatively, companies evaluate data management in terms of cost, speed and capacity: How much does it cost to capture or retrieve a piece of data? How quickly can we get it into the system or call it up? How much will the system hold? Qualitative measurements are timeliness, relevance and clarity: Do we have access to it when we need it? Is it what we need? Can we make sense out of it?

• Information

The word information is derived from Latin informare which means "give form to". The etymology thus connotes an imposition of structure upon some indeterminate mass. Allen and Selander (1985) have analyzed how the word is used in the Swedish language and found
that this is probably the most widely used meaning of the word. In the Oxford Dictionary, definition of the word it is connected both to knowledge and communication.

*Knowledge communicated concerning some particular fact, subject or event; that of which one is apprised or told; intelligence, news.*

The word "inform" originally meant, "to give shape to" and information is meant to shape the person who gets it, to make some difference in the receiver’s outlook and insight. It follows that the receiver not the sender decides whether the message s/he gets is really information - that is, if it truly informs her/him.

Quantitative measures of information management tend to include the various quantitative models available to evaluate information. Qualitative measures include informativeness and usefulness: Did the message give the receiver some new insight? Did it help him to make sense of a situation and contribute to a decision or the solution to a problem?

Unlike data, information has a meaning - it is data endowed with relevance and purpose [Peter Drucker]. Not only does it potentially shape the receiver, it has a shape: it is organized to some purpose. Data becomes information when its creator adds some meaning. The value can be added in various ways [15]:

- **Contextualized**: we know for what purpose the data was gathered.
- **Categorized**: we know the units of analysis or key components of the data.
- **Calculated**: the data may have been analyzed mathematically or statistically.
- **Corrected**: errors have been removed from the data.
- **Condensed**: the data may have been summarized in a more concise form.
• **Knowledge**

According to Webster's Dictionary, knowledge is the fact or condition of knowing something with familiarity gained through experience or association. Knowledge may also be described as a set of models that describe various properties and behaviors within a domain. Knowledge may be recorded in an individual brain or stored in organizational processes, products, facilities, systems and documents.

The importance of sound definition of knowledge relates to the importance of knowledge management in organizations. In recent years practitioners and researchers have come to recognize the importance of organizational knowledge as an asset to the organization (Davenport and Prusak (1998), Sveiby (1997), Alavi (2000)) [20]. As a part of managing organizational knowledge the use of knowledge management systems in organizations is growing rapidly and creating a strong need for a method of identifying the knowledge requirements (and sources) of the organization for modeling purposes [1].

**Defining knowledge:**

- Davenport and Prusak [Davenport, 1998, Pp 5] define knowledge as:

  "Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms."

- Alavi [1] defines knowledge:
"Knowledge is a justified belief that increases an entity's potential for effective action"

- Sveiby defines knowledge as "a capacity to act" but stated that it is only a practical notion for managers rather than a broad definition.

- ODell and Grayson (1998) give a working definition of knowledge as "information in action" and say further that knowledge in the context of their book is "what people in an organization know about their customers, products, processes, mistakes, and successes, whether that knowledge is tacit or explicit."[cited in 20].

- Nevo and Wand provide a definition for organizational knowledge [20]:
"Knowledge is a justified belief - either held by or maybe invoked by an entity (out of organization practices) - that can be communicated to others (such as in the form of predicates), or acted upon by its holder to create useful outcomes for the organization.

Knowledge derives from information as information derives from data. If information is to become knowledge, humans must do virtually all the work. This transformation happens through:

- **Comparison**: how does information about this situation compare to other known situations?

- **Consequences**: what implications does the information have for decisions and actions?

- **Connections**: how does this bit of knowledge relate to others?

- **Conversation**: what do other people think about this information?
Knowledge can also move down the value chain, returning to information and data. The most common reason for that being too much volume.

2.1.3 Defining Knowledge Management

This section mentions some of the definitions of Knowledge Management. I have included multiple definitions as I realize that none of the definitions is complete but does highlight the different facets of Knowledge Management. Also this will help the reader to realize the importance of having a consensus on what KM encompasses.

- Knowledge Management involves the identification and analysis of available and required knowledge assets, related processes, and the subsequent planning and control of actions to develop both the assets and processes as to fulfill organizational objectives. Knowledge assets are the knowledge regarding markets, products, technologies and organizations, that a business owns or needs to own and which enables its business processes to generate profits, add value etc. [1].

- Karl Sveiby [24] defines KM by looking at what the people in this field are doing. According to him there are two tracks of activities - and two levels:

  **IT-Track KM = Management of Information.** Researchers and people in this field tend to have their education in computer and/or information science. They are involved in construction of information management systems, AI, reengineering, groupware etc. To them Knowledge = Objects that can be identified and handled in information systems.

  **People-Track KM = Management of People.** Researchers and practitioners in this field tend to have their education in philosophy, psychology, sociology or business/management. They are primarily involved in assessing, changing and improving
human individual skills and/or behavior. To them Knowledge = Processes, a complex set of dynamic skills, know-how etc that is continuously changing. They are traditionally involved in learning and in managing these competencies individually - like psychologists- or on an organizational level - like philosophers, sociologists or organizational theorists.

- Knowledge management often encompasses identifying and mapping intellectual assets within an organization, generating new knowledge for competitive advantage within the organization, making vast amounts of corporate information accessible, sharing of best practices, and technology that enables all the above - including groupware and intranets [16]

- Knowledge Management is the collection of processes that govern the creation, dissemination, and utilization of knowledge. In one form or another, knowledge management has been around for a very long time. Practitioners have included philosophers, priests, teachers, politicians, scribes etc [Brian(Bo) Newman]

- As defined by Thomas Bertels [14], knowledge management is the management of the organization towards the continuous renewal of the organizational knowledge base - this means e.g. creation of supportive organizational structures, facilitation of organizational members, putting IT-instruments with emphasis on teamwork and diffusion of knowledge (as e.g. groupware) into place.

- According to Denham Grey [14], Knowledge Management is the audit of "intellectual assets" that highlights unique sources, critical functions and potential bottlenecks, which hinder knowledge flow to the point of use. It protects intellectual assets from decay, seeks
opportunities to enhance decisions, services and products through adding intelligence, increasing value and providing flexibility.

- According to R. Gregory Wenig [14], knowledge management (for the organization) consists of activities focused on the organization gaining knowledge from its own experience and from the experience of others, and on the judicious application of that knowledge to fulfil the mission of the organization. These activities are executed by marrying technology, organizational structures, and cognitive based strategies to raise the yield of existing knowledge and produce new knowledge. Critical in this endeavor is the enhancement of the cognitive system (organization, human, computer, or join human-computer system) in acquiring, storing and utilizing knowledge for learning, problem solving and decision-making.

- KM is the systematic process of finding, selecting, organizing, distilling and presenting information in a way that improves an employee's comprehension in a specific area of interest [25]. Knowledge Management helps an organization to gain insight and understanding from its own experience. Specific KM activities help focus the organization on acquiring, storing and utilizing knowledge for such things as problem solving, dynamic learning, strategic planning and decision making. It also protects intellectual assets from decay, adds to firm intelligence and provides increased flexibility [25].

- Knowledge Management is the art of performing knowledge actions such as organizing, storing, gathering, sharing, disseminating, and using knowledge objects such as data, information, experiences, evaluations, insights, wisdom, and initiatives- all of which,
though not identical, are, from the point of view of knowledge management, simply items to be managed [23].

2.2 Findings on Knowledge Management Initiatives in Organizations

The following is based on the analysis of case studies and views of people involved in Knowledge Management initiatives and research.

2.2.1 Why do organizations need to invest in KM initiatives?

Ann Macintosh [16] of AIAI identifies some of the specific business factors as reasons to manage knowledge:

- Marketplaces are increasingly competitive and rate of innovation is rising.
- Reductions in staffing create a need to replace informal knowledge with formal methods.
- Competitive pressures reduce the size of work force that holds valuable business knowledge.
- The amount of time available to experience and acquire knowledge has diminished.
- Early retirements and increasing mobility of workforce lead to loss of knowledge.
- There is a need to manage increasing complexity as small operating companies are transnational sourcing operations.
- Changes in strategic direction may result in loss of knowledge in a specific area.

To paraphrase these points:

- Most of our work is knowledge based.
- Organizations compete on the basis of knowledge.
• Products and services are increasingly complex, endowing them with a significant information component.

• The need for life-long learning is an inescapable reality.

Knowledge and information have become the medium in which business problems occur. As a result, managing knowledge represents the primary opportunity for achieving substantial savings, significant improvements in human performance, and competitive advantage.

2.2.2 Why is Knowledge Management difficult?

There have been many roadblocks to adoption of formal knowledge management activities. In general, managing knowledge has been perceived as an unmanageable kind of problem - which was intractable with traditional management methods and technology.

We tend to treat the activities of knowledge work as necessary, but ill-defined, costs of human resources, and we treat the explicit manifestations of knowledge work as forms of publishing - as byproducts of "real" work. [6]. As a result, the metrics associated with the knowledge resources and pure ability to manage those resources in meaningful ways have not become part of business infrastructure.

There are many problems associated with identifying the knowledge assets and being able to use them in an efficient and cost-effective manner [16]. Enterprises need:

• To have an enterprise-wide vocabulary to ensure that the knowledge is correctly understood.

• To be able to identify, model and explicitly represent their knowledge.

• To share and reuse their knowledge among different applications for various types of users; this implies being able to share existing knowledge sources and also future ones.
To create a culture that encourages knowledge sharing.

Knowledge engineering methods and tools have come a long way towards addressing the use of a company's knowledge assets. They provide disciplined approaches to designing and building knowledge-based applications. There are tools to support the capture, modeling, validation, verification and maintenance of the knowledge in these applications. However, these tools do not extend to supporting the processes for managing knowledge at all levels within the organization.

In short, we have to understand that the nature of business itself has changed, in at least two important ways:

1. Knowledge work is fundamentally different in character from physical labor.
2. The knowledge worker is also fundamentally different in character from the physical laborer. The new reality dramatically alters the methods by which we must manage, learn, represent knowledge, interact, solve problems, and act.

2.2.3 Analysis of Case Studies on Knowledge Management Initiatives in Organizations

In order to understand how knowledge is really being managed in companies today, I went through several case studies, some of which are mentioned in Table 2.1. There are a few companies like Anderson Consulting, Ernst & Young, Hewlett Packard, Microsoft, Buckman Laboratories etc that are mentioned in several places due to their commitment and success in deriving benefit and competitive edge through efficient management of knowledge. The analysis of the case studies lead to the following conclusions:
Most organizations rely on the experts themselves to furnish their original knowledge profiles and to maintain them over time. Some companies have set up incentive systems to encourage employees to contribute to the Knowledge base. Some organizations have it as criteria for formal evaluation of employees. But it seems important to have separate Knowledge Management staff to keep the knowledge database up to date.

