CHAPTER I

INTRODUCTION

1.1 Introduction:

Knowledge is a broad and abstract notion. Knowledge has been defined as an understanding awareness, or familiarity acquired through study, investigation, observation or experience. It has been conceived as a justified personal belief that increases an individual’s capability to take effective action. Explicit knowledge is stored in text books, software products and documents. Tacit knowledge is stored in the minds of people in the form of memory, skills, experience, education, imagination and creativity. Some knowledge believed to be tacit can in fact be transformed into explicit knowledge. This type of knowledge is called implicit knowledge. The value of implicit knowledge is recognized by top level authorities of management within the organization, as it is considered to be critical for enabling employees to fulfill their roles. Both implicit and explicit knowledge are important however, implicit knowledge is hard to identify and manage.

The objective of Knowledge Management is to transfer the implicit knowledge to explicit knowledge as well as transfer explicit knowledge from individual to groups within the organization. Hence, knowledge management is concerned with creating, preserving and applying knowledge that is available within the organization. The recent interest in organizational knowledge has prompted the issue of managing the knowledge possessed by an organization for its benefit. Knowledge Management (KM) is being viewed as a discipline for identifying and leveraging the collective knowledge in the organization to help organization compete.

According to Ross Dawson “Knowledge Management is a newly emerging, interdisciplinary business model that has knowledge within the framework of an organization as its focus. It is rooted in many disciplines including business economics, psychology, and information management. It is the ultimate competitive advantage for today’s firm. Knowledge Management involves people, technology and processes in overlapping parts”\(^1\).

Knowledge management can be discussed in general as the ability to create, communicate, and apply the knowledge to achieve organizational goals. Knowledge management refers to the production, sharing, application, and transformation of knowledge.
Knowledge Management involves mainly 3 activities as:

(1) Acquisition of knowledge;

(2) Creating the culture of knowledge sharing; and

(3) application of technological facilities.²

According to Peter F. Drucker, “no matter knowledge management is applied to schools or enterprises, the principles and norms are the same, and the major difference lies in how things are managed”³. In other words, “knowledge management aims to transform personal knowledge into organizational knowledge through innovation, storage, sharing, and exploitation of knowledge, so as to help the organization seek higher performance, and better competitiveness”.⁴

Knowledge Management is a process where organizations have formulated ways in the attempt to recognize and archive knowledge assets within the organization that are derived from the employees of various departments or faculties and in some cases, even from other organizations that share the similar area of interests or specialization.⁵ Besides, it is defined as the process of transforming information and intellectual assets into enduring value. It also connects people with the knowledge that they need to take action, when they need it.⁶ Moreover, KM is concerned with making the right knowledge available to the right processor such as human or computer, at the right time in the right presentations for the right cost.⁷

Knowledge management is the concept of taking data and turning it into useful and applicable knowledge in a business environment. There is no one specific way that this done, and there's no one specific definition of the process or the concept. No matter how complex the organization’s KM concept may be but few general steps are carried out in any KM process such as Data Capture, Data Storage, Data Organization, Data Analysis, Knowledge Sharing.

Knowledge Management System (KM System) refers to a system for managing knowledge in organizations. KMS, is a concept usually enabled by Information Technology, it is an IT based system for managing knowledge in companies for supporting the creation, acquisition,
storage and dispersion of information. The main purpose of a KMS is to allow a company’s employees to readily access documented archives of facts, information sources, and results. One of the main goals of knowledge management systems is simply to make it easier for businesses and other organizations to share information and to make sure organizational knowledge is freely available to those who need it.

1.2 Knowledge Management Activities:

Knowledge Management comprises of activities which help to exploit tacit and explicit knowledge for overall benefit of the organization. These activities enable to achieve the goal of knowledge management system. Following can be summarized as basic activities performed in knowledge management:

Create: Knowledge is created i.e knowledge is identified and stored.

Organize: Here, the knowledge is properly filtered and organized so as it can be efficiently retrieved.

Disseminate: Knowledge is shared via proper means among the employees, clients, vendors and users.

Discover: Knowledge retrieved is used and implemented in various activities business activities.

Learn: Knowledge sharing increases the productivity, as it becomes enables and motivate learning.

Technology plays a vital role in implementing above activities. Organizations use different types of technological tools such as Database Management Systems, Internet, Web Portals, Groupware software, Content Management Systems, Collaborative Computing, Social Networking, Intranet etc. These tools enable and enhance the knowledge management activities.

1.3.1 Software:

Software is a generic term for organized collections of computer data and instructions, often broken into two major categories: system software that provides the basic non-task-specific
functions of the computer, and application software which is used by users to accomplish specific tasks.

Software is created with programming languages and related utilities, which may come in several of the above forms: single programs like script interpreters, packages containing a compiler, linker, and other tools; and large suites (often called Integrated Development Environments) that include editors, debuggers, and other tools for multiple languages.

Software are used in every area of application like banking, railways, education, scientific purpose, business, industries etc., these are the special areas of application. A large portion of our day to day activities such as watching television, heating food in microwave, washing clothes in washing machine, driving a motor vehicle, or communicating on mobile phone are dependent on software. Despite the visibility of internet and access of desktop computers in consumer market, Software Engineering remains a discipline that has yet to reach maturity. Since last two decades increased consideration was given to the process used for software development to improve the quality of software delivered.

1.3.2 Software Engineering:
Software engineering is concerned with the process of software production from the early stages of system specification through to maintaining the system after it has gone into use. “Software engineering may be defined as the systematic design and development of software products and the management of the software process. Software engineering has as one of its primary objectives the production of programs that meet specifications, and are demonstrably accurate, produced on time, and within budget.”