Several simultaneous Knowledge Management initiatives seem to occur in large organizations. The departments engaged in such initiatives are unaware of the existing systems in place in the other departments in the same organization. Hewlett Packard (HP) is a good example where many divisions and departments are undertaking specific efforts to better manage knowledge. Managers are attempting to capture and distribute the knowledge resident in their own business units and departments. The Computer Systems Marketing organization at HP, for example has put a large amount of marketing knowledge into a World Wide Web-based system that can be accessed around the world. It contains product information, competitive intelligence, white papers and ready-to-deliver marketing presentations. HP Laboratories is developing approaches to facilitate access to both internal and external knowledge. The Corporate Information Systems Department is putting document-based knowledge of procedures, personnel and available information into Web and Lotus Notes systems. The Systems organization is also attempting to map the various sources of knowledge about information systems development and management around HP. Maybe with time the organizations would opt for consolidation of the various KM systems and have a separate KM department to handle it. This will happen as the market for dedicated KM tools matures and the need to integrate the existing KM systems is felt by the organizations like Hewlett Packard.
• The companies with successful KM stories have people dedicated to the Knowledge Management effort. Also there is a commitment from senior management in terms of project support and resources. For example: Ernst & Young spends 6% of its consulting practice revenues on knowledge management and technology. Buckman labs, a manufacturer of specialty chemicals spent $7,500 per employee per year to implement KNetix, its knowledge sharing system.

• The effective KM teams usually consist of employees from different areas in an organization rather than the IT department only. Some organizations like the Buckman labs renamed their IT and MIS department as Knowledge Support Department etc to make the effort more explicit.

• Reward systems encourage employees to use and contribute to the knowledge base of the organization. Also the rewards should be attractive enough to entice the employees to contribute their knowledge.

• The KM system should be easy to use and users who need training should be provided with adequate help. For example: KNetix (Buckman Labs) supports some European and Asian languages to encourage employees worldwide to use the KM system.

• It is very important to build trust among the knowledge sharing community using the organization’s KM system. The employees must be able to trust that they have received the best information and those who send information to the knowledge base should be able to trust that it will be used in an appropriate manner. Having a Code of Ethics can help build trust in the system.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Project Description</th>
<th>Technology Used</th>
</tr>
</thead>
</table>
| 1 Hewlett-Packard | • Employee Training  
  • Connex System to search for knowledge sources  
  • Knowledge Links system for advancing product development and introduction  
  • HP Network News used to answer dealers' queries using Lotus Notes | • Lotus Notes  
  • Connex uses web browser to interface a relational db  
  • Knowledge Links is a web-based collection of product development knowledge |
| 2 Microsoft | • SPUD project for training employees and to match jobs and employee capabilities | • Web front end, SQL server, through Intranet |
| 3 IBM | • To provide an efficient means for IBM software testers to exchange ideas and collaborate on projects | • Lotus TeamRooms and Lotus SameTime, Lotus Notes |
| 4 Acer | • To provide an efficient and effective means to train employees located throughout a global enterprise | • Knowledge Transfer: Online Training system developed with Lotus LearningSpace |
| 5 Sun Microsystems | • Train sales professionals about the new products using SunTAN system. It contains sales training information, sales support resources, product updates and materials, competitive intelligence and an array of other content on the Sun intranet  
  • Enhance its relationships with customers by putting catalogs and technical information online | • Java programming language which helps the programs to run on any machine  
  • SunWEB Intranet to link its 20,300 employees worldwide  
  • Plans to use Oracle database to track and profile individual use of the system. |
| 6 Sequent Computer Systems | • KMS called Sequent Corporate Electronic Library (SCEL) that captures, archives and helps its 2500 employees to retrieve the relevant information  
  • Sharing knowledge and collective skills of its employees to be used to minimize project risks  
  • Monitor the creation and usage of knowledge | • SCEL integrates DBMSs, other file systems, full text retrieval engines, OLTP and DSS applications.  
  • Deployment of Internet Protocol Suite, STMP based messaging network and World Wide Web technologies.  
  • A number of components of the solution use Microsoft technologies. |
| 7 Texas Instruments | • Capitalize on its knowledge through transfer of best practices | • Lotus Notes used for collaboration  
  • Access to best practices is enabled through an intranet site that uses InterNotes Publisher. |
<table>
<thead>
<tr>
<th></th>
<th><strong>Consulting Companies</strong></th>
<th></th>
</tr>
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</table>
| 8  | **Ernst & Young**                                                                      | • Use knowledge to speed up the process of providing consulting solutions for clients  
• Center for Business Knowledge includes a library, a call center for answering consultant requests, and a database of consultant skills  
• Integration and retrieval of multiple sources of information  
• Lotus Notes  
• Plans to eventually narrow down to Lotus Notes, the Web, the skill database and a few others  
• Verity products to help employees navigate through geographically dispersed knowledge resources. |
| 9  | **Arthur Anderson**                                                                     | • Repository of world class business practices  
• Provide clients with ever growing body of knowledge  
• In-house software development  
• Real time intranet access to all of Arthur Anderson's knowledge bases and to external information sources. |
| 10 | **Hewitt Associates**                                                                  | • To enable structured sharing of knowledge and information between associates worldwide. It helped improve quicker and more complete client responses and improved customer satisfaction  
• Lotus Notes and Lotus Domino  
• Consulting Alert (Lotus Notes tool). |

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<tr>
<th></th>
<th><strong>Service Firms</strong></th>
<th></th>
</tr>
</thead>
</table>
| 11 | **Shaw Pittman (Law Firm)**                                                            | • To share law firm's intellectual capital with all employees and clients  
• To make new hires productive more quickly  
• Lotus Notes extranets and databases. |
| 12 | **Scotiabank**                                                                         | • To enable customer relationship managers to easily collaborate and share knowledge enterprise wide  
• Prospector, a KM IT system developed with Lotus Notes and Lotus Domino. |
| 13 | **Teltech (Portal for locating expert)**                                               | • Maintains a network of experts  
• Integrated source map to provide integrated view of sources of information  
• Provides access to over 1600 online databases, other vendor databases and Teltech's expert database. |
| 14 | **VHA Inc (Healthcare Provider)**                                                       | • To reduce clinical variation, the gap between what medical institutions know is good clinical practice for a patient's condition and what care a patient actually receives  
• Clinical Knowledge Management (CKM) system, a knowledge repository of authorized clinical information and instructions, developed with lotus Notes and Lotus Domino. |
| 15 | **European Insurance Firm**                                                            | • Improve the quality of customer response at its call center  
• Reduce training time for the personnel in charge of customer service  
• Provide knowledge on tap on various policies, procedures etc  
• Front-end interface through a web browser  
• Authoring Tools  
• Instructor Toolbox II and Assistant from Asymetrix to enable users to create and store learning content. |
### Manufacturing Companies

<table>
<thead>
<tr>
<th>No.</th>
<th>Company</th>
<th>Features</th>
<th>System Requirements</th>
</tr>
</thead>
</table>
| 16  | Buckman Labs (Speciality Chemicals Manufacturer) | • To enable front line sales people to solve customer problems  
• Provide a forum for knowledge sharing  
• Providing online course material on a variety of relevant courses for employees | • Intranet system with Unix as the primary host system, Windows NT server applications |
| 17  | Hyundai            | • To achieve faster decision making by knowledge sharing  
• Training employees worldwide | • Internet access to the IBM RS/6000 server  
• Lotus Domino server that interfaces with the web browser  
• Lotus Notes |
| 18  | Shell International | • Build a centralized knowledge repository  
• Monitor the web and sent relevant information to the users’ desktops | • Knowledge Agent from AppliedNet that allows the creation of a centralized knowledge repository and acts as a broker for corporate memory |

### 2.3 Findings on Knowledge Management Technologies and Tools

Where KM is concerned, technology is certainly not the single point of focus. It involves multiple other disciplines including Cognitive Science and Learning, Communication and Human Resources, Behavioral Science and Motivation, Business Strategy and Business Process Analysis, to name a few. According to a recent Delphi research report, knowledge management is not viewed so much as a technology as it is as a cornerstone of an organization’s best business practice and culture. The fact still remains though that if there is one thing that can transform knowledge management from a conceptual entity to a business reality, it is technology.
Now-a-days the market talks about every technology, from a database to expert systems, to be a 'KM' technology. Quite simply because it is fashionable to associate oneself with KM today. To name a few technologies that get associated with KM:

- Internet, Intranet
- Data Warehousing
- Data Mining
- AI, Expert Systems
- Simulation
- Doc Management
- Collaboration
- Groupware
- Web Mapping tools

And this is by no means an exhaustive list. An organization needs to understand what some of these technologies have to offer in terms of functionality and understand the way it could form the underpinnings of an overall KM solution. It is important to be able to distinguish between an enabling technology and the functionality or application that it can deliver. The following section talks about the underlying technologies.

2.3.1 Knowledge Management Technologies

I propose to classify the KM technologies into those which are database storage dependent and those which rely on non databased sources like word processing documents, unstructured texts in different formats, presentations, multimedia files, mail folders, content from the web in the form of HTML or XML documents etc.
The first category may include technologies like legacy systems or other OLTP systems including ERP, CRM or other functional applications or the EIS/DSS category of support technologies. These could include several technologies like RDBMS, object-oriented databases, proprietary databases and the like. Storage technologies might comprise of data marts and data warehouses. Knowledge retrieval and utilization can be done through Data Discovery technologies, GIS (Geographical Information Systems) and Data Visualization and OLAP (Online Analytical Processing) engines.

Some of the more important technologies in context of KM are discussed below:

- **Data Warehousing:** Inmon has defined data warehousing as a "subject oriented, integrated, time variant, non-volatile collection of data in support of management’s decision making process". Data warehousing enables one to extract information from legacy systems and other online transaction processing and business applications. A data mart generally works at the departmental/division level. Data marts are developed with specific business functions in mind like sales forecasting or new product development. It has a pre-designed set of business objectives before consolidating or aggregating the data. A data warehouse on the other hand is the enterprise wide view of all the data stores.

- **Data Mining:** While data warehousing helps to aggregate and cleanse all the data within the organization from multiple sources, it is the data mining technology that actually helps to find patterns and correlations within all this data, leading to knowledge discovery.
Artificial Intelligence and Expert Systems: The expert system technologies help to translate the expertise or knowledge in people's heads into a set of rules that can be stored within the expert system application, which can then be used by non-experts too. Knowledge generation that can be aided by expert systems is but one component of an overall KM solution. KM entails other important processes as well. There are certain AI algorithms and technologies that can add tremendous value to some functions like search, information retrieval and filtering. AI and Expert systems need not be implemented as full-blown applications. There are certain aspects of these technologies, if judiciously used in conjunction with other technologies, can help strengthen the overall KM solution. For example, AI has provided a very scientific mechanism for knowledge representation through the use of logic, rules, semantic networks and frames. These methods provide valid mechanisms of representation in the context of knowledge management too.

The second category comprises mainly of technologies that enable document management, search and collaboration.

Web Publishing and Hypertext: To enable sharing information and content over the web, it becomes extremely important to be able to author and publish these documents in standard formats that are user friendly. It should be possible to put the content together in such a manner that authorized users on the web can browse it. Moreover it should serve as a link to the related documents on the same or other sites. HTML has been used very widely for document creation on the web. It can be seen as an application of SGML (Standard Generalized Markup Language) and it evolved as a means of creating web documents. Perhaps the most important development in this area has been the evolution
of XML (Extended Markup Language). XML is basically a simplified version of SGML and far than just an alternate option for HTML. While taking care of most of the shortcomings of HTML, the XML technologies have provided a robust set of standards for web documents.

- **Search Engines and Text Mining:** Text mining does to documents what data mining does to structured data. Text mining discovers patterns within documents, classifies the documents based on these patterns and summarizes information from the same. The contents are mined using techniques like statistical analysis or other non-statistical methods like clustering or neural networks and so on. Text analysis unlike data analysis would need to include techniques like linguistic, lexical, grammatical and semantic analysis. IBM’s Text Miner has several features like feature extraction, clustering, categorization and summarization.

Most text mining tools incorporate a search engine. A search engine generally has a user interface for the query request and also for displaying the query output, facility for specifying the search templates along with the specifications, if any, on where to look and finally indexing and query execution mechanisms.

- **Document Management:** These are important category of tools in the context of KM. They use multiple technologies to provide a wide range of functionality with respect to creation, maintenance and retrieval of documents. Most of these tools provide a combination of functions that provide maintenance of document repositories at the core, but generally provide a varied combination of other affiliated functionalities like
document creation, indexing, search and retrieval. There are some document management tools that even provide workflow and collaboration like Documentum and Open Text.

- **Workflow:** In a number of cases applications based on workflow have been the logical precursors to knowledge management solutions. This is because, on one hand they deal with documents or textual content that is integral to KM solutions and, on the other, they deal with the transfer of information between people. That is why tools like Lotus Notes used earlier for conventional workflow applications are today being used along with their collaboration features for KM solutions.

However it is not always necessary to use commodity software like Lotus Notes to build such solutions. There are organizations like TMP [Natarajan, 2000, Pp 71-73], for instance who are using solutions that have been built bottom-up using Java script and HTML on the front-end, and ASP and COM objects on an IIS and MTS server respectively. This ensures greater scalability and platform independence to some extent. TMP worldwide is the largest yellow-paging agency and recruitment consultants in the world with gross billings of approximately $475 million in 1998 and over 30% of the US national yellow-pages market.

In the KM context, workflow is being transformed into something much larger than mere routing of documents for routine business applications. Use of intelligent agents for contextual document routing clubbed with yellow-paging mechanisms is what enhances mundane applications to incorporate the knowledge element.
• **Collaboration:** If there is one group of technologies that is absolutely integral to KM, it is collaboration. Knowledge management is about bringing people together to tap their expertise and judgement. Collaboration in either physical or the virtual sense is mandatory. In closely-knit business units, the best form of collaboration obviously is the people coming together physically. But collaboration over a good network infrastructure remains the only viable solution to take care of the dispersed geographies and time. Collaboration can use different technologies like:

  - Messaging
  - Discussion groups
  - Chats
  - Audio conferencing
  - Video conferencing

Depending on the nature of the requirement, the network infrastructure, bandwidth and cost considerations, a suitable mode of collaboration can be determined.

• **Content Management:** Content Management includes design, authoring, review, approval, storage, testing, and deployment of the content on the company’s intranet site. Once in service, content needs to be maintained, monitored, upgraded, and eventually retired and archived. Effective content management requires clearly defined roles and documented workflow for all forms of content. There are off-the-shelf tools available in the market today that help implement content management. Examples of such tools include Vignette Content Manager Server, VIP Content Manager from Gauss etc.
2.3.2 Knowledge Management Tools

For technology decisions to be translated into solutions, the call for either customized development or the use of pre-packaged tools or in some cases a combination of the two. There are hundreds of tools that claim to knowledge enable an organization. There are no standard benchmarks available to be able to rate them. Where standards for knowledge management are concerned, things are still at very nascent stage. While bodies like Institute of Knowledge Management at IBM (IKM) and Knowledge Management Consortium (KMC) are working towards some guidelines, a robust set of comprehensive standards that can be followed both for evaluation and development of KM solutions is yet to evolve. Right now the organizations are attempting to adhere to the standards available in some of the underlying technologies like metadata standards for Document Management, use of open standards technology like XML, Java, component technology etc.

2.3.2.1 Choosing the Right Tools

One has to precede the decision on tools by the technology decision. This gives a broad framework within which the choice of tools is made. Most of the leading tools, however are based on open standards and work on most of the important platforms [Natarajan, 2000, Pp 143-145]. There are other macro level considerations like interoperability that have to be looked at before going into a detailed evaluation of features and capabilities. Where an evaluation of tools is concerned, there are several complexities involved. In the absence of standard taxonomies and with not much commonality in the functionality of any two KM tools, any kind of linear evaluation becomes virtually impossible.
A methodology has been suggested by Natarajan and Shekhar [Natarajan, 2000, Pp 143-145] where a comprehensive repository of the tools is built. The repositories are populated with information from the respective web sites for the tools and product literature along with the evaluation CDs or downloadables. The evaluation of products by the research team adds to the repository. It is dynamically updated by anyone who could have attended a product presentation or seminar. The products are grouped under some broad categories, like document management, workflow, collaboration, search, portals etc. on the basis of what is perceived to be its key strength. By this logic Lotus Notes would be classified under collaboration tools, because that is seen to be its primary strength in the KM context, although it does have other features like search and workflow. An evaluation grid is created that explodes each category into specific features. A broad functionality like 'Search' is broken down into support for natural querying, full text search, Boolean search, interest profile searching, metadata search, drill down search and so on. Retrieval too can be looked at more closely by exploding it into features like document summarization, multiple categorization, clustering, relevance ranking, links to other related documents and personalization. Likewise collaboration is broken down into specific features like messaging, chat, white boarding, application sharing, notification and discussion groups. A tool's rating is based on whether or not it possesses a feature. Each category is given a certain weight to yield an overall product score. If only a specific capability is to be evaluated, it can be viewed accordingly. In addition to the ranking by the Tool Retrieval Engine, the choice of tool depends on the existing investments and infrastructure, the technology skill-base and the how well it fits.
2.3.2.2 Examples of some KM tools

- Managing Knowledge Repositories

**Lotus Notes:** Lotus Notes and Intranet-based Webs are the two leading toolsets for managing knowledge repositories today. Although the functionality of these two tools are merging, there are still differences between them. Notes excels at database management, and replication of databases for remote disconnected use in the field. The Web is ideal for publishing information across multiple types of computer platforms, for multimedia databases, and for displaying knowledge that is linked to other knowledge through hypertext links. The Lotus Domino Web server allows knowledge to be created in Notes and then be distributed over the Web. Notes based knowledge management implementations are often accompanied by other tools particularly where the knowledge of external knowledge is concerned.

**Examples of Implementation:**

- McKinsey uses Lotus Notes based solution for knowledge transfer between employees in multiple locations.

- Anderson Consulting too uses Lotus Notes databases as their information repositories but they have developed customized front-ends for information retrieval.

- Integrating multiple sources of information and information retrieval

**Knowledge Retrieval product suite from Verity:** Organizations whose main purpose has been to try and seamlessly integrate multiple sources of information and retrieve them in a
user-friendly manner have gone in for tools like the Knowledge Retrieval product suite from
Verity, Excalibur Retrievalware from Excalibur Technologies, UNISearch from Comsquared
and IBM's Text Miner.

The Verity product suite comprises Verity Developer Kit, Verity Core Search Engine,
Information Server with Verity Internet/Intranet Spider, Profiling Toolkit, Agent Server and
Toolkit as well as a CD Web Publisher.

Examples of Implementation:

- Bay Networks has attempted to link its disparate information systems and provide
  knowledge at point of use to its employees in various branches and remote locations by
  using Verity products.

- Ernst and Young needed a tool to manage its vast knowledge capital. The main
  parameters they were looking for were connectivity to their existing Notes based
  knowledge bases, scalability and advanced search capabilities. They use Verity since it
  meets their requirements and helps their employees to navigate through geographically
  dispersed knowledge sources.

- Search

GrapeVINE: GrapeVINE is used for its search capabilities in the specific context of user
interest profiles. An administrator first tells grapeVINE where to look for useful information
and knowledge. grapeVINE then monitors those places (web sites, file servers, Lotus Notes
databases) and checks all the new information. Using an organization specific taxonomy or
category tree, grapeVINE classifies new documents against those categories. Each user
creates an "interest profile", which is simply a list of topics the user needs to have in order to do the job well.

Examples of Implementation:
- GrapeVINE being one of the earliest KM tools, the users are several leading organizations like Dow Chemicals, Amoco, Bank of America, Chrysler, Swiss Reinsurance and Unilever, who have used it for intelligent retrieval, setting up alert mechanisms and locating experts.

Other product in this category is **Netscape Compass Server** which provides a set of tools that help administrators gather and organize enterprise resource scattered across intranets so that users can easily find and retrieve information whenever they need it. Besides offering flexible search and browse services, Netscape Compass Server allows users to subscribe to personally profiled topics of interest and receive a daily summary of relevant information from the intranet and the Internet. Document format support includes HTML, PDF, Microsoft Office (Word, Excel, Powerpoint), WordPerfect and many others. It also supports document indexing across thousands of servers as well as support for SSL secured sites and client-to-server security.

- Creating and Managing Centralized Knowledge Repositories

**Knowledge Agent (KA) from AppliedNet:** KA allows the creation of a centralized corporate knowledge base and acts as a broker for corporate memory. It accepts feeds from various internal and external sources like document repositories, e-mail, discussion groups, web-sites and news feeds.
Example of Implementation:

- Shell International wanted a centralized knowledge repository, thus it went in for KA which facilitated such an architecture. Shell, with its web site that receives more than 450,000 visitors each month, uses KA to monitor what is happening on the web and send relevant information to the users’ desktops.

- Document Management, Search and Retrieval

**PC DOCS/Fulcrum:** For most organizations the need has been to take care of both document management and search and retrieval functions for knowledge enabling their activities. This explains the popularity of tools like PC DOCS/Fulcrum, which provide the entire gamut of functionality. In case of PC DOCS/Fulcrum, the Document Management capabilities covering the entire document life cycle that is provided by PC DOCS is complemented by Fulcrum’s advanced search and retrieval capabilities. Other tools in this category include Dataware II Knowledge Management Suite and the Pentagon suite of products from FileNet.

Examples of Implementation:

- Several organizations like Hewlett Packard, Saatchi & Saatchi, Royal Bank of Scotland, Siemens Nixdorf, Eurocontrol, Telecom Italia are using PC DOCS/Fulcrum for their KM solutions.

- Collaboration

**Livelink from Open Text Corp.:** KM solutions built with collaboration as their primary focus have used products like Livelink from Open Text Corp. Livelink provides a
collaborative environment for managing documents, project information and business processes along with workflow systems. Both pull and push based retrieval is enabled through comprehensive search and broadcast channels respectively. Applications in the area of customer care have been greatly facilitated by a collaborative tool. Other tools in this category include Knowledge Works from Cipher Systems and Knowledge Server from Intraspect.

**Examples of Implementation:**

- Companies like Siemens, Bell Sygma Incorporated and Clearnet Communications have used Livelink's document management and collaboration facility to enable a high level of customer satisfaction in a highly competitive environment.

**Content Management**

**Vignette Content Management Server from Vignette:** It allows the users to submit, edit, review, and approve the content. It defines workflow processes with e-mail notifications to manage collective efforts of the teams. It has the ability to schedule the launch and expiration of the content.

**Examples of Implementation:**

- Companies like Daimler/Chrysler, Motorola, United Airlines and Lands’ End are using Vignette Content Management Server to manage their content.
3. Knowledge Sharing in Organizations

3.1 Introduction

An organization might possess or generate an abundant amount of knowledge most of which is usually tacit. The challenge is to make the owners of the knowledge resources share those resources with others in the organization. Of all the material on knowledge sharing that I have come across the authors stand undivided on the fact that cultural barriers in an organization are the biggest inhibitors to efficient sharing of knowledge [5]. The organization needs to provide an environment where people thrive by sharing rather than hoarding their knowledge. Collaboration is the basic requirement for a knowledge sharing initiative to be successful. On the cultural side it includes the collaboration between the employees, teams, departments to accomplish a task and on the technology side it includes exposure to basic collaboration tools like email, news groups etc. Once the cultural challenge has been recognized, the codification of knowledge and providing access to that knowledge needs to be considered. Codification may be a daunting task especially when the knowledge to be codified is highly specialized and tacit in nature. Accessibility includes meta-knowledge (location, ownership, type, history) and the ease with
which the knowledge can be accessed and used. This chapter discusses the requirements for successful knowledge sharing in further detail.