1.3.3 Software Engineering Process and Models:
Software engineering process comprises of the activities performed for the software development and maintenance. Software engineering is not a single step procedure, it is performed in a sequence of phases or steps. This phased development process is also known as Software Development Life Cycle. Software Development process comprises of different phases in a top down or cyclic approach. Each phase takes inputs from the previous phases, add new features and then produce output. The output generated from each phase is often termed as intermediate product, work product, or deliverable. There are different types of software process or software development life cycle models proposed by different theorist or practitioners.
The software development life cycle or software development process describes the activities performed during the development process such as design, coding, testing, implementation and maintenance of the software product. It describes the evolution of the software product from just a requirement or customer need to developed or delivered product and lasting till the maintenance of the delivered product. A process model is defined as “a framework containing the processes, activities and tasks involved in the development, operation, and maintenance of a software product, spanning the life of the system from the definition of its requirement to the termination of its use” 9. There various types of life cycle model such as:

1. Waterfall Model
2. Spiral Model
3. Incremental Model
4. Spiral Model
5. Agile Methodologies
6. Prototype Model etc.

The software engineering field is very instable and volatile. There is a constant penetration of new tools, techniques, languages and increasing demand of innovation and improved quality from the customers. Also due to high level of competition in the market, there is a pressure of delivering a quality product, in a given short period of time and at a reasonable cost. Software development companies are striving hard to find a solution for improving their software development process, increase quality and reduce time. It became crucial for these companies to keep their employees updated with the changing technology, maximise the reuse of experience gained from one project into another, and retain the best talent. Proper co-ordination among team members, especially teams working on remote site is also an issue of concern. These problems have turned the attention towards Knowledge Management. Knowledge Management has emerged as best solution for many problems faced by the software development firms.

1.4 Role of Knowledge Management in Software Engineering:
The software engineering discipline is a knowledge centric process and so it has gained much attention of knowledge management. For any software development organization the main assets are not the physical asset such as plant, machine or hardware etc. but the knowledge held by its employee. Knowledge possessed by the people and experienced acquired during the course of work on the software development project plays a crucial role. Software Engineering field demands the need to manage this knowledge asset present in different forms thereby, paves way for Knowledge Management. Knowledge Management helps to manage this knowledge asset by providing means for creating, acquiring, storing and disseminating knowledge throughout the organization.

Some aspects of knowledge management suggested by Wiig are:

- Survey, develop, maintain and secure the intellectual and knowledge resources of the enterprise.
- Determine the knowledge and expertise required to perform work tasks, organize it, make the requisite knowledge available, “package it” and distribute it to the relevant points of action.
- Provide (...) a knowledge architecture so that the enterprise's facilities, procedures, guidelines, standards, examples, and practices facilitate and support active Knowledge management as part of the organization's practices and culture.10

Thus, it is apparent that knowledge management is beneficial in the software engineering field. Today, many software development companies have implemented Knowledge Management Systems. The present research works studies the application of Knowledge Management in the software development companies within Maharashtra state of India.

1.5 Literature Review:

The Knowledge Management is a broad concept, applied in various fields. There is a growing amount of literature about Knowledge Management in terms of books, research papers & articles, research reports and case studies. Knowledge Management is a multi disciplinary field and thus covers vast area of application. Many research articles, books and case studies on the knowledge management and applied aspects have been studied during the present research. The review of literature is presented in following paragraphs:
Baiyin yang, Wei Zheng, Chris Viere conducted a research project supported by a grant from the National Science Foundation of China (NSFC Project No. 70725005). Authors critically evaluated the selected KM model and proposed a holistic KM model. The authors expressed in the research project that, the present model of KM fail to recognize the knowledge such as values and visions, they view knowledge management in a linear or cyclic process and fail to identify the multidimensional nature of knowledge. The research findings discussed implication of holistic knowledge for human resource development. The study contains description of three knowledge facets – implicit, explicit and emancipator knowledge. Knowledge of an individual is viewed in three new forms, Affectual knowledge, Conceptual Knowledge and Perceptual Knowledge. These three forms of knowledge act as the base of proposed model. Further the article explains the holistic theory of organizational knowledge and continues to describe the Holistic KM model. The article presents a comparative review of selected KM models. The article is concluded by summarizing the features of holistic knowledge. Overall, the article presents the holistic model by combining the different aspects of knowledge such as affectual, perceptive and conceptual which are all needed to be considered at the same time.

The article titled “Perspectives on Knowledge Management Models” written by Dragos Sebastian Cristea and Alexandru Capatina describes the characteristics of some widely used knowledge management models. The authors presented a detailed description about few widely used KM models and explained their usefulness, advantages and disadvantages. The article gives an introduction to knowledge management models in its beginning followed by a detailed insight about various models such as Von Krogh and Roose model, Nonaka-Takeuch model, “Choo” model, “Wiig” model, Boisot model and the Adaptive Bennet model. Detailed description of each model is presented. The article concludes by summarizing the features of each model.

A new knowledge management model is proposed in the article “A Model of Knowledge Management and the N-Form Corporation” by the author Gunnar Hedlund. Hedlund have presented this model keeping in mind the organizational structure followed by American and Japanese companies. This model proposes a KM model named “N-Form” model which is build on the interplay between the articulated (tacit) knowledge and implicit knowledge at different levels such as individual level, group level, organizational level and inter organizational level. This model calls for departure of M-form organizational structure where there is a role based hierarchical division in the structure. This model stressed on the
combination of knowledge rather than its division. The proposed model has many advantages such as temporary constellation of people, importance of personnel at low levels, lateral communications of the people, a catalytic and architectural role of top management etc.

Nonakakujiro’s\textsuperscript{14} most widely read article entitled “Knowledge Creating Company” described how the highly successful Japanese companies like Honda, Canon, Matsushita etc. manage their knowledge. The article points out the Western Management strategies in comparison to the successful Japanese way of managing knowledge. For example according to Western Management an organization is viewed as a machine of “information processing” whereas the Japanese firms consider organization as a living organism rather than a machine. Much like an individual a company can have a collective sense of identity and fundamental purpose. Article presents few slogans used by Japanese companies and the success stories related to it and credit this success to the Japanese managers who exploit the knowledge of its employees. The article also brings it to light the reason why Japanese companies are ahead in continuous innovation as compared to their counterpart western countries. The reason lies in successful management of knowledge by Japanese companies. The spiral of knowledge is explained in rest of the article where Nonaka gives insight on how companies manage tacit and explicit knowledge and the different kinds of transition between tacit and explicit knowledge. Nonaka further explains the role of management in performing these transitions in tacit and explicit knowledge.

The article entitled, ”Knowledge Management and Knowledge Management Systems : Conceptual Foundations and Research Issues” written by Maryam Alavi and Dorothy E.\textsuperscript{15} presented a detailed review of knowledge, knowledge management and knowledge management systems with reference to various literature work by renowned authors. The literature review of knowledge management revealed the complex and multi faceted view of knowledge management. The article presents and reviews different definitions of knowledge and its forms. Further the article discusses about organizational knowledge, knowledge creation process in the organization, knowledge management processes. The article highlight the role of IT tools in organizational knowledge management system. The authors presented a wide range of scholarly work on knowledge management and knowledge management system paving way for further work on KM by researchers.

Elizabeth A. Smith\textsuperscript{16} discussed various issues related to tacit and explicit knowledge in her article entitled “The role of tacit and explicit knowledge in the workplace”. The article gives
a detailed insight on knowledge, knowledge-creating companies and knowledge management. The contribution of tacit and explicit knowledge are discussed and illustrated. Methods to recognize, use, share, acquire and measure tacit and explicit knowledge are shown. The paper also presents ways to balance the use of tacit and explicit knowledge at the workplace and also the ways to improve understanding of knowledge are presented. Practical examples of how tacit and explicit knowledge are handled by renowned companies like Xerox, Accenture, Ernst & Young, World Bank etc. is very well explained in the article. The paper concludes by suggesting the companies to recognize their tacit and explicit knowledge wealth and utilize it to solve problems, achieve goals and have a major competitive advantage. Organization must create a work-centric environment to encourage sharing and use of all forms of knowledge is also mentioned in the article.

The paper “Tacit to Explicit Knowledge Conversion : Knowledge Exchange Protocols” authored by Richard T. Herchel, Hamid Nemati, David Steiger discussed core issue of knowledge management that is the conversion of knowledge from one form to the other. The author presented a protocol for converting tacit knowledge into explicit knowledge. He mentioned the SOAP protocol which is used in medical community. A sample SOAP knowledge exchange protocol is discussed in the article. The study conducted an experiment on 238 students with a mentioned list of eight hypotheses. The experiment tries to understand the effect of protocol used for conversion of tacit to explicit knowledge. Using a proper statistical tool the hypotheses are tested and it is found that 4 hypotheses are rejected. Thus, the article presents a detailed insight on the knowledge exchange protocols to be followed while converting one form of knowledge to another.

The research paper written by Liana R., Kathrin K., Frantisek S. entitled “Personal Knowledge Management : The role of Web 2.0 tools for managing knowledge at individual and organizational levels” discuss about the use of Web 2.0 tools for personal knowledge management. This paper discusses new approaches for personal knowledge management in the era of Web 2.0 technologies. The paper implements a systematic research methodology. The findings of the research show that, Web 2.0 enables a new model of personal knowledge management (PKM) including formal and informal communication, collaboration and social networking tools. It is found that, this new PKM model facilitates interaction, collaboration and knowledge exchange on the web and in organizations. The paper provides concrete examples of practical implementation of Web 2.0 and creates awareness and understanding of Web 2.0 and its role in personal knowledge management.
Gerald Goh and Co-author\textsuperscript{19} conducted a multiple case study to understand the effect of culture on knowledge management in their research paper “The Effect of Culture on Knowledge Management Practice: A qualitative Case Study of MSC Status Companies”. The paper presents a detailed scholarly review about knowledge, knowledge management and its implications. Authors have conducted a research based on MSC (Multimedia Support Corridor) status companies in Malaysia. After a detailed review of few case studies it is found that there are number of significant cultural knowledge management enablers within the Malaysian context. Collaboration, mutual trust, learning, leadership, incentives and rewards are the cultural factors that act as enablers of knowledge management process of the organization. The research proposes a new variable kiasu-ism which is an inhibitor to knowledge management. Further research on kiasu-ism is suggested by the authors to understand its implications in knowledge management initiatives in Malaysian organizations.

The present research paper entitled “A comparative Study of Knowledge Management Assessment in Business Excellence Awarded and Non-Awarded Organizations in India” written by Deepak Chawla and Himanshu Joshi\textsuperscript{20}, presents a survey on Indian top and middle level companies to assess the knowledge management practices and their benefits gained by the companies. The study was conducted on 16 private and public sector Indian organizations along with the participation of 57 top and middle level executives for the survey. In this research an attempt has been made to distinguish between the Indian companies awarded for the business excellence and companies who have not been awarded for business excellence. The distinction is made on the basis various dimensions of knowledge management assessment tools (KMAT) used by both categories of the companies. The test on these sample of 57 executives revealed the result that, the companies which are awarded for business excellence fare better in all dimensions of knowledge management as compared to their counterpart companies. Further results revealed that, knowledge management culture process, culture and measurement aspect of knowledge management are well structured in award winning companies in comparison to non-awarded companies. The article concludes by suggesting areas where knowledge management practices can be improved thereby enhancing the performance and excellence in business. The research findings can prove beneficial for the organizations in facilitating business excellence by developing knowledge intensive processes.

Another research paper “Knowledge Management Implementation: Holistic Framework Based on Indian Study” written by Parag Sanghani\textsuperscript{21} gives a detailed insight on knowledge
management practices implemented by Indian organizations. The research paper provides definition and classification of knowledge by supporting a strong literary review. It also presents a KM implementation Framework. The author introduced a new knowledge management implementation framework which takes into account the human factor which was otherwise not considered by other frameworks. This new proposed framework puts emphasis on providing training to the employees, giving them incentives and rewards for sharing their tacit knowledge. Major objective of the paper is to present conceptual KM implementation framework based on learning of current KM practices.