3.2 Requirements for Knowledge Sharing

![Diagram of Factors Influencing the Knowledge Sharing Initiative]

Before I explain the dimensions in detail, I would like to suggest the reasons behind my choosing these dimensions. So, the description for each dimension includes the 'Basis for inclusion'. This consists details of the resource mentioned in the 'Reference' section after Chapter 5 of the thesis. I think this will provide the reader with the option of exploring in detail, any dimension that is of particular interest to the reader. Also it provides more credibility to the conceptual model in Fig 3.2.
3.2.1 CULTURE

Senior Management Support

Basis for Inclusion:

- An article that appeared in Sloan Management Review [2], describes senior management support to be one of the determining factors for a successful KM project. The types of support they think as being helpful includes:
  - Sending messages that KM and organizational learning are critical to company's success
  - Providing funding and other resources for infrastructure
  - Clarifying what types of knowledge are most important to the company

Senior Management support is required to overcome the barriers to communication especially the typical structural barriers in a hierarchical organization (departments, divisions, etc.), different operating companies in different countries, language barriers and cultural barriers. Management plays an even bigger role in providing the right environment that encourages knowledge sharing.

The knowledge sharing initiative also requires substantial financial support from the top management. Buckman Labs, a specialty chemicals manufacturer, spends $7,500 per employee per year on its knowledge sharing efforts. Ernst and Young Consulting spends 6% of its consulting revenues on managing the knowledge resources and providing access to employees.
Knowledge is often seen as power. The challenge for senior management is to help employees overcome the perception that if they share their expertise, they become dispensable.

Incentives for Sharing

Basis for Inclusion:

- At Gemini Consulting, the firm has built knowledge sharing into its performance, promotion and compensation schemes. At American Management Systems, annual best practices awards recognize those who contribute, those who apply particular practices successfully and those who achieve significant value in the process.

- In 'Working Knowledge' [Davenport, 1998, Pp 62-67], Davenport and Prusak describe the importance of incentives for employees to encourage them to share knowledge.

Most enlightened organizations have begun to implement strategies to encourage sharing of knowledge by their employees. They use a variety of incentives to show that they are serious about sharing knowledge. For example, some have rewards and recognition programs for knowledge sharers; these range from kudos in the company newsletter to substantial pay bonuses. Other companies evaluate employees for raises, advancement and even extra vacation time partly on how much they participate in knowledge sharing activities.

This is all the more true for consulting companies whose main product is the intellectual capital. Some consultancies are re-evaluating and adjusting their performance and compensation review procedures to strengthen the link between behavior and action when it comes to collaboration [21].
Culture to Share and Trust

Basis for Inclusion:

- In a roundtable discussion on knowledge sharing [3], Robert H. Buckman (CEO, Buckman Labs, a speciality chemicals manufacturer in Memphis, Tenn.), Thomas W. Brailsford (Manager of knowledge ownership at Hallmark Cards in Kansas City, Mo.) and Hubert Saint-Onge (Senior VP of Strategic Capabilities at the Mutual Group) stand united on the fact that creating a culture to share and trust happens to be the most important challenge for a successful knowledge sharing initiative.

- In 'Working Knowledge' [Davenport, 1998, Pp 97-100], Thomas H. Davenport and Lawrence Prusak mention lack of trust to be one of the main inhibitors to successful knowledge transfer in organizations.

- The 1998 KPMG Report on Knowledge Management [15] suggests that lack of willingness to share and trust is the biggest barrier to effective knowledge management.

Following are some ways for fostering a culture supportive of sharing:

- **Hiring people who will share:** To have employees who will share their knowledge, its best to encourage this practice from the beginning. Creating a culture in which employees share knowledge starts with the hiring process. In such cases the job interview process involves plenty of interaction both social and business, between current and prospective employees [13]. Smart recruiters tend to look for candidates with the right ethic, including those who are prone to sharing.
• **Develop Trust:** Organizations with successful knowledge sharing programs encourage sharing by developing an atmosphere of trust among employees and between the company and the individual. The Code of Ethics in an organization helps build trust for sharing knowledge.

• **Vary Motivations:** To instill the sense of sharing knowledge, some organizations provide different incentives at different levels within the organization to win over executives, department heads and individuals [13].

  At Ernst and Young, on the Executive level the KM department tries to provide a solid business case. Members of the KM team try to measure the results of sharing knowledge in terms executives will understand, such as specific number of additional market campaigns that can be launched or specific reductions in the time it takes to a new product to the market.

  For department heads and divisions, the KM team presents the benefits relevant to each division. It involves talking about lead generation when the target audience is sales and about campaigns when it's marketing.

  On individual levels organizations should identify the behaviors they want to encourage and others they want to eliminate and then provide incentives to recognize the positive behaviors. At Cap Gemini Ernst and Young, employees who publish research papers or post information to the company discussion groups or chat rooms receive royalty points when others use that information. These points can be used for a number of privileges, including extra vacation time.
- **Show public recognition:** Showing public recognition in form of certificates, employee's name on the company's Wall of Fame, mention in the company's newsletter etc. encourages employees to share their knowledge. It also demonstrates the company's commitment to sharing knowledge.

- **Reorganize for Sharing:** People naturally share knowledge with others in their own teams. A company can encourage sharing among people on separate teams using various incentives, or can restructure the organization so that people are members of many different teams, which increases the pool of knowledge sharers. Once integrated teams are formed, inter-group knowledge sharing can be encouraged through conferences, classes and mentoring programs.

Northrop Grumman's Air Combat Systems in Los Angeles is forming integrated product teams. In this scenario employees would still be a part of their core functional teams, such as engineering, manufacturing, product support or material support. But those who work on, for example FA-18 Hornet, will also belong to multifunctional, integrated product teams made up of people who work on that aircraft.

- **Create communities:** Organizations involved with the Knowledge Sharing initiative have knowledge communities consisting of their employees who share common expertise or skills, technical knowledge or just interest in a particular subject matter. People willingly share knowledge when they have common interests. By creating communities The World Bank creates communities by expanding each worker's contacts to include colleagues with whom they share knowledge, although they might never meet in person.
• **Develop Leaders:** Having a designated knowledge management team and establishing positions like the CIO (Chief Information Officer) or the CKO (Chief Knowledge Officer) indicates the company’s commitment to the Knowledge Sharing initiative. Also, the knowledge management team helps in creating and maintaining the repositories for knowledge, refining, managing and distributing the knowledge and provide the information technology to support the repositories and processes. In order to foster a constantly learning and changing environment, a chief learning officer is necessary [26].

**Code of Ethics**

**Basis for Inclusion:**

- Creating a Code of Ethics helped Buckman Labs, a chemicals company in Memphis, Tenn., to develop trust for knowledge sharing in the organization [6].

The Code of Ethics is the glue that holds the company together and provides the basis of respect and trust that are necessary in a knowledge-sharing environment. These fundamental beliefs are essential to being able to communicate across many barriers to communication that may exist within an organization. A common set of shared values is critical to guide the relationships within the organization that wants proactive knowledge sharing.

The code of ethics would be of little value to the employees if the company doesn’t take it seriously. A Code of Ethics at Buckman Labs forms the basis of evaluation on the employee’s evaluation forms to ensure that the employee’s behavior confirms to the code of ethics.
3.2.2 ACCESSIBILITY

The success of the knowledge sharing initiative comes from the use of the knowledge resources by the employees. The users need to have knowledge about the knowledge resources (ownership, location, type and other forms of relevant meta-knowledge).

Meta-Knowledge

Basis for Inclusion:

- Maryam Alavi [1], suggests the Network Model for knowledge management systems. In this case the KMS does not contain knowledge itself but pointers to the holders of tacit knowledge. Knowledge about experts enables the users of the KMS to identify and access the experts. The theses extends the model to both tacit and explicit knowledge resources. The knowledge sharing system described in Chapter 4 of the thesis maintains meta-knowledge about these knowledge resources.

Some important aspects of meta-knowledge are:

- **Ownership**

In the proposed knowledge sharing system, with pointers to the knowledge resources, it is important to establish the ownership of the resource especially the tacit resources. The user interested in knowing more about the tacit resource can establish contact with the owner. In case of explicit knowledge, the user needs to know who owns or manages the explicit resource, e.g., the company librarian who manages the system that keeps track of all the relevant publications and can be contacted to get access to the resource.
• **Location**

The proposed knowledge sharing system provides pointers to the knowledge resources. The summary/description about the knowledge source just provides enough information to generate interest for the user to learn more. The user might want to know more about the resource and depending on the nature of the resource, tacit or explicit, the user would try to establish contact or acquire access to the knowledge resource.

• **Type of Knowledge Resource**

**Explicit knowledge** is that knowledge that either is written down in a knowledge base or captured in formal document for example a patent. These are proven and quantifiable assets employed to generate the revenue recorded explicitly at the bottom line.

**Tacit knowledge** is that knowledge that is in the heads of the employees.

The knowledge type (tacit or explicit) impacts the rate of transfer as well as the choice of transfer mechanisms. Given the situated and articulated nature of the tacit knowledge, the rate of its transfer is slower than the rate of transfer of explicit knowledge. Tacit is best transferred through collaboration, shared experience, and rich interpersonal interactions over time. Explicit knowledge on the other hand can be effectively transferred through "leaner" interactions and communication channels [1].

**Currency of information**

**Basis for Inclusion:**

- Entering information into the system must be a part of someone’s job rather than just relying on the employees to contribute to the knowledge base [5]. Busy managers and
professionals will rarely take the time to enter detailed information into a database unless it is a part of the job. UNISYS designated 30 people as the representatives from each of the operating groups to ensure that someone is concerned about entering and using information. The consulting firm of Ernst and Young for example has more than 250 individuals at its Center for Business Knowledge managing and maintaining the knowledge repositories. In addition to this central group, staff members throughout the various Ernst and Young practice areas are responsible for collecting, organizing and storing practice specific knowledge.

Currency involves keeping the information up-to-date and getting the appropriate people to contribute consistently. The knowledge repository might contain internal and external knowledge for use by the employees. Out of date knowledge, if accessed by the users might even prove detrimental to the knowledge sharing initiative. This is more valid in case of knowledge about market trends, customers, competitive knowledge and new product knowledge or breakthroughs.

Personalization

**Basis for Inclusion:**

- The proposed knowledge sharing system manages access to the knowledge resources by providing meta-knowledge about those resources. The best pay off for the investment in such an initiative would be if employees use the available knowledge resources to improve their capacity to take effective action. Personalization can help achieve this by using the information about the user. This information involves job requirements,
interests, and needs of the user. In addition to this the knowledge sharing system can make recommendations based on user profiles of other users with similar knowledge requirements.

Collaboration

**Basis for Inclusion:**

- In their article [9], Charnell Havens (Chief Knowledge Officer for Pricewaterhouse Coopers) and Dylan Havens (Project Director at Marshall Erdman and Associates) discuss the importance of collaboration and how it can be done effectively through knowledge repositories' management.