Parth B. and Pravin K. discussed different aspects of Knowledge Management and its application in their paper “Knowledge Management and its Utilisation : an Overview”. The authors have mentioned the relevance of knowledge management for organizations. The paper explains the concept of knowledge and knowledge management, its need, its value and the benefits of knowledge management for the organization. It shows the importance of knowledge management activities for the organizations and various challenges faced while implementing the knowledge management process. Further, the role of IT in knowledge management is mentioned. They explained various types of Knowledge Management initiatives in different sectors of India such as Corporate level organizations, R&D level initiatives, Financial level initiatives and Academic level initiatives and also the role of knowledge management in Library is explained. The paper concludes by mentioning the observations drawn from the paper.

The paper entitled “Management strategies for individual knowledge and organizational knowledge” written by Ganesh D. Bhatt presents a new framework of knowledge management for exploring the difference between the individual knowledge and organizational knowledge and presents a set of management strategies to handle these two distinct kind of knowledge and how to transform an individual knowledge into organizational knowledge. The author presents scholarly definition of knowledge, individual knowledge and organizational knowledge. Also the difference and relationship among the individual and organizational knowledge is given. The role of management in creating organizational knowledge is explained followed by mention of management strategies for handling individual and organizational knowledge. The paper concludes by arguing that part of knowledge is public and the other part of knowledge is private. The public knowledge is easy to manage but the private knowledge is very difficult to control. The paper gives
suggestion for managing this private knowledge such as creating an environment of collaboration and informal coordination can result in controlling the private knowledge. Paper further suggests that successful management of private knowledge can empower the overall organizational knowledge.

Santwana Chaudhuri\(^4\) conducted a study of Indian IT companies situated in Kolkata and Hyderabad in his research paper “Knowledge Management in Indian IT Industries”. The study is to understand the basic reason for implementing knowledge management practices. The study also focuses on the corporate culture maintained and its importance A total sample 194 companies in Kolkata and Hyderabad region out of which for the survey 20 companies are selected. The survey is conducted using a questionnaire. With the help of questionnaire following data such as Reason for launching KM, Knowledge Acquisition and Sharing sources, Managing ideas and Innovations are gathered for all the 20 IT companies. The relationship between organization culture and knowledge management is also presented. The concluding remark shows that according to the data collected it is found that it is the majority companies such as TCS, IBM, Infosys, Oracle, Satyam etc. have a well established KM system and the knowledge management initiatives have proven beneficial for these companies. The success of KM is also based on implicit culture of the organization, the philosophy and belief of trust, giving people the continuous learning opportunities.

Abhilasha Singh and Ebrahim Soltan\(^5\) conducted a study related to knowledge management in Indian companies in their article “Knowledge Management practices in Indian Information Technology Companies”. The study is aimed at identifying the knowledge management awareness level and implementation strategies of Knowledge Management practices in Indian IT companies. A sample of 10 companies has been selected from North region of India and data was collected using secondary source. During the study various phases of knowledge management such as knowledge generation, knowledge codification, knowledge transfer and knowledge application were taken into account. Authors suggested the ways to improve knowledge sharing culture of the organization and the HR practices must be aligned with knowledge management so as to gain maximum benefits.

Poonam Singh Sangwan’s\(^6\) article “Knowledge Management : An Organizational Competence Perspective” provides theoretical explanation of knowledge, its type and knowledge management. The paper also presents various important characteristics of
knowledge, categories of knowledge, knowledge value and needs for knowledge are also identified. The paper is strongly supported by scholarly reference.

The present article titled “Knowledge Management: Why do we need it for” written by Bhojaraju G., gives a brief introduction about Knowledge Management. The author provides explanation about needs of knowledge management, its definitions, components of knowledge management, KM assets, various challenges faced during knowledge management activities. The paper also describes the process of KM initiatives at any organization. The article presents a brief case study on KM initiatives at ICICI OneSource. The author argues that knowledge sharing and knowledge reuse should be encouraged at the organizational level as well as at individual employee level. Knowledge measuring and rewarding for knowledge performance can encourage knowledge sharing is also suggested in the paper. The corporate culture that encourages knowledge performance is vital for the success of the knowledge management. The paper concludes by suggestion for the implication for policy and future practices of knowledge management.

J. Andrade and Co. Authors in their research paper titled “A Reference Model for Knowledge Management in Software Engineering” proposed a reference model of knowledge management in the field of software engineering. The authors argued that, software engineering is a field where knowledge and experience plays a fundamental role and, in this discipline changes are particularly fast and new methodologies and techniques and technology constantly appear and that need to modify or refine the existing knowledge. In this scenario knowledge management strategy can prove very beneficial for improving the efficiency of software engineering process. The authors have presented a formalization scheme that is able to represent, capture and transmit the relevant organizational knowledge as well as meta knowledge required during the software development process to persons involved in software development process. This will ensure the each person involved in the software development process will have quick access to the best knowledge at the right time, thereby it results into overall efficiency. Finally, the paper concludes by listing out the improvements occurred after implementing the proposed scheme.

The research paper written by Gerarado Matturo and Andres Silva entitled “A Model for Capturing and Managing Software Engineering Knowledge and Experience” discusses the implementation of knowledge management process in the software development process. The
authors argues that, during the software development process each person gain knowledge and experience, these knowledge and experience can be reused in other projects to improve the efficiency of the software development process. The authors suggested a model for identifying and capturing this knowledge and experience of an individual and making it available for reuse and accessed and also storing the lessons learned from the projects which may help in improved efficiency of future projects. Knowledge and experience gained during the software development process are normally not given much importance, by suggesting this model for software engineering the authors claim that, knowledge and experience identification and capturing becomes integral part of the software development process and hence brings improvement in the development process of the software.

The paper entitled “Knowledge Management practices in software development organizations : An Australian experience” written by Aybuke Aurum and Co. Authors discuss current practice of knowledge management in software engineering process in two Australian Companies. The two companies were selected where KM practices are applied in their software development work. The paper brings to light various KM practices and KM process used in the software engineering process. The paper also mentions various enablers of KM process in terms of leadership, technology, culture, process and measurement. It is found after the study that, software developers believes in the usefulness of knowledge sharing but the software developers had a limited utilization of the KM systems. Various technology enablers of knowledge management used at the companies were, personal networks, informal network, groupware etc. The authors suggest that, there is a need to formalise the knowledge sharing system at these organizations. It is also discovered from the study that, the tools and techniques needed for knowledge management system were not adequate, and also in both the companies a uniform knowledge management model was not established. It is found that, leadership is considered as the top most enabler of knowledge management practices and personal network technology also plays a vital role in knowledge sharing.

Carolina and Angel wrote a research paper entitled “Strategic knowledge management, innovation and performance” discussing the relation of knowledge management and innovation and performance of the organization. The paper aims at showing the effects of KM strategies on organization’s innovation and performance ability. The authors discussed that, organizations fail to realize the real benefits of knowledge management practices. Authors present their study based on survey of 310 Spanish organizations. The findings of the
study shows that, the KM strategies including codification and personalisation have direct or indirect impact on organizations innovation and performance capabilities. The KM practices increase organization’s innovation capacity and thereby increases the overall performance indirectly. The KM practices also directly affect the organizations performance in different dimensions.

Finn Olav B. and Togeir Dingsoyr, in their research paper entitled “Knowledge management in software engineering: A systematic review of studied concepts, findings and research methods used”, did a systematic review identifying empirical studies of KM initiatives in Software engineering, and discussed the concept and presented the major findings which showed a significant role of knowledge management in the organizations.

Another research work done by authors Narasimha B., Mohammed Khalifa and Efraim Turban in their research paper entitled “Integrating KM into enterprise environments for next generation decision support” investigated an approach for integrating decision support and knowledge management process using knowledge discovery techniques. Based on the proposed approach, an integrative framework is presented for building enterprise decision support environment using model marts and model warehouses as repository for knowledge obtained through various conversions.

The research article entitled “Knowledge Management in Indian IT Organization” written by Mr. P Arangana and Ms. J. Lakshmi studied KM activities undertaken by the IT companies, its need and the advantages gained. The article begins with introduction to the concepts of knowledge management, knowledge management components, functions of knowledge management, tools used for knowledge management, need for KM in IT organizations, challenges faced by IT organizations in implementing KM, study of various IT companies implementing KM. The study argues that for IT industry it becomes important to ensure that knowledge in the minds of resources is safeguarded. It is very important for IT organizations to maintain their intellectual capital that is the knowledge of their employees which is possible by implementing KM.

According to Vadivelan Sivanantham who authored the research article entitled “Knowledge Management in Agile Projects”, the main asset of software development is not manufacturing plants or buildings and machines but the knowledge held by the employees and the development culture of an organization. The author emphasized on the types of knowledge involved in the lifecycle of software projects and describes mechanisms to
effectively manage them in Agile software development. It then argues for the need to scale Agile development strategies in knowledge management to address the full delivery process. The paper discuss various aspects related to knowledge management and software development and their interrelationship. The paper concludes by advising some mechanisms to be implemented in Agile development method which ensure full utilization of knowledge.

Partho Sengupta, Huzafa Lukhanwala and Ajit Mahajan\textsuperscript{36}, in a research paper entitled “Social and Collaborative Knowledge Management in the FMCG sector”, discussed the potential of knowledge management with respect to organizational survival and competency in the face of increasingly discontinuous environmental change. They further argued that in the FMCG sector, effective knowledge management takes on a new dimension. An interactive knowledge management solution plays a critical role in the building of strong customer relationships. Social and Collaborative Knowledge Management (SCKM) enables organizational intelligence namely in the form of Knowledge Management using Web 2.0 Solutions and Microsoft SharePoint. The paper suggests that, FMCG companies implement the concept of SCKM to get an insight into what their consumers feel about their competitor’s products. This gives the FMCG companies an insight into what new needs and wants consumers now expect to be fulfilled.

Farida Hasanali’s\textsuperscript{37} in her research paper “Critical Success Factors of Knowledge Management” argues that elementary success factor of knowledge management (KM) is to have a common understanding of the terms “knowledge management” and “knowledge sharing” and how they apply to your situation and needs. The success of KM initiatives depends on many factors categorized as leadership, culture, roles and responsibilities, information technology infrastructure and measurement.

Galen Gruman\textsuperscript{38} wrote an article entitled “Capgemini adopts social networking for knowledge management “ where he discussed the need of a sophisticated knowledge management system at Capgemini, that gathers and filters information from communities around the globe.

A research article entitled “Knowledge Management Technology” authored by A.D. Marwick\textsuperscript{39} presents a review of technologies that contribute to knowledge management solutions using Nonaka model of organizational knowledge creation framework. The extent to which knowledge transformation within and between explicit and tacit knowledge can be supported by the technologies is discussed, and likely future trends are identified. The aim of
the paper is to provide an overview of technologies that can be applied to knowledge management and to assess their contribution in knowledge creation and knowledge sharing.

Another author Shu-Mei Tseng also studied relation of information technology and knowledge management in the article titled “The effects of information technology on knowledge management systems”. The research paper explores the roles and effects of IT on KMS, and conclusions are drawn after a proper literature review, expert interviews and questionnaire analyses. It is concluded that even though, IT is the foundation for managing knowledge assets, it is merely a tool to assist in the implementation of KMS. The key to implementing KM is the people themselves.

Kazuo Hosono in his research article “Application of Knowledge Management in System Development” discussed the role and importance of knowledge management in system development process. The author emphasizes how sharing of knowledge among the team and project managers is crucial towards the success and efficiency of the project. The article discuss about the SolutionNET, a knowledge management tool implemented at the Fujitsu company. Further, the paper introduces the implementation of ProjectWEB, which is a support tool of SolutionNET. The paper concludes with suggestions for enhancement of ProjectWEB tool.

A critical review, presentation, and integration of two main concepts Knowledge Management and Organization learning Capability is focused in the research paper titled “Knowledge Management And Learning Capability To Enhance Organizational Innovativeness” written by Ayse Günsel, Evangelia Siachou, A.Zafer Acar. The research paper attempts to integrate KM and OLC in a holistic approach so that managers can utilize it for organizational innovativeness. The authors constructs a KM framework reflecting the steps of KM life cycle which is facilitated by Organizational Learning Capability with a view point to increase organizational innovativeness. The study presents practical implications for the managers and executives. The authors suggest that, the managers must realize the value of knowledge based entities in order to accomplish organizational innovativeness. Further, they suggest that manager must establish and maintain a KM system in order to ensure the effective processing of the incoming knowledge. The importance of organizational learning capability should be realized because innovation depends on learning how to use incoming knowledge. Lastly, it is suggested that Knowledge Management and Organizational Learning
Capability should be considered as complementary to each other and also efforts should be taken to integrate OLC into the KM system.

An easy step by step process to implement Knowledge Management practices are explained in the research paper “A Practical Approach to Implement Knowledge Management” written by James A. Albers. The author emphasizes on the importance of knowledge capturing, acquiring and sharing in the organization and for this organization needs to implement KM system. The paper presents a simple step by step approach for implementation of Knowledge Management in an organization by considering key elements related to knowledge management such as knowledge management team, knowledge management strategy, knowledge assessment and audit, information technology assessment, and project plan and measurement systems. The author also mentions some best practices, common pitfalls, lessons learned and success factors throughout the implementation process.

Andre and Dr Rob van der in their book titled “Knowledge Management Dealing Intelligently with knowledge” gives basic information related to knowledge management. The book covers description of concepts like knowledge, knowledge in organization, dimensions of knowledge in organizations, Knowledge Management and information about organizations can benefit from Knowledge Management. It is a small book covering basic topics in simplified language.

A small handbook titled “Knowledge Management : A Global Perspective” tries to bring the most recent research findings and best practices in order to demonstrate the potential challenges related knowledge management. The book consist of sixteen well organized and researched chapters selected from international authors. The research papers collected covers wide area of application of knowledge management. The book gives a deeper insight into the knowledge management practices across multiple domains.

Another book entitled “Knowledge Management : A Resource book” written by Thothathri Raman covers detailed description related to knowledge management. There are 15 chapters beginning with history of knowledge, the way the knowledge was accumulated and assimilated over the year, the knowledge vision of the corporate, the way KM was incorporated into strategy, the role of knowledge workers, the way a knowledge corporation is built, the challenges of the new age and the social role of knowledge. Number of illustrations has been provided to explain the KM concepts. A separate section of cases is
also provided showing how KM works. The epilogue points to the future directions and idea for further reading on the subject.

Elias M. Awad & Hassan Ghaziri’s book entitled “Knowledge Management” covers many facets of knowledge management from concepts, to people, to tools, to procedures. The book is about knowledge, how to capture it, how to transfer it, how to share it and how to manage it. The book also explains the use of computer for capturing and sharing tacit knowledge and network that transfer tacit and explicit knowledge. The book is organized in five parts where Part I covers the basic concepts, Part II covers Knowledge Creation and Capture, Part III covers Knowledge Codification and System Implementation, Part IV covers KM system tools and portals and last Part V deals with Ethic Legal and Managerial issues.

Bryan Bergeron’s book “Essentials of Knowledge Management” is practical survey of the field of Knowledge Management. The book aims to examine the approaches to knowledge management that contributes to corporate competitiveness. The books illustrates the practical business aspects of Knowledge Management in an easily understandable language. Therer are eight chapters covering key technical, cultural or economic issues of the technology. Some of the chapters are knowledge organization, Knowledge workers, Process, Technology, Solutions, Economic. The book ends with providing suggestion for further reading in the topic.

Filemon A Uriarte’s book “Introduction to Knowledge Management” provides an introduction to various elements of knowledge management. The book is specially designed for the beginners in the field of knowledge management. The book has six chapters. The first chapter introduces the concepts of knowledge. The second chapter defines knowledge management. The third chapter deals with the history of knowledge management. The fourth chapter explains the elements of knowledge management. The fifth chapter is about knowledge management tools. The final chapter covers step by step procedure for implementation of knowledge management system.

Dr. B. Rathan Reddy, in his book entitled “Knowledge Management [tool for business development]” mentioned, “KM is a systematic leveraging of information & expertise. Knowledge Management is understanding gained through experience of “know-how” i.e accumulation of facts, procedures and rules”. Further the book covers major issues concerning knowledge management such as Drivers of KM, Technology and KM, Human
Resource and KM, Learning Organizations, Cross Functional Areas and KM. The book covers 25 case studies of various companies implementing KM.

“Working knowledge : How Organizations Manage What They Know” is one of the best seller book in the field of knowledge management authored by Thomas Devenport and Laurance Prusak. The main aim of the book is develop preliminary understanding about what knowledge is within the organization. How does it look and sound in daily life and works? How it is different from data. The second aim of the book is to discover the cultural and behavioural issues related to knowledge? What does successful knowledge looks like?

An handbook titled “Achieving successful knowledge management initiatives: Turning knowledge into action and creating business benefit” written by Rob van der Spek and Jan Kingma discusses the benefits of knowledge management in improving business’ efficiency. The book covers basic concept of knowledge management, assumptions underpinning our perspective on knowledge management, what should knowledge management deliver? What are the keys to successful knowledge management? Effective enablers focused on the empowerment of employees, effective change management system by top management, effective management of knowledge management program. The book describes the importance of knowledge management implementation in business environment and how the company can avail full benefit from the same.


The book entitled “Software Engineering” written by K.K. Agrawal and Yogesh Singh, explains the basic principles of Software Engineering. After introducing the basic fundamental concepts, the book covers detailed explanation of Software requirement and specification, software design, software metrics is provided in the book.
“Sharing Knowledge in the Corporate Hive” is an exclusive report published in the magazine by Guy Currier. In this report, a formal study of 342 managers knowledgeable about their company’s usage of knowledge management and collaboration technologies is conducted. The research is conducted by Ziff Davis Enterprise Research by using online questionnaire. Questions related to the knowledge management, collaboration tools and document management techniques used by the organization were asked. The results generated revealed trends about the relationship among knowledge management, collaboration tools and document management systems. The trends revealed that the organizations which used knowledge management and collaboration tools in combination achieved their goals in short span of time. Thus the research concluded that the fusion of knowledge management with collaboration tools creates a knowledge sharing system offering tangible benefits and improving organization’s overall performance.

“Case Studies in Knowledge Management” book written by Murrey Jennix is a collection of 20 case studies investigating the implementation of knowledge management practices. The book includes cases from many different countries like Australia, Austria, Behrain, China, Egypt, Germany, Great Britain, Hong Kong, India, Newzealand and the United States. Variety of business situations are presented including banking, engineering, government, consulting, manufacturing, military, project management, software development and public utilities. The book consists of twenty chapters covering all the issues related to KM and different types of cases.

The case study of Tata Consultancy Service (TCS) by Dr. Santosh K. Mohanty and Manish Chand, discussed the knowledge management maturity model implemented at TCS. The model named 5iKM3 is used for assessing and harnessing the organizational ability to manage knowledge. The knowledge management maturity model 5iKM3 has been developed to leverage the organizational knowledge for business benefits. Further, the study explains the need for developing model, basic pillars of KM – People, Process and Technology, and the five states used to benchmark KM maturity. At last, the case study describes the Assessment model, the purpose of which is to offer a framework facilitating the activities performed during the 5iKM3 model.

Another case study of a leading giant company, Infosys, entitled “Infosys’ Knowledge Management Initiatives” written by Indu P gives the case of knowledge management system of Infosys, named Knowledge Management Maturity Model (KMM). Following
topics are covered as a part of the case study, they are: background note about the company and its evolution, Infosys’ Intranet based learning components, the launch of KSHOP a knowledge portal, improving the functions of KSHOP, knowledge creation and knowledge sharing, using advanced KM systems. The case study presents statistical review showing the benefits of KM which includes on an average 5% improvement in productivity in specific software development projects. At last, the study concludes that the company identifies KM as one of the three leadership areas along with collaborative and convergence technologies. Infosys firmly believed that in the light of changes in the business environment, managing, knowledge effectively remained a key contributor to the success of the company.

Another case study of Wipro Technologies by Manimaran Rajakannu\(^9\) investigated KM Initiatives under taken by the company. The study shows that Wipro launched their KM System named TecNet in April 2002. TecNet acts as repository of technical documents, evaluation reports and best practice documents which will ensure availability of information to the developer community of Wipro. This aims at reducing rework and ensuring better and quicker completion of development and technical projects.

Another case study titled ” Knowledge management practices within a knowledge-intensive firm: the significance of the people management dimension” written by Maxin Robertson and G. O’Malley Hammersley\(^6\) focused on the role of people management practices play in facilitating knowledge management. The findings of the study reveals that perhaps too much reliance has been placed on technological solutions to KM to date. The authors emphasized the contextual nature of KM and the practices or system in support of KM.

A research report on Knowledge Management presented by BML consulting in conjunction with Griffith University\(^6\) was also studied. The research findings indicates the importance of knowledge management within the organizational framework and the acceptance of this new management strategy in the Indian context. The research report covers following points, Executive Summary, Introduction and methodology, Current state of KM, Experience to date of KM, Achieving benefits, KM and role of technology, The organizational implications, The knowledge journey.

A survey based research is conducted by The Harris Research Center\(^6\) on behalf of KPMG Management Consulting to evaluate the awareness of knowledge management by different organizations and their current implementation of KM. The research also shows the benefits availed from knowledge management implementations and future plans related to it. For the
survey a sample of 100 UK companies with a turn over more than 200 million pounds a year were taken and the respondents were among the top executives, finance and marketing directors and those having the responsibility of knowledge management activities. The research report begins with current awareness and initiatives of knowledge management implemented by these companies followed by showing the statistics about the Cost of Ignoring the knowledge. An analysis about the failure to store critical knowledge effectively and failure to exploit the technological infrastructure is presented. The report also presents statistical information about need for vision and strategy, investing on knowledge, and full benefits for early adapters of knowledge management. In the concluding part the findings and conclusions drawn from the research are presented.

Elin hultkivist’s Master thesis entitled “ A case study of knowledge management at large software company : How knowledge worker cope with large amount of information ” submitted to University of OSLO, Department of Informatics, is a qualitative case study, carried out at Microsoft Norway. The main aim of the thesis is to understand role and benefits of Knowledge Management in Information management and learning in an organization in the knowledge based society. The findings of the thesis shows that, KM provides large amount of information to the employees, this information can be a source of stress for some employees. Employees must adopt some strategies to cope with this information. The study also explores the relationship of information management and learning. There is also a notion about corporate culture in relation to knowledge management strategies. Finally, the thesis concludes finding that knowledge management is an integrated part of the corporate culture as well as normal work practices.

1.6 Significance of the Study:
The present study is undertaken considering the significance of this new management tool. It is being looked as one of the emerging tool of management in new millennium. More attention is now being paid by the organizations to human capital. This is being considered as one of the most important resource of the enterprise. The age of s/w companies in India is of about 40 years. In these four decades the s/w organizations have travelled a long way and have got the recognition world-wide. The companies in India are applying new means and ways of doing things. KM is one of the most preferred tools nowadays in s/w companies for performance improvement and to remain in fray in this competitive business setup. The application of KM tools and techniques has not been studied in Indian s/w companies of Maharashtra State. The present research taken up with an aim to fill the research gap.
Accordingly the researcher has selected the topic of KM in s/w companies of Maharashtra state. The study is undertaken during the period 2009 to 2013.

1.7 Objectives:
This study investigates the current practice of Knowledge Management (KM) in Software Engineering (SE) in context to Software development companies in Maharashtra region. Specific objectives of the study are:

- To determine the current practices of Knowledge Management in Software Engineering projects by the software development companies in Maharashtra.
- To describe activities that comprise the Knowledge Management process in these companies.
- To identify different models of Software Engineering based on Knowledge Management practices.
- To establish the impact of technology and culture as enablers of the Knowledge Management process for Software Engineering in Maharashtra.
- To reduce the gap in literature concerning the Knowledge Management process for Software Engineering, by evaluating current state of Knowledge Management as applied to software development organizations of Maharashtra using detailed investigation.

1.8 Hypothesis:

- **Hypothesis 1**:
  - **Null Hypothesis (H₀)**: Software Development companies promote knowledge sharing culture irrespective of the number of software developed by the software companies.
  - **Alternate Hypothesis (H₁)**: Software Development companies’ promotion of knowledge sharing culture depends on the number of software developed by the software companies

- **Hypothesis 2**:
  - **Null Hypothesis (H₀)**: Software Development companies promote knowledge sharing culture irrespective of the opinion that knowledge sharing can harm the secrecy of the organization
  - **Alternate Hypothesis (H₁)**: The knowledge sharing culture of software development companies is related to the opinion that, knowledge sharing can harm secrecy of the firm.
**Hypothesis 3:**
- **Null Hypothesis (H₀):** Software Development companies promote knowledge sharing culture irrespective of the number of programmers working in a team.
- **Alternate Hypothesis (H₁):** The knowledge sharing culture of the software development companies depends on the number of programmers working in a team.

**Hypothesis 4:**
- **Null Hypothesis (H₀):** There is reusability of knowledge (Modules and Codes) irrespective of size of organization in terms of number of employees.
- **Alternate Hypothesis (H₁):** The reusability of knowledge (Modules and Codes) is related to the size of organization in terms of number of employees.

**Hypothesis 5:**
- **Null Hypothesis (H₀):** There is reusability of knowledge (Modules and Codes) irrespective of number of software developed by the organization.
- **Alternate Hypothesis (H₁):** The reusability of the knowledge (Modules and Codes) and number of software developed by the organization are co-related.

**Hypothesis 6:**
- **Null Hypothesis (H₀):** There is reusability of knowledge (Modules and Codes) irrespective of Software development model preferred for developing software.
- **Alternate Hypothesis (H₁):** The reusability of knowledge (Modules and Codes) depends on the SDLC model preferred for developing the software.

**Hypothesis 7:**
- **Null Hypothesis (H₀):** There is reusability of knowledge (Modules and Codes) irrespective of number of programmers working in a team.
- **Null Hypothesis (H₁):** The reusability of the knowledge (Modules and Codes) depends on the number of programmers working in a team.

**Hypothesis 8:**
- **Null Hypothesis (H₀):** Software development companies recognize knowledge as asset base.
- **Alternate Hypothesis (H₁):** Software development companies do not consider knowledge as their asset base.

**1.9 Research Methodology:**

The present research conducted to identify various knowledge management activities carried out during the software development process, and understand the benefits of the same. As the software, during its development life cycle goes through various phases, the present research studied the type of knowledge management activities that are performed during each phase and how it helps in transition from one phase to another. The research also covers the type of
knowledge culture that exists in the organizations and the significance of knowledge during the project life cycle. It also includes how both tacit and explicit knowledge is used and reused during each stage of life cycle and in new projects.

For the present research the organizations involved in software development projects are selected. The study is restricted to Maharashtra region. The software development organizations from various cities within Maharashtra region are selected. Total population of organization in Maharashtra region is more than 2000, out of which, a sample of 50 companies are selected for the present study. Maximum companies are selected from Mumbai and Pune city. The present study began with conduct of a pilot survey of 8 companies in Pune and Aurangabad region for measuring the KM initiatives. Initially, there were 70 questions included in the Pilot Survey. After testing the survey results the structured questionnaire was reframed. The companies selected for the research have their business span from local, regional, national to international level. Majority of the companies selected are of international stature. The criteria based sampling was used for selecting the units for representing all the region in the sample. Out of 50 sample size highest 16 organizations were taken from Pune and Mumbai, 9 organizations from Nagpur and 3 organization each were taken from Aurangabad, Jalgaon and Nashik region of the State.

Keeping in mind the objectives of the research, a questionnaire, comprising of 50 questions was designed. The questions were closed ended with 4 to 5 options. The questionnaire contained questions which revealed answers regarding various aspects of knowledge management and its application in the software development process. The questionnaire was divided into four sections; Section A having questions on profile of respondents and profile of the organizations, Section B having questions on Maintenance of Knowledge and Sharing of Knowledge, Section C on Evaluation of Knowledge Management and Knowledge Management in Software Engineering and Section D on Advantages and Disadvantages of Knowledge Management. In addition to the structured questionnaire, personal interviews with professionals on key posts were also conducted to get clearer picture about various knowledge management activities in their respective organizations.

After the data collection, data entry was done in excel worksheets. Tables and charts were generated using MS-Excel and MS-Word. First, individual factor tables were constructed for all 50 questions. Then, cross factor tables were also generated for data analysis and interpretation and drawing up of conclusions.
1.10 Scope and Limitation:

The present research is limited to only Maharashtra state only. It covers only 50 companies from various regions under Maharashtra state. The study included the software companies involved in development of Software Engineering projects. The scope includes all types of s/w development companies.

1.11 Period of Study

The period of study is from 2009 to 2013. The primary data used in the study has been collected by questionnaire and interviews wherever needed during the above period.

1.12 Chapters Scheme:

The thesis is arranged in the following chapters:

1. Introduction

2. Knowledge Management.


4. Knowledge Management practices in selected software development companies.

5. Data Analysis and Interpretation.

6. Conclusion and suggestions
References:


42. Ayse Gunsel, Evangelia Siachou, A.Zafer Acar, “Knowledge Management And Learning Capability ToEnhance Organizational Innovativeness”, 7th International Strategic Management Conference, Published by Elsvier, Ltd 2011.


57. Dr. Santosh Mohanty, Manish Chand, SiKM3 Knowledge Management Maturity Model, Case Study of Tata Consultation Services (TCS), www.tcs.com.


63. Elin Hultkvist, “A case study of knowledge management at large software company: How knowledge worker cope with large amount of information”, Master thesis submitted to University of OSLO, 201