- In her article [10] on Knowledge-based communities of practice at AMS (American Management Systems, 13th largest consulting firm in the world), Susan S. Hanley (Senior Principal and Director of Knowledge Management Initiatives at AMS) talks about collaboration at AMS.

- The main purpose of knowledge sharing is to enable people to collaborate by making their knowledge available to others and using the knowledge from others to improve their overall capabilities and hence improve the organizational performance. In the context of a knowledge sharing system this happens when people contribute links to the knowledge resources that can then be retrieved by other users interest in that concept. Also, collaboration happens when people use the credibility information for knowledge resources based on the ratings by experts in that field.

- In the context of knowledge sharing our objective is to enable people to share their ideas and knowledge resources they might possess or know of. The knowledge sharing system
helps people to get access to the knowledge contributors and information about those people, who might be experts in their respective fields.

The first mode of collaboration usually starts with face-to-face contact, a chance meeting, a business or social introduction or maybe just a telephone call or an email [9]. Two people meet, they recognize value in each other and they resolve to keep in touch. Collaboration at this stage is about potential. An organization need not, indeed cannot, control this process since it is highly personal and often arises through serendipity. Organizations are involved in creating collaboration between individuals with similar interests. Organizations must address how work environments—cultural, operational, technological, and physical—enhance or inhibit collaboration.

In the context of knowledge sharing our objective is to enable people to share their ideas and knowledge resources they might possess or know of. The fundamental requirement is a robust corporate memory with systems for people to contribute ideas, experiences and work solutions and to access the contributions, searching both broadly across disciplines, as well as precisely, based on current needs [9]. A knowledge sharing system, like the one proposed in Chapter 4, helps people to get access to the contributors and information about those people, who might be experts in their respective fields. The system helps us capture meta-knowledge about the relevant knowledge resources (both tacit and explicit).

3.2.3 CODIFICATION

Like individuals, organizations may lose track of their knowledge and forget. Since organizations are continuously engaged in the process of knowledge generation and
application, it will be futile to attempt to codify and store all organizational knowledge. According to Davenport and Prusak, knowledge codification involves three primary considerations:

- Determining the knowledge domain and content to be codified.
- Identify the source of the required knowledge, specifying the mechanisms and media for its collections, and determining the timing and frequency of its codification and updates.
- Specifying methods and tools for access and retrieval of the codified knowledge.

For a sound knowledge sharing initiative I propose that the organization look into the following aspects of codification:

Organizational Ontology

Basis for Inclusion:

- In 'An Ontological Approach to Knowledge Management[18], Dorit Nevo and Yair Wand suggest at least five ways in which ontologies can be used for knowledge management.
- In another paper Nevo and Wand [19] describe organizational ontology as formal semantics of the language used for knowledge exchange in the organization.
- Mike Uschold and Robert Jasper [12] describe the following uses for ontologies:
  - Neutral authoring
  - Ontology as specification
  - Common access to information
  - Ontology-based search
Alexander Pretschner and Susan Gauch [7] advocate the use of ontologies for personalized searches in their paper on 'Ontology Based Personalized Search'.

- Ontologies can help in knowledge sharing by:
  - **Classifying the knowledge resources**
    Corporate data sources may be large but they don’t involve too many concepts [11]. Classification of the knowledge resources based on the organizational ontology forms a basis for knowledge sharing environment and allows the user of the system to leverage the other uses of the ontologies.
  - **Querying the meta-knowledge repositories**
    Organizations have an increasing amount of information available and the task of retrieving resources that are of interest has increasingly become difficult. An ontology is used for searching an information repository for desired resources. The chief benefit of this approach is faster access to important information sources, which leads to more effective use and reuse of knowledge resources [12]. Having an organizational ontology helps the user to search for the relevant concepts, the way they have been defined in the ontology. The results for the query show the links to the relevant knowledge resources leveraging the relationships that particular concept might have with other related concepts as defined in the ontology database.
  - **Ontology based Personalized Search**
    The users for a system have two ways to find the information they are looking for: they can search, and they can browse [7]. Searching is more useful when the user already knows the
information s/he is seeking and the collection is small enough to be well understood. Browsing is useful when the user is not sure as to what information is available, which is often true when the collection of information is large. In context of the knowledge sharing system the organizational ontology helps the user to look for the relevant information more efficiently. Browsing might involve clicking on the concepts defined in the organizational ontology and having access to the documents that have been classified with that particular concept. The display of the relevant knowledge resources for a particular individual will depend on the user rights and the usage history for the user. The user profiles can be deployed for more efficient information retrieval and filtering. When searches for certain concepts are performed repeatedly, this is an indication of user's interest in that particular subject.

- **Subscription to knowledge resources**

  Based on the organizational ontology, the user can subscribe to concepts (e.g. subscribing to knowledge resources that are classified under 'compilers'). The user can further fine-tune the subscriptions by subscribing to sub-concepts (e.g. compiler construction).

- **Security**

  Security involves providing different levels of access to different individuals in an organization for the same knowledge resource. It also includes denying access to some knowledge resources for certain individuals. Ontology, consists of a description of concepts in an organization, knowledge about which has to be managed by a KSS. This helps us accomplish this by allowing or denying access to
those concepts. For example, the management can just deny access to the concept of 'promotion criteria' and hence the related documents. It might be more complex when the knowledge resource has multiple classifications, e.g. the same document being classified under both 'promotion criteria' and 'salary details'. In this case, an individual might not have access to any of the documents dealing with 'promotion criteria' but can still access the knowledge resources classified under 'salary details':

- we have to make sure that individual is denied access to a knowledge resource only when one of the classifications for the knowledge resource includes 'promotion criteria'.
- the individual still has access to the knowledge resources classified exclusively as 'salary details' or under multiple concepts not involving 'promotion criteria'.

**Determining User Access**

A user may have access to a knowledge resource due to the user:

- being an individual with specific job requirements and interests.
- performing a certain role in an organization.
- being a member of a group working on a particular project or having similar interests.

In order to give access rights to a user by virtue of his/her role in the organization, a list of concepts from the ontology can be assigned to a certain role. Defining a user in that role should automatically give access to those concepts and hence the knowledge resources classified under those concepts. A similar practice can be adopted for the members of a certain group.
Contents Maintenance

Contents in the context of the knowledge sharing system mean the meta-knowledge. These contents can help the user of KSS to access the knowledge resources if required. The user's rights to contribute to the KSS can be managed through the use of the ontology database, which defines all the organizational concepts. The expert can be given rights to comment or rate the knowledge resource if it belongs to the knowledge areas in which the expert specializes. This forms a part of the meta-knowledge and helps the other users to determine the credibility of the resource. The specialization is determined based on the expert's profile in the KSS. For example, the expert in Online Analytical Processing (OLAP) might be able to add/edit/comment on knowledge resources that are or can be classified under OLAP. This helps to give credibility to the knowledge resources as the experts from the same specialization will have the privilege to comment on each other's work.

Ontology is an explicit specification of some topic. Ontology provides a vocabulary for representing and communicating knowledge about some topic and a set of relationships that hold among the terms in the vocabulary.

Technology

Basis for Inclusion:

- An article that appeared in Sloan Management Review [2], suggests proper technical infrastructure to be one of the success factors for an organization wishing to build successful KM projects.
- In a roundtable discussion on knowledge sharing [3], Robert H. Buckman (CEO, Buckman Labs, a specialty chemicals manufacturer in Memphis, Tenn.), Thomas W. Brailsford (Manager of knowledge ownership at Hallmark Cards in Kansas City, Mo.) and Hubert Saint-Onge (Senior VP of Strategic Capabilities at the Mutual Group) consider technology to be the best enabler for collaboration and knowledge sharing in organizations.

- A survey conducted by Kennedy Information [21] revealed that most respondents from management consulting groups considered technology to be very significant to their knowledge sharing initiatives.

- The 1998 Knowledge Management Report by KPMG [15] very clearly outlines the importance of technology infrastructure for effective knowledge management. Lack of appropriate technology infrastructure was determined to be a major barrier to effective knowledge management by 26% of the respondents in the survey.

- Knowledge sharing between individuals happens best when there is a person-to-person communication. But the limitations of time and space make it impractical for large organizations to adopt this approach. But technology can help us achieve this large-scale collaboration among the employees who might be spread all over the globe. Some examples of these technologies include: knowledge repositories, knowledge retrieval tools, chat rooms, video conferencing etc.

What has really made it possible for people and even organizations today to even contemplate harnessing knowledge energies for better management has been the rapid evolution in technology that we have seen over the last decades. Knowledge management
technology has spread out over different dimensions—computers, networks, and other information technology hardware, and KM-specific software. Most software still attends to individual KM challenges rather than to resolving such challenges more comprehensively. As the KM market matures, more powerful KM software will become available [23].

Corporate intranets present the most prevalent technical infrastructure for development and management of knowledge repositories [1]. This is because intranets provide an ideal environment for multimedia publication of knowledge across multiple types of computer hardware and software, and for easy retrieval and display of interrelated knowledge items through hypertext links.

Security and Confidentiality

**Basis for Inclusion:**

- A survey by Reimis [21] describes security and confidentiality to be one of the three major challenges in 'Knowledge Sharing within Management Consulting firms'. The same survey includes comments from employees in big consulting groups, which are involved with knowledge management initiatives. They consider security to be of utmost importance because the knowledge they manage is of high strategic relevance.

The knowledge bases hold information of strategic importance for the company. It is important to ensure adequate security and confidentiality of the organization databases - not just from external sources but also from terminated employees or those who leave to join competitors. Organizations are concerned about the unintentional misuse of the information from their knowledge databases. Some companies have taken to the practice of only putting
the information in their databases that is not client sensitive. There has been a trend in the consulting companies where employees are asked to sign confidentiality and non-compete agreements, a growing number of which include clauses governing the ownership and access to what’s available electronically [21].
4. Architecture and Requirements for a Knowledge Sharing System (KSS)

4.1 Introduction

In 1995 a study found that professionals spent approximately 60% of their time gathering and validating information, 18% of their time on productive work and, finally, 22% of their time attending meetings, taking coffee breaks, etc [8]. In the case of EDS (Electronic Data Systems) Chief Knowledge Officer, Charnel Havens calculated that reducing the time spent on information gathering and validation by a third would result in time savings worth billions of dollars. Consequently, ways have to be found to reduce the time spent in validating and finding the information. The Knowledge Sharing System (KSS) proposed in the following sections can help in supporting effective and efficient knowledge sharing.

The proposed KSS manages the knowledge resources. It does this by maintaining the metaknowledge about the knowledge resources. These resources include both the tacit and the explicit knowledge resources that might be useful for the users of the KSS. The knowledge sharing system is intended to:

1. Interact with the system and view the information that matches the user’s profile, interests and requirements. The information can be presented in customized views to the user.

2. Provide access to the organizational ontology to enable better knowledge sharing. The ontology is a part of the architecture for the knowledge sharing system. The uses the organizational ontology might provide are mentioned in section 4.2.1
3. Provide enough knowledge about the knowledge resources in order to enable the user to access the knowledge resource. This meta-knowledge includes the knowledge type, location, ownership information and history of the knowledge resource. This can also include measures to support assessing the credibility of the knowledge.

4. Provide the user with the ability to query the knowledge bases. The queries might be based on the following criteria:

- **Knowledge type** (tacit/explicit: find only the explicit knowledge resources for 'compiler construction').

- **Physical existence** (floppy, hard-drive, files, reports, manuals, books, tacit knowledge in the brains of people: find the books on 'direct marketing').

- **Owner** (find the knowledge resources for which 'Noam Chomsky' is the owner).

- **Knowledge resource** (find the meta-knowledge about "The SQL Guide to ORACLE" which includes the ownership information).

- **A combination of one or more of the above** (explicit knowledge resources that exist in the form of presentations, reports, papers or books for which 'Thomas Davenport' is the owner).

The important requirements that distinguish this knowledge sharing system from other information systems (e.g. library information systems) are:

- The use of organizational ontologies

- Support for Collaboration

- Support for Personalization
These have been discussed in detail in the following sections. Section 4.2 talks about the requirements of the KSS and the architecture that supports those requirements.

4.2 Requirements and Architecture for a Knowledge Sharing System

This section seeks to use the conceptual model suggested for successful knowledge sharing (in Chapter 3, Fig 3.2) for deriving the requirements for a KSS and further suggests the architecture which helps meet those requirements.

The following table helps make this transition more explicit:

<table>
<thead>
<tr>
<th>Dimension of Knowledge Sharing:</th>
<th>Made explicit through requirement/s of:</th>
<th>Related Architectural Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>CULTURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Management</td>
<td>♦</td>
<td>♦</td>
</tr>
<tr>
<td>Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewards for Sharing</td>
<td>♦</td>
<td>User Profile database</td>
</tr>
<tr>
<td>Culture to share</td>
<td>♦</td>
<td>User Profile database</td>
</tr>
<tr>
<td>Code of Ethics</td>
<td>♦</td>
<td>♦</td>
</tr>
<tr>
<td>ACCESSIBILITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meta-knowledge</td>
<td>Organizational Ontology</td>
<td>Ontology database, Meta-</td>
</tr>
<tr>
<td>Currency of Information</td>
<td>Contents Maintenance</td>
<td>Meta-knowledge repository</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Personalization</td>
<td>Organizational Ontology, Personalization features</td>
<td>Personalization, Ontology database, User Profile database</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Organizational Ontology, Collaboration</td>
<td>Ontology database, Collaboration</td>
</tr>
</tbody>
</table>

**CODIFICATION**

<table>
<thead>
<tr>
<th>Organizational Ontology</th>
<th>Organizational Ontology</th>
<th>Ontology database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>Security and Confidentiality</td>
<td>Security</td>
<td>Ontology database, Meta-knowledge repository, Security</td>
</tr>
</tbody>
</table>

- Difficult to accomplish through the Knowledge Sharing System.

# Technology provides the basic networking and computing infrastructure for the knowledge sharing system.

**CULTURE**

It is hard to translate the sub-dimensions of culture into technology solutions as a requirement or an architectural component of the KSS. Technology can help change culture by automatically tracking those who are actively contributing, browsing, and retrieving
knowledge from corporate memory [10]. Using the user profile database to determine the usage trends for the KSS can help set up reward systems and hence recognize the individuals who share their knowledge. The culture to share knowledge is a pre-requisite for implementing a knowledge sharing solution. If the organizational culture is such that the employees do not believe in knowledge sharing, no information system can help in efficient knowledge transfer.

ACCESSIBILITY

Meta-knowledge: The user for the knowledge sharing system needs to have enough meta-knowledge about the knowledge resource to enable him/her to access the resource. The meta-knowledge includes: knowledge type, location, ownership information, history of the knowledge resource and credibility of the knowledge resource. All these concepts have been defined in the organizational ontology. The meta-knowledge about a particular knowledge resource is stored in the meta-knowledge repository.

Currency of Information: Making sure that the users have access to the most current meta-knowledge about the knowledge resource is achieved by maintaining the history of the knowledge resource as a part of the meta-knowledge repository and by maintaining the meta-knowledge for different versions for the same knowledge resource.

Personalization: Using the predefined concepts from the organizational ontology, the user profiles from the user profile database and the personalization module can provide personalized delivery of information. The personalization module is the software component
that performs personalization. It may be developed in-house or can be off-the-shelf software. It helps to better utilize the knowledge resources. The user might be interested in a particular topic but might not be able to access the resource due to searches based on classification which happens to be different from the one defined in the organizational ontology. But personalization helps to leverage the user profile (user profile db) and inform the user of the resources with classification that might be of interest to the user.

**Collaboration:** The users of the KSS collaborate by contributing to the knowledge resources and putting up the meta-knowledge about the knowledge resource. The experts in specific areas, depending on their access rights can enter comments about a particular knowledge resource. This helps other users to determine the credibility of the knowledge resource, especially if the user is unfamiliar with the knowledge domain. The users also collaborate as a part of the group. Having the same vocabulary enables better collaboration. If the user might come across a useful knowledge resource that can be of use to the other group members, the user can always forward it to the group or subscribe to the knowledge resource for the benefit of the entire group.

The meta-knowledge repository maintains access information about the tacit and the explicit knowledge resources in the organization. The credibility information and the feedback from experts in similar areas help users to validate the resources before deciding to access those resources.
CODIFICATION

Organizational Ontology

Organizational ontology have been discussed in detail in section 3.2.3. Using ontologies for the knowledge sharing system can enable or support:

- Classifying the knowledge resources
- Querying the meta-knowledge repositories
- Ontology based personalized search
- Subscription to knowledge resources
- Security
- Determining user access

Security and Confidentiality: Security and confidentiality is important as the KSS is managing a strategic resource - knowledge. Security includes denying access to certain knowledge resources and providing varying levels of access to the same knowledge resources (granularity of access). It is important to have varying levels of access for knowledge resources as the access may be based on the role performed by the individual or the requirements for the individual to have access to a particular level of detail. The individual profile can define concepts from the ontology to which the user has access. The access may be based on the user's personal profile, the user being a part of the group or due to the role the individual performs in the organization.
4.2.1 Requirements for KSS

This section outlines the functional requirements of a KSS. These requirements have been mentioned in Table 4.1. These requirements are specific to a knowledge sharing system and highlight the aspects that distinguish it from other information systems. The special requirements for the KSS include:

1. Organizational Ontology
2. Personalization
3. Collaboration

1. Organizational Ontology

Definition

An Ontology can be defined as a specification of "the objects, concepts, other entities that are assumed to exist in some area of interest and relationships that hold among them". (Genesereth and Nilsson, 1987, cited in Gruber, 1993).

In the context of knowledge sharing, the term 'Ontology' means a 'specification of a conceptualization' [18]. That is, an ontology is a description (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents.

Ontologies for Knowledge Sharing in Organizations

Ontological analysis clarifies the structure of knowledge. Given a domain, its ontology forms the heart of any system of knowledge representation of that domain. Without ontologies, or the conceptualizations that underlie knowledge there cannot be a vocabulary for representing
knowledge. Thus, the first step in devising a knowledge representation system and vocabulary is to perform an effective ontological analysis of the field, or domain. Ontologies enable knowledge sharing. Suppose we perform analysis and arrive at a satisfactory set of conceptualizations and their representative terms, of some area of knowledge - for e.g. electronic devices domain. The resulting ontology would likely include domain specific terms such as transistors and diodes, general terms such as functions, casual processes, and voltages. We can then share this knowledge representation language with others who have similar need for replicating the knowledge analysis process. Shared ontologies can thus form the basis for domain-specific knowledge representation languages. The glue that (conceptually) binds these communities together is the ability to reduce semantic ambiguity for the purpose of sharing and reusing knowledge, and/or achieve inter-operability.

Using Ontologies for the Knowledge Sharing System

A look at Table 4.1 would reveal that an organizational ontology is a basic requirement for the proposed knowledge sharing system. Having ontologies for the KSS will provide the solution for effective knowledge sharing. In the context of the KSS, the organizational ontologies can be used for meeting the following requirements. The requirements have been explained in Section 3.2.3 (Chapter 3)

- Classifying the knowledge resources
- Querying the meta-knowledge repositories
- Ontology based Personalized Search
- Subscription to knowledge resources
2. Personalization

Maintaining a user profile is a pre-requisite for personalization. The user profile can constitute the information from:

- **the group profile for the user:**

  The users may be member of a group depending on their job descriptions (e.g. product development group) or depending on their interests (users interested in 'Knowledge Management'). The organizational ontology can be used to assign concepts to a group and any new members assigned to that group will have those concepts defined as a part of their user profile. The data from the user profile database can be used by the personalization component of the KSS to provide personalized delivery of information to the user's desktop. The groups may be assigned explicitly by the system administrator or implicitly by the system based on usage analysis.

  An example of group profile may be a team of engineers working on a product design for a new automobile. This knowledge is of strategic importance to the organization and only the members of the particular group need to have access to this knowledge by virtue of their user group.
• the profile for the designated role performed by the user:

The organizational ontology can be used to assign concepts to a role and any instance of that role would automatically have those concepts as a basis for personalized delivery of information. In an insurance firm, the users for the KSS include the call center representatives and the insurance agents. The system administrator creates a user ID for each of the call center representatives and insurance agents. The insurance agents have more access privileges than call center representatives, but all agents have similar access needs. The administrator can create a group named agents, which includes all the insurance agents' user IDs. The administrator can also create a user group named representatives that includes the call center representatives' user IDs. The privileges that have been defined for the user groups become the privileges for all the members of that group. What is special here is that the privileges are defined using concepts from the ontology.

• user as an individual:

This profiling further involves the information aggregated from:

• user's usage analysis
• user's interest profile
• user's assigned profile which is defined by the information the user is expected to have to perform well at the job.

Effective capabilities are created when the users in the organization use the knowledge resources. The user who is new to a particular domain can benefit from the fact that the user
has been assigned a group or a specific role. Techniques like collaborative filtering can utilize the information about the usage trends for users in similar roles or groups or with similar interests. This information helps the knowledge sharing system to provide personalized delivery of information, while also using the initial profile filled by the user. The system can suggest knowledge sources that might be of interest to the user. The user might be interested in a particular topic but might not be able to access the resource due to searches based on classification which happens to be different from the one defined in the organizational ontology. But personalization helps to leverage the user profile (user profile db) and inform the user of the resources with classification that might be of interest to the user.

3. Collaboration

The requirements for collaboration are:

- The ability of the user to contribute information about a knowledge resource
- The ability to retrieve information about a knowledge resource
- The ability to customize (via personalization)

Users search for information about knowledge resources that has been contributed by other people in the organization and also contribute knowledge links to help others to access those knowledge sources, thus leading to collaboration. Personalization helps by managing user profiles and suggesting knowledge resources that might be of interest to the user. The user might not have accessed these resources otherwise.

Collaboration in the case of the KSS happens in the following ways:
User's making comments on each other's work provided they belong to the same area of specialization and have rights to make contributions to knowledge resources classified by a concept from the organizational ontology. This further leads to determining the credibility of the knowledge resource for people who are not experts.

Collaborative filtering tools discover correlations in large bodies of data and use the results to predict likely affinities. For example, "Readers who accessed meta-knowledge about this knowledge source also accessed meta-knowledge about..." followed by a list of other knowledge resources. While based on many individual decisions, the larger pattern that emerges is much more than the sum of its parts - and is often far more dependable than the just individual preferences. This can be helpful in suggesting knowledge resources to the user based on the user profile, especially if the user is new to a domain. Collaborative filtering is useful for a user searching for a topic the user has no prior knowledge about. In such cases collaborative filtering can suggest an initial set of listings for knowledge resources that the user might be interested in.

4.2.2 Architecture for a Knowledge Sharing System

The entity being managed by the knowledge sharing system is the knowledge resource. These resources are managed by maintaining the meta-knowledge for the resources as shown in Fig 4.1. The concepts from the ontology database are used to classify the knowledge resources. The user searching for a concept would receive the meta-knowledge for the knowledge resources that match the concept. Then the user may access the knowledge resource.
The requirements for the KSS have been defined in last section (4.2.1). The architecture helps us translate the requirements into a system that enables us to share the knowledge resources while using ontologies, providing personalization and collaboration.

Fig 4.1 Using the knowledge resources in the Knowledge Sharing System (KSS)
Fig 4.2 shows the role of the knowledge sharing system in providing information about knowledge resources consisting of both the tacit and the explicit knowledge resources. The explicit knowledge resources may exist in structured (database format) or/and unstructured (documents, reports, multi-media etc) format. The tacit knowledge resources refer to the knowledge in the minds of individuals. The KSS can include the information (meta-knowledge) about this knowledge and the individuals possessing it.

Fig 4.2 The Role of a Knowledge Sharing System
The proposed architecture for the knowledge sharing system (KSS) has been shown in Fig 4.3. The system has a three-layered architecture:

1. **The Presentation Layer** which allows the user to interact with the knowledge sharing system.

2. **The Service Layer**, which provides the services, offered by the KSS: Search, Administration, Security, Personalization and Collaboration.

3. **The Repository Layer**, which comprises of the Ontology database, the meta-knowledge repository and the user-profile database.

![Architecture for a Knowledge Sharing System (KSS)](image)

**Fig 4.3** Architecture for a Knowledge Sharing System (KSS)

Interaction
The Knowledge Sharing System (KSS)

The entity being managed by the KSS is the knowledge resource itself. The knowledge resource is managed by maintaining the meta-knowledge about the resource.

The architecture for the KSS consists of three layers:

- The Presentation Layer
- The Services Layer
- The Repository Layer

1. Presentation Layer

The user interacts with the KSS through the presentation layer. This interaction allows the user to perform basic functions like:

- Perform the required searches
- Have customized views to information
- Deliver information about the knowledge resources to the users desktop based on the user's profile
- Access the organizational ontology
- Edit the user profile
- Provides access to administration

2. The Services Layer

The Service Layer provides six main services for the Knowledge Sharing System:

1. Search
2. Security
3. Personalization
4. Contribute
5. Collaboration
6. Administration

The following describes each of the service modules and the interactions the module might have with other components (services or repositories).

Search

The search module provides the ability to query the meta-knowledge repository, the ability to notify failed searches and to save the results of a search for future reference.

The user forms the query, which is processed by the search engine. The concepts mentioned in the query are matched against the concepts defined in the ontology database. The search results are refined for the user by using his/her profiling information. The knowledge resources to be searched from the meta-knowledge resources include the ones that are classified by the same concepts as have been short-listed. Before the search is done on the meta-knowledge repository, security restrictions if any, are checked for.

The search mechanism includes:

- Use of an ontology to perform efficient searches. The concepts and their relationships defined in the ontology help the user frame queries that will come up with more relevant results and at the same time the same classification used for the knowledge resources help
the system to utilize personalization and security features. The common vocabulary that the modules share help improve interoperability of these modules.

- The ability to use the personalization features to determine the concepts that are of interest to the user by virtue of his/her role, group or personal interests or usage. This enables ranking the resources according to the user profile information and to make recommendations for resources that the user might be interested in. The relevance of the resources is determined from the relationships defined between the concept being queried and the related concept for which the recommendation is made. These concepts and their relationships with other concepts is defined in the ontology database.

- Ability to verify security restrictions (if any) before searching for meta-knowledge about resources that are classified with the concepts that have been determined to be relevant to the concept being searched for.

Table 4.2: Interactions of Search module

<table>
<thead>
<tr>
<th>Module</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontology database</td>
<td>To verify the existence of the concept contained in the user’s query, in the ontology. Also find the related concepts.</td>
</tr>
<tr>
<td>(Repository Layer)</td>
<td></td>
</tr>
<tr>
<td>Meta-knowledge repository</td>
<td>To identify the resources which have the same classification as the concepts that have been determined to be relevant to the query being processed.</td>
</tr>
<tr>
<td>(Repository Layer)</td>
<td></td>
</tr>
<tr>
<td>Personalization (Service)</td>
<td>To use the user profile information. This enables the</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Layer) system to present results that better match the user profile. Also it helps to present a list of the related knowledge resources that the user might be interested in.

Security (Service Layer) To verify the access rights to the concepts that have been chosen to be of relevance to the user based on the user’s query and profile. This is done before identifying the meta-knowledge about relevant resources in the meta-knowledge repository.

Presentation Layer Enable the user to define the query and present the outcomes of the search.

Security

The security module is used to implement restricted access to knowledge resources. After the user submits the query, the search module retrieves the related concepts from the ontology database. Before the meta-knowledge for the relevant knowledge resources is retrieved from the meta-knowledge repository, the concepts are verified against the security rights for the user conducting the query. If the user is denied access to any of the concepts short-listed from the ontology database, further search for those concepts is not conducted against the meta-knowledge repository.

- The Security module manages granularity in the levels of access for different users depending on the information provided by the Administration module (e.g. any employee...
in the organization may be able to look at the evaluation criterion for employees but only managers and other senior executives might have the access to detailed breakdown for each criterion in the list).

- The module filters the results for a query by verifying the user’s rights to the concepts that have been determined to be of relevance to the user.

### Table 4.3: Interactions of Security module

<table>
<thead>
<tr>
<th>Module</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search</td>
<td>This module provides the classifications and the concepts that have been determined for search results to be displayed in answer to the user’s query.</td>
</tr>
<tr>
<td>Administration</td>
<td>Determines the user’s role, group and other relevant information to make sure that the security model censors the knowledge resources that the user is not allowed to access.</td>
</tr>
<tr>
<td>Contribute</td>
<td>The user can only contribute to the domain if the user has the rights to do so. Usually, experts will have rights to contribute knowledge links for the concepts that they are experts in. This concepts need to be defined in the expert’s profile.</td>
</tr>
</tbody>
</table>

# It might not be practical to have the administrator define access rights for all the concepts for every user of the KSS. A better approach might be to block the concepts that have restricted access. Then those concepts can be allowed access by specific users who are
allowed to access meta-knowledge about those knowledge resources. These concepts are mentioned in the organizational ontology.

**Personalization**

The Personalization module helps use the knowledge resources more effectively by determining what might be of relevance to the user. As mentioned in Chapter 1, knowledge generation and codification are important for knowledge sharing but don’t create any capabilities till the knowledge is accessed by the users and improves their capacity to act. Personalization uses the information about the user’s role in the organization, the groups the user belongs to, topics of interest to the user and other requirements for user’s specific job profile and the usage information. It receives all this information from the user profile database. Personalization might use techniques like collaborative filtering to notify the user of other relevant knowledge sources that might be of interest to the user. The system might use some measures for automatic profiling for users but the technology decisions are outside the scope of this research.

<table>
<thead>
<tr>
<th>Module</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation Layer</td>
<td>To receive subscriptions to certain concepts. The user defines the concepts the he/she wants to receive information about.</td>
</tr>
<tr>
<td>User Profile database</td>
<td>Provides information about the usage trends for the user, user’s role and groups. This helps in refining the user’s</td>
</tr>
</tbody>
</table>

Table 4.4: Interactions of Personalization module:  

83
| **Ontology database** (Repository Layer) | To match user’s skills, subscriptions and access management (group/role) information with relevant concepts in the ontology database. |
| **Meta-knowledge repository** (Repository Layer) | To retrieve the knowledge resources that match the concepts short-listed by the organizational ontology |
| **Security (Service Layer)** | Filter the search results against the security restrictions (if any) before searching the meta-knowledge repository. |

**Contribute**

The contribute module includes the ability of the user of the KSS to add meta-knowledge to the meta-knowledge repository. The user does this through the presentation layer. The user might also comment on the credibility of knowledge resources depending on the user’s security rights to the concepts, which are used to classify the particular knowledge resource. The contribution to the meta-knowledge repository might have a centralized or a decentralized approach.

**Centralized Approach**

In the centralized approach the central knowledge management group or department enters the meta-knowledge. In this case the contributors to the KSS may send the details of the content of the knowledge source with other relevant information about it to the central KM
department. After the knowledge source has been validated and classified based on the organizational ontology, the link would be added to the KSS.

**Pros:**

- better data integrity through proper classification and validation procedures.
- easier to circulate any procedure changes within a defined knowledge management department rather than having to circulate it to all the employees in the organization. These changes might be changes to meta-knowledge entry interface or information about other fields that need to be captured.
- avoids the deployment of troubleshooting personnel at the KM department to respond to the problems faced by the knowledge contributors.

**Cons:**

- need for a dedicated KM department for an organization.
- the users might never get exposure to the underlying ontology or other useful details that enable better knowledge sharing in the organization. Lack of understanding of the system can even discourage the contributions made by the users of the system.
- conflict between the classification suggested by the contributor and how the document is actually classified under in the KSS.
- The KM department will have to go through a detailed process of getting the knowledge source validated by experts or from people from the relevant department. It might take too long to publish the link on the KSS and the knowledge source might not be that relevant anymore.
Decentralized approach

This approach involves giving adequate rights to the users to directly contribute to the KSS. This requires the contributors to strictly abide by the quality standards and other pre-defined procedures.

Pros:

- better understanding of the underlying organization ontology. This enables the spread as common terminology in the organization
- faster addition of the knowledge link to the KSS
- defining meta-knowledge entry as a part of the employee’s job and subsequent cost savings for setting up a separate work force to do the same.

Cons:

- problems might arise due to unacceptable quality of the knowledge source
- some users might avoid contributing to the KSS due to the extra work and accountability it involves.

Collaboration

The underlying motivation for implementing a knowledge sharing system is to use technology to improve collaboration between people in the organization.

Collaboration in case of the knowledge sharing system happens through the three modules: search, personalization and contribute. Users search for knowledge resources that have been contributed by other people in the organization and also contribute knowledge links to help others to access those knowledge sources, thus leading to collaboration. Personalization helps
by managing user profiles and suggesting knowledge resources that might be of interest to
the user. The user might not have accessed these resources otherwise.

- Collaboration is the basic service supported by the knowledge sharing system.
  Collaboration happens when people access the knowledge resource, use comments and
  suggestions made by other users to determine the credibility of the knowledge resource.
- The users of the knowledge sharing system collaborate by sharing their knowledge -
  putting meta-knowledge about knowledge resources and enable others to access the same.
- The experts contribute by providing additional links to knowledge sources. They can
  make suggestions and comment on knowledge resources that fall under their area of
  specialization as defined in the meta-knowledge repository. This provides credibility to
  the information for the knowledge resource to be used by non-experts in that particular
  domain or new to the domain.

Administration

The Administration module mainly deals with access management. It defines the roles and
groups. It enables the definition and assignment by the administrator. A role or a group will
have related concepts pre-defined for it. That information is available in the ontology
database. For example, an employee in charge of hiring will have in his/her profile the
concepts of hiring policy, compensation package, employee benefits and other related
knowledge resources predefined for the role.
Table 4.5: Interactions of Administration module

<table>
<thead>
<tr>
<th>Module</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontology database (Repository Layer)</td>
<td>Depending on the role or the groups defined for the user, the related concepts are determined from the ontology database. The user role and groups are defined in the user profile database.</td>
</tr>
<tr>
<td>Meta-knowledge repository (Repository Layer)</td>
<td>This helps determine the skill information for the user and assigning groups based on interest or other information available about the user.</td>
</tr>
<tr>
<td>Presentation Layer</td>
<td>Enables the administrator to define the role and groups for the users and edit the same.</td>
</tr>
</tbody>
</table>

3. The Repository Layer

The repository layer includes:

- The ontology database
- The meta-knowledge repository
- The user profile database.
Ontology database

In the context of knowledge sharing, the term 'Ontology' means a 'specification of a conceptualization' [18]. That is, an ontology is a description (like a formal specification of a
program) of the concepts and relationships that can exist for an agent or a community of agents.

The ontology contains the definitions of the concepts and relationships between the concepts as shown in Fig 4.4

An example of an ontology is the Enterprise Ontology, which is a collection of terms and definitions relevant to business enterprises. It was developed as a part of The Enterprise Project, a collaborative effort to provide a method and a computer toolset for enterprise modelling [13].

The concepts for Enterprise Ontology were defined by brainstorming. These concepts were then grouped into various more or less distinct work areas such that there was more similarity in meaning and a need to refer to terms with an area than between different areas. The ontology was classified into six work areas:

- **Meta-Ontology** - terms used to define the terms of the Ontology. e.g. Entity, Relationship, Role
- **Activity, Plan, Capability and Resource** – terms related to process and planning. e.g. Activity, Planning, Authority, resource Allocation
- **Organization** – Terms related to how organizations are structured. e.g. Person, Legal Entity, Organizational Unit, Manage, Ownership
- **Strategy** – Terms related to high level planning for an enterprise. e.g. Purpose, Mission, Decision, Critical Success Factor
- **Marketing** – Terms related to marketing and selling goods and services. e.g. Sale, Customer, Price, Brand, Promotion
Committing to an organizational ontology as the one defined above provides the people in the organization with a common vocabulary. Having a common vocabulary improves collaboration, as there is no ambiguity about the concepts for which the knowledge is being shared. This helps to improve collaboration between people who operate in different domains in the same organization. For example, the Systems Analyst trying to elicit the system requirements for an information system for HR department. The people involved are from different areas of specialization and have their own jargon. But having an ontology with predefined concepts can help the two collaborate in a better way.

Meta-knowledge repository

The meta-knowledge that needs to be captured includes:

- **Knowledge about the knowledge resource**
  - **Knowledge Type** Classification of the knowledge source as tacit or explicit.
  - **Classification** The meta-knowledge includes the classification of the knowledge source based on the organizational ontology. Having information about what the knowledge source is about would enable the user to define knowledge resources and identify them.
  - **Owner** This involves information about the holder (author) of the knowledge source or an individual/expert who possesses knowledge on the relevant topic. Detailed information about the owner might be available as a link to the employee or expert database. In case of explicit knowledge, the owner is the person that can be contacted to
access the knowledge source (corporate librarian who manages the corporate archives).

The ownership is discussed in more detail later in the section.

- **Location** This includes information about the location of the knowledge resource. In case of explicit knowledge, it might involve information about the department, corporate library, archives etc where the knowledge resource could be found. Specific information about whom to contact is captured under 'ownership'.

- **History of the knowledge resource** This includes the date of creation, subsequent dates of modification and the user who made those changes. This is important for maintaining the versions of a knowledge source. It also helps to delete the knowledge source that is no longer useful for the users.

- **Credibility of information for the knowledge resource:** The credibility of the knowledge resource is important for both the tacit and the explicit knowledge resources. It is particularly important for a user who is new to a knowledge domain. The credibility ratings might be based on, for example, the usage analysis or on the basis of comments made by the experts.

- **Ownership Information**

Ownership information is required to identify and locate the people who maintain the explicit or tacit knowledge. It is all the more important in the case of holders of tacit knowledge (employees, experts or specialists).

This includes a description of employee's or expert's educational and training history, academic standing, work experience, research publications, areas of interest, language skills etc.
For performing informed searches for employees/experts, it is useful to rate them. One way of achieving this is to develop a list of competencies (explicit and implicit) and have different skill levels defined for each category. For example, the SPUD [4] system at Microsoft defines four competency types:

- **Foundation**: These include the entry-level skills for software developers, e.g., requirements definition for a new system.

- **Local/Unique**: Above the foundation level there are local/unique competencies. These are advanced skills that apply to a particular job type. A network specialist, for example, might need a fault diagnosis competency for local area networks.

- **Global**: The next level of competencies is global and would be present in all employees within a particular function or organization. Every worker in the Controller organization, for example, would be competent in financial analysis; every IT employee would be competent in technology architectures and system analysis.

- **Universal**: The highest level in competencies is universal competencies; universal, that is, to all employees within a company. Such competencies might be knowledge of the overall business the company is in, the products it sells, and the drivers of the industry.

**User Profile Database**

The user profile database contains information about the user profile. The main purpose of having the user profile information is to provide the user with an ability to perform effective information searches on the KSS. Thus, the user profile should capture the user's interests and preferences. In addition to having individual requirements the user may require information by virtue of groups the user belongs to (e.g. finance department) and the roles
performed by the user (e.g. HR manager) in the organization. Hence the user profile is a combination of:

- **The individual profile** of the user, which consists of the preferences and interests specified by the user.

- **The role profiles** which, consists of the concepts that the user might be interested in by virtue of the user’s role in the organization (e.g. HR manager)

- **The group profiles** of the user which take into account the concepts that might be of interest to the groups that the user belongs to (e.g. product development team)

The user profile database contains information about the roles performed by the user and the groups that the user belongs to.

Other possible uses of the user profile are to support security and personalization:

- The profile can contain information needed to determine whether an individual user is allowed to access certain information in the meta-knowledge repository (as an individual, member of groups or the user roles). Reasons for including this information is that access to certain meta-knowledge might be limited due to security concerns. Security can be achieved by matching the user profile (user + group + role) with the security specifications (these specifications may be included in the ontology database)

- The user profile can also contain information about the usage. This might include
  - The contents that were searched for, by the user.
  - The knowledge sources that the user commented on.
  - Information about the users contributions (if any) to the meta-knowledge repository.

This information can be helpful in providing personalization services to the users.
5. SUMMARY

5.1 Summary

Organizations have begun to realize the importance of managing knowledge. Management has come to recognize that knowledge is a primary asset, hence the formal, organized push to capitalize on knowledge available in the organization.

Knowledge Management activities can be classified as: Knowledge Generation, Knowledge Codification and Knowledge Utilization. Knowledge generation and codification do not necessarily lead to improved performance and business value. Knowledge creates value when it is applied by organizations to create capabilities and to take effective action. Since knowledge is generated and codified throughout the organization, a key challenge in the application of organizational knowledge is transferring it from the source where it is generated or resides to where it is needed and used [1].

There are many problems associated with identifying the knowledge assets and being able to use them in an efficient and cost-effective manner [16]. These range from technical challenges such as having an enterprise-wide vocabulary to creating a culture that encourages knowledge sharing in the organization. There are many tools that intent to support knowledge use in an organization. There are no standard benchmarks available to be able to evaluate the tools. Where standards for knowledge management are concerned, things are still at very nascent stage. While bodies like IKM (Institute of Knowledge Management at IBM) and KMC (Knowledge Management Consortium) are working towards some guidelines, a robust
set of comprehensive standards that can be followed both for evaluation and development of KM solutions is yet to evolve. Right now organizations are attempting to adhere to the standards available in some of the underlying technologies like metadata standards for Document Management, use of open standards technology like XML, Java, component technology etc.

For effective knowledge sharing to happen in an organization, the three dimensions of culture, accessibility and knowledge codification need to be carefully analyzed. Innovations in computing, networking, and circulation of knowledge within the workplace all are part of what makes knowledge management now a doable effort.

The objective of this research was to suggest requirements and propose an architecture for a Knowledge Sharing System which manages meta-knowledge about both the tacit and the explicit knowledge resources in an organization. To achieve the objective, I set the following sub-objectives:

- Study of the present state of knowledge management
- Focus on knowledge sharing aspect of knowledge management in order to propose a conceptual model for knowledge sharing. This model can then form the basis for determining the requirements for the KSS and proposing an architecture that could meet those requirements.

The objectives were accomplished by:

- suggesting a conceptual model for knowledge sharing
• translating the dimensions of the model to functional requirements for the knowledge sharing system
• suggesting an architecture that meets those requirements.

I propose a 3-layered Knowledge Sharing System (KSS) to support access to the knowledge resources in an organization. The knowledge repositories based on this model contain pointers to the knowledge resources, not the knowledge itself. The KSS is intended to function as a directory that can supplement the search for knowledge. It contains meta-knowledge i.e. knowledge about the knowledge sources. The meta-knowledge may include the information about the location, ownership, type and history of the knowledge source. This helps to locate both the explicit and the tacit knowledge resources in the organization. The KSS maintains an organizational ontology, which provides glossary or terminology internal to the organization and the relationships between these terms. The system allows searching for knowledge resources based on knowledge type, owner, physical existence of the resource or a combination of one or more of these. The highlights of the knowledge sharing system are the use of organizational ontologies, providing personalization features and supporting collaboration via exchange of meta-knowledge in order to make the best possible use of the available knowledge resources.

I feel that this research can contribute to the knowledge management research pool by:
• Providing an integrated view for a knowledge sharing system. I accomplish this by suggesting a conceptual model for knowledge sharing, translating the dimensions of the
model to functional requirements for the knowledge sharing system and then suggesting an architecture that meets those requirements.

- Helping the reader know about the different facets of knowledge management (KM) and how it can bring value to an organization. Also, the different technologies that get associated with Knowledge Management and how to make the right choice of KM tools.

- Describing the barriers to a successful Knowledge Management initiative and expected causes of failure. This can help an organization be more careful on those specific issues. This will also help the organization realize if it is ready for such an initiative.

- Helping the reader know about the factors that effect knowledge sharing and hence work on those factors to achieve better chances of success.

- Working as a preliminary guide for someone planning to invest in a ‘pointer’ type knowledge management system.

- Providing the basic guidelines for requirements and architectural components and helping the systems analyst to better elicit the requirements and the required architecture.

- Helping management to better appreciate the resource requirements and the degree of commitment the project may require and hence the viability of the project for the organization.

5.2 Limitations

- The research assumes that if the meta-knowledge about a knowledge resource has been captured in the meta-knowledge repository of the knowledge sharing system, then the particular resource is accessible. I have not taken into account other factors that might
come into play. For example: The organizational expert for a certain topic might not want to share his/her knowledge with me due to personal or political reasons.

- The proposed architecture for the knowledge sharing system provides a general framework for the system. When the real implementation is to be done the architecture and requirements will require more details. It is unclear, for example, what data structures will best support the meta-knowledge repository.

5.3 Directions for Future Research

There are some issues that can be studied further in the context of a knowledge sharing system:

- Representation of organizational ontologies - both for the relational and object-oriented database models.

- Database architecture for the proposed knowledge sharing system.

- Since there is not much evidence in the literature about the firms systematically evaluating the benefits and outcomes of their KM initiatives, it will be interesting to measure the benefits of KM initiatives.

- Research on dealing with the cultural and other barriers to effective knowledge management.
REFERENCES:


