SE-MABKM: An Epoch For Organization Knowledge Management

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Abstract: It is true to say that current working environment is ‘MFSWE’ i.e. multi facet smart working environment. Such environment requires smart system that performs tasks intelligently and smart system can be developed by the smart framework. In order to support such environment the concept of SE-MABKM has been brought forward for effective management of organizational Knowledge Management. While as SE-MABKM is providing a conceptual framework for OKM especially for software organization. In the software organization knowledge management became part and parcel. SE-MABKM framework will work as put the requirement and activation of knowledge Management Communities to design and develop an effective tools or application for smart working environment for various life cycles like Management life cycle. Organizational process Improvement Life cycle, and Software development Life cycle as well as Software Test Life cycle. Management caterers to the critical issues of organizational adaptation, survival, and competence in face of increasingly discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings. Reason of this paper writing is providing a framework for multi agent based knowledge management for software companies and after that this framework to be applied at various life cycle model in individual as well as collaborative manner for effective knowledge management tools and application development.

Keywords: SE-MABKM, MFSWE, KM, OKM, MABKM, MAS

I. INTRODUCTION

Organizational knowledge to be manage in effective manner otherwise they will manage effectively in reverse direction of policy. Today tools, application to be developed in this manner that it is used in further. Better software development policy can make better software Application. Organizational knowledge base is Became important tools for strategic decision making. While as we are crossing the horizon with knowledge and approach so here Multi Agent System (MAS) ‘Multiple Interacting Intelligent Agents’ can be used to solve problems that are difficult or impossible for an Individual Agents or Monolithic System to solve. Intelligence, May Include methodic, functional, procedural or algorithmic search, find and processing Approach. The agents in a multi-agent system have several important characteristics: Autonomy: the agents are at least partially autonomous, Local view: no agent has a full global view of the system, or the system is too complex for an agent to make practical use of such knowledge Centralization: there is no designated controlling agent (or the system is effectively reduced to a monolithic system) Typically multi-agent systems research refers to software Agents. However, the agents in a multi-agent system could equally well be robots, humans or human teams. A multi-agent system may contain combined human-agent teams. Multi-agent systems can manifest self-organization as well as self-steering and other Control Paradigms and related complex behaviors even when the individual strategies of all their agents are simple. When agents can share knowledge using any agreed language, within the constraints of the system's communication protocol, the approach may lead to a common improvement. i.e languages are Knowledge Query, Manipulation Language (KQML) or FIPA’S Agent Communication Language (ACL). While as MAS are self organized and knowledge management is necessary for organization development. Knowledge management is became the key to successes and this successes can be achieved via knowledge practices framework [1]; in my study of knowledge management approach for knowledge based Management framework. Both Industry and Academia are interested in knowledge management practices and organizational knowledge base development. As per the knowledge the successes of product life cycle depends on the three essential elements that is technology, people and process. So with the help of SE-MABKM Concepts (Support of Software Engineering via Multi Agent Based Knowledge Management) we are providing a knowledge based framework development based on the multi agent approach [2]. This framework knowledge practices to be applied based on the multi agent system. Within the organization each and every data to be recorded in centralized manner for further effective decision making. SE-MABKM is providing a framework where each and every data collected by the various agents to be recorded itself in the centralized ways. In the SE-MABKM, Knowledge management process and practices is performing based on Multi agent (MABKM). MABKM is providing a ways for effective organizational KM practices Knowledge communities which are suffering for better policy and practices to get better ROI but management policies are unable to produce desired result [2]. SE-MABKM is providing framework based on that in future software or application to be developed [3], With the help of SE-MABKM process strategic organization policy management at software companies to be boost via centralized data storage with proper indexing, Bandwidth, warehousing and data mining approach. It also provide effective data ware housing ,data mining, proper utilization of bandwidth as well as indexed form of data for fast retrieval. In this research paper we have deals concepts
about MAS and its characteristics. MABKM and its operational ideology, SEO process and practice for optimum knowledge management and integration of MABKM into various life cycle of SEO in individual as well as combinational that will gives then concepts of SE-MABKM and its regulatory framework and finally Effectiveness of SE-MABKM and Implementation factor of SE-MABKM.

II. AGENT AND MULTI AGENT SYSTEM

The various definitions presented in the literature identified the key properties that characterize an intelligent agent [5][6][7][8][9][10][11][12]:

Autonomy: agents operate without the direct intervention of humans or others, but have some kind of control over their actions and internal state using a set of tendencies. Tendencies are individual goals to be achieved by the agent.

Social ability: agents cooperate, negotiate, and communicate with other agents.

Reactivity: agents perceive their environment, and respond in a timely fashion to changes that occur in it in order to satisfy their design objectives.

Pro-activity: agents do not simply act in response to their environment; they are able to exhibit goal-directed behavior by taking the initiative. Agents are capable of handling complex and high-level tasks. The decision as to how such a task is best split up into smaller sub-tasks, and in which order, and way, the sub-tasks are best performed, should be made by the agent itself.

Temporal continuity: agents are continuously running processes.

Mobility: an agent has the ability to transport itself from one computer to another, retaining its current state.

Learning: agents are able to learn and adapt themselves to fit their environment.

We also identified classes of agents have been defined in the literature: reactive agents and cognitive agents [5][6][7][9][10][13].

Cognitive agents possess internal representation models of the world and expertise, have goals and plans, are capable of reasoning, and can cooperate, coordinate, negotiate, and communicate with other agents.

Reactive agents in contrast do not have any internal symbolic models of their environment, and they act using a stimulus/response type behavior by responding to the present state of the environment in which they are embedded. Work on reactive agents originates from research work carried out by [14] in robotics at MIT in 1985. In his paper, he objected to cognitive agents, and developed reactive agent architecture for the control of autonomous mobile robots. The most common modules of the internal architecture of an agent are perception, execution, self-knowledge, acquaintance knowledge or social knowledge, domain knowledge, reasoning, learning, cooperation, and communication [5][6][10][11][12][17][16][18][19]. These are described in more detail below.

Perception: the perception module is one of an agent's interfaces to its environment. Commonly the perception module obtains signals from the agent's sensors. But in most architecture this module is integrated into the communication interface.

Self-knowledge: the agent's self-knowledge contains agent's knowledge about itself, including its physical state, location and skills, etc.

Domain knowledge: this knowledge concerns the problem-solving domain and environment. Usually this module contains the description of the problems to be solved.

Social knowledge (acquaintance knowledge): this knowledge, also called beliefs, is the knowledge used by the agent to interact with its acquaintances. It describes the skills and identity of acquaintance agents. The knowledge is used by the agents to identify other agents with whom it is useful to interact, and wish to determine which agents have the skills necessary to perform a particular task. This knowledge must indeed model the role, competence, the localization (address of an agent), the goals, the plans, and the resources of these dealings to be able to interact with them.

Learning: an agent working in a dynamic environment needs to adapt to changes in that environment. It needs to learn in order to update its knowledge about its environment, other agents, and the problems to be solved.

Reasoning: it is the decision making process which decides to act on the basis of the information it receives, and in accordance with its own objectives to achieve its goals.

Communication: it is the interface used by the agent to communicate with its environment and other agents.

Cooperation: defines the models of coordination and cooperation to interact with other agents in order to perform tasks for other agents. Till now we have discuss the characteristics of intelligent agent and now we are discussing the MAS.

A. MULTI-AGENT SYSTEM (MAS)

Various definitions have been proposed for the term multi-agent system (MAS). [20] defined a MAS as a loosely coupled network of problem solvers that work together to solve problems that are beyond the individual capabilities or knowledge of each problem solver. More recently, [12] defined MAS as a system composed of a population of autonomous agents, which interact with each other to reach common objectives, while simultaneously each agent pursues individual objectives [21]. The main characteristics of MAS, defined by [10], are:

- Each agent has incomplete information, or capabilities for solving the problem, thus each agent has a limited viewpoint; There is no global system control; Data is decentralized; Computation is asynchronous.

Figure 1: Black Board architecture

Two main multi-agent architectures have been addressed in the literature: blackboard and autonomous architectures.
problems that are beyond their individual capabilities. Each without cooperation. Cooperation is necessary because no sophisticated problem solving and can work independently, with the work of [20,26] where he defined that cooperative distribution architecture is its relative inefficiency because of its very centralized control mechanism and its lack of local memory. As stated by [11], blackboard architectures cannot be considered as multi-agent systems as they do not respond to the characteristics of MAS. However, they are still used in many applications because of their ease of implementation. In autonomous architectures, illustrated in Figure 2, the agents are not controlled or managed by any other agents; rather they communicate and interact directly with any other agent in the system to achieve the global objective. Knowledge and control are distributed, in the sense that each agent embodies its own knowledge and control.

In order for MAS to solve common problems coherently, the agents must cooperate, coordinate, and communicate amongst themselves. Cooperation, coordination, and communication are central to MAS. Agents need to interact with other agents to achieve their objectives either because they do not have sufficient capabilities or resources to complete their problem-solving alone, or because there are interdependencies between the agents that follow from being situated in a common environment [24]. These interactions can vary from simple information exchanges to requests for particular actions to be performed, cooperation (working together to achieve a common objective), coordination (arranging for related activities to be performed in a coherent manner), and negotiation (a process by which a group of agents come to a mutually acceptable agreement on some matter) [25].

**B. MULTI AGENT CHARACTERIZATION**

In above section we deals the concepts of agent and MAS now we are focusing on some more special characteristics of MAS which makes it different from others.

**B1. COOPERATION AND COORDINATION**

Work on cooperative distributed problem solving began with the work of [20,26] where he defined that cooperative distributed problem-solving studies how a loosely coupled network of problem solvers can work together to solve problems that are beyond their individual capabilities. Each problem-solving node in the network is capable of sophisticated problem solving and can work independently, but the problems faced by the nodes cannot be completed without cooperation. Cooperation is necessary because no single node has sufficient expertise, resources, and information to solve a problem, and different nodes may have expertise for solving different parts of the problem. According to [27], cooperation occurs when the actions of each agent satisfy either or both of the following conditions:

- Agents have a possible goal in common, which no agent could achieve in isolation, and their action tends to achieve that goal.
- Agents perform actions, which enable or achieve not only their own goals, but also the goals of agents other than themselves. There are several reasons why agents need to cooperate and coordinate their activities (19,17,28). Distributed expertise, resources, and information. No individual agent has sufficient competence, resources, or information to solve the entire problem. Many problems cannot be solved by individual agents working in isolation because they do not possess the necessary expertise, resources, or information. Different expertise may need to be combined to solve a very difficult problem that is out of the scope of any individual agent. Different agents may have different resources which all need to be scheduled to produce a final product. Finally different agents may have different viewpoints of a problem. Agents in MAS possess different capabilities and expertise. Coordination is necessary because with decentralization in agent-based systems anarchy can set in easily. No agent possesses a global view of the entire agency to which it belongs, as this is simply not feasible in any community of reasonable complexity. Consequently, agents have only local views, goals, and knowledge that may conflict with others.

Meeting global constraints: Global constraints exist when the solution being developed by a group of agents must satisfy certain overall conditions if it is to be deemed successful. There are dependencies between the agents. Interdependence occurs when goals undertaken by individual agents are related either because local decisions made by one agent have an impact on the decisions of other community members, or because of the possibility of conflict interactions amongst agents.

Efficiency. Cooperation and coordination can significantly increase efficiency. Even when individuals can function independently, thereby obviating the need for cooperation, information discovered by one agent can be of sufficient use to another agent that both agents can solve the problem twice as fast. The main issues to be addressed in inter-agent cooperation include the following [12]: How tasks are distributed and allocated among agents? How to coordinate the activities of the agents to avoid conflicting situations (coordination)? How can the overall problem-solving activity of the agents be optimized so as to produce a solution that maximizes the coherence metric? So for this question we are dealing the concepts if Collaboration by task allocation.

**C. COLLABORATION BY TASK DISTRIBUTION OR ALLOCATION**

Task distribution, also called task allocation, involves the definition of the organizational mechanisms through which agents can combine their skills to perform collective work. Task allocation can be managed by centralizing the distribution process or by distributing it among all the agents concerned [13,31,11,19,12].

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**Figure 2: Autonomous Architecture**

![Figure 2: Autonomous Architecture](image-url)
C1. TASK ALLOCATION THROUGH MEDIATION

In centralized task allocation, allocation involves special agents, mediators or traders to manage the allocation of tasks to the agents, but not directly between agents. In this case, the mediator agent should have the necessary knowledge of all the agents in the system, including their competence and their availability. Figure 3 shows a mediator agent allocating a task $T$ to a suitable agent through its knowledge about the agents.

![Diagram of mediator agent allocating task](image)

When the mediator agent receives a request from an agent to carry out the task $T$, then it sends an appropriate request to the relevant agents. If only one of the agents accepts to carry out the task, the mediator agent can simply allocate it to that agent. If more than one agent accepts the task, the mediator agent selects one according to relevant criteria. If all the agents refuse the task, the mediator agent informs the originator of the request that it could not find a suitable agent for the task. The advantage of task allocation through mediation is that the mediator possesses sufficient knowledge about its coordinated agents and their competence to ensure global consistency. The main drawbacks are its bottlenecks, and the centralized structure is not fault tolerant because failure of the mediator causes failure of the whole system.

C2. DISTRIBUTED TASK ALLOCATION

Through the Contract Net Protocol. In distributed task allocation, each agent individually finds the suitable agents that are able to carry out its task without any degree of centralization. A classical technique for distributed task allocation is the contract net protocol. It is the most common and best-studied mechanism for distributed task allocation in agent-based systems [19][12]. The contract net protocol is a high level protocol for achieving efficient cooperation introduced by [32] based on a market-like protocol. The basic metaphor used in the contract net protocol is, as the name of the protocol suggests, contracting. Smith took his inspiration from the way that companies organize the process of putting contracts out to tender in public markets.

The contract net protocol received an enthusiastic welcome from the distributed artificial intelligence community. In this approach, a decentralized market structure is assumed and agents can take on two roles: a manager and a contractor. The basic premise of this form of cooperation is that if an agent cannot solve an assigned task using local resources/expertise, it will try to find other willing agents with the necessary resources/expertise to solve the tasks.

The tasks are assigned using a contracting mechanism. The manager agent advertises the task by a task announcement to other agents in the net, Figure 4. In response, contracting agents evaluate the task with respect to their abilities and engagements and submit bids. A bid indicates the capabilities of the bidder that are relevant to the execution of the announced task. The manager agent evaluates the submitted bids, and selects the most appropriate bidder to execute the task, which leads to awarding a contract to the contractor with the most appropriate bid. The contractor assumes the responsibility for the execution of the task. After a task has been completed, a report is sent to the manager. The advantages of the contract net protocol include the following: dynamic task allocation via self-bidding which leads to better agreements, it provides natural load balancing (as busy agents need not bid), agents can be introduced and removed dynamically, and it is a reliable mechanism for distributed control and failure recovery. In the basic contract net protocol, it is assumed that the manager waits for all the bids before evaluating them, this can cause the manager to wait indefinitely. To overcome this problem, [11] proposed to assign for each task announcement a deadline for the receipt of bids, and all those arriving after this date are directly rejected and are not taken into account in the selection step. Another problem is that between the time a bidder submits its proposal to the manager and the time it is awarded the contract or rejected, it is committed to carrying out the task. While submitting any future proposals, it must take into account the earlier commitments thought not awarded yet. To solve this problem, [33] extended the contract net protocol to a time bound negotiation framework or a finite time-guarantee protocol by attaching the commitment duration to the task announcement and bid messages. Contracts in the basic contract net protocol have been binding, i.e. once an agent agrees to a contract, it should honor it full commitment and has to follow through with it no matter how future events unravel. Although a contract may be profitable to an agent when it is established, it may not be profitable after some future events have occurred. In the majority of realistic scenarios, agents are situated in dynamic environments, where agents may become aware of new information, another agent may attempt to interact with it, and so on. As a response to these practical situations, the contract net protocol has been recently extended to the leveled commitment contracts as another method attaching commitments to the negotiation protocol for capitalizing on future events[30][34][35][36][37][38][39]. Instead of conditioning the contract on future events, a mechanism is built into the contract that allows de-committing. This is achieved by specifying the level of commitment by de-commitment conventions. De-commitment conventions describe circumstances under which an agent should de-commit. They also specify the appropriate contract's alternative actions to retain, rectify or abandon the commitments. If an agent wants to de-commit, the agent can do so simply by proposing a de-commitment convention. The method requires no explicit conditioning of the contract on future events: each agent can define its own conditioning dynamically. The coordination of actions was described by [40] as the set of supplementary activities which need to be carried out in a multi-agent environment, and which a single agent pursuing the same goals would not accomplish. According to [31], coordination is a process in which agents engage in order to insure their community acts in a coherent...
manner. Coherent means that the agents' actions get well, and that they do not conflict with one another. For [30], coordination is the process by which an agent reasons about its local actions and the anticipated actions of others to try and ensure the community acts in a coherent manner. The main approaches that have been developed for coordinating activities are centralized planning, multi-agent planning, game theory, and negotiation [12][19][30][11].

Figure 4 Step to contact net Protocol

D. CENTRALIZED PLANNING

This approach assumes the existence of a single planner agent which plans and distributes fragments of the plan to the slave agents whose role is limited to be executive only. This agent also handles the task allocation and coordination of agents. The slave agents must ultimately report their results to the master agent. In this case, while the master slave has full autonomy with respect to the slaves, the slaves have only partial autonomy with respect to their master. [30,31][11] pointed out that such centralized rigid structure is contrary to the assumptions of MAS. It presumes that one agent has a global view of the entire agency in many domains, which is an unrealistic assumption.

D1.MULTI-AGENT PLANNING

With the multi-agent planning approach to coordination, agents usually form a multi-agent plan, which specifies all their future actions and interactions with respect to achieving their goals, and may interleave execution with more planning and re-planning. Multi-agent plans are typically built to avoid inconsistent or conflicting actions. With this approach agents know in advance exactly what actions they will take, what actions their acquaintances will take, and what interactions will occur. There are two basic approaches to multi-agent planning: centralized and distributed. In centralized multi-agent planning, there is usually a coordinator agent who, on receipt of all partial plans or local plans from individual agents, analyses them in order to identify potential inconsistencies and conflicting interactions and grouped them to unsafe actions to create critical regions. The coordinator agent then attempts to modify these partial plans and combines them into a multi-agent plan where conflicting interactions are eliminated either by re-planning (re-arranging actions) or by inserting into individual plans communication primitives to synchronizes the actions of the agents appropriately. For more details about synchronization see [11]. In distributed multi-agent planning, the idea is to provide each agent with a model of other agents' plans. Agents communicate in order to build and update their individual plans and other agents' plans until all conflicts are removed. The principal drawbacks of the multi-agent planning approach are that the amount of information exchanged between the agents is very high and communication is costly. In addition, the centralized planning approach presents the same limitations of centralized structure. The distributed multi-agent planning is very complex to implement in terms of detection and resolution of conflicting interactions.

D2.NEGOTIATION

Negotiation is a widely used technique for conflict resolution in multi-agent systems. It is the most fundamental and powerful mechanism for managing inter-agent dependencies. A basic definition of negotiation is that of [41], negotiation is the communication process of a group of agents in order to reach a mutual accepted agreement on some matter. For [12] negotiation proceeds in a series of rounds, with every agent making proposals, trade options, offer concessions at every round. The proposals that agents make are defined by their strategy, must be drawn from the negotiation set, and must be legal, as defined by the protocol. If agreement is reached, as defined by the agreement rule, then negotiation terminates with the agreement deal. [25] defined a generic framework of negotiation. In this framework, negotiation can be viewed as a distributed search through a space of potential agreements. For a given negotiation, the participants are the active components that determine the direction of the search. The minimum requirement of a negotiating agent is the ability to make and respond to proposals. To improve the efficiency of the negotiation process, the recipient need to be able to provide more useful feedback on the proposals it receives. This feedback can take the form of a critique (comments on which parts of the proposal the agent likes or dislikes) or a counter proposal (an alternative proposal generated in response to a proposal). From such feedback, the proposer should be in a position to generate a proposal that is more likely to lead to an agreement. Since negotiation involves exchanges of messages, negotiation protocols defining primitives of dialogue need to be defined. The most known and used dialogue primitives are found in the contract net protocol involving offers, bids, and contracts. Various negotiations methods have been defined in literature and most of them are inspired by human negotiation [30][31][42][43][19][25]:

- Market-based negotiation: the simplest and the most renowned negotiation protocol, and the most widely used in agent-based systems is the contract net protocol involving offers, bids, and contracts [13][31][25][19][40]. It is a high-level negotiation protocol that provides many advantages, and most importantly its flexibility and dynamic nature which suits industrial agent-based applications.

- Plan-based negotiation: this is based on cooperation strategies for resolving conflicts among plans of a group of agents. [46][15] described a three-phase cycle negotiation plan. This model of negotiation could be centralized or distributed. In centralized negotiation, an arbitrator agent receives the local plans of the individual plans, detects the conflicts, and initiates a negotiation process to overcome the conflicts. The arbitrator agent assists whenever agents are in conflict by reviewing their proposals and using their local plans to generate alternative proposals. Negotiation is an iterative process with a three-phase cycle:
The arbitrator agent makes a proposal to resolve the conflicts, which are evaluated by the agents in conflict. Arbitrator agent generates counter proposals if the agents in conflict are not happy with the proposals, or the original proposal may be simply accepted. Arbitrator agent submits the counter proposal for review by the agents.

In distributed plan-based negotiation, the three-phase cycle negotiation process is distributed among the agents. Every agent can be an arbitrator and can negotiate with other agents in order to arrive to a mutual agreement. Centralized negotiation presents the disadvantage of centralization of the negotiation on the arbitrator agent. Distributed plan negotiation is more effective but still very expensive in communication and difficult to implement.

Game theory-based negotiation: negotiation employs techniques based on game theory to structure and organize negotiation between the agents. The key concepts in the game theory approaches are the following: utility functions, a space of deals, strategies, and negotiation protocols. Utility is defined as the difference between the worth of achieving a goal and the price paid in achieving it. A deal is an action an agent can take which has an attached utility. The negotiation protocol defines the rules that govern the negotiation. The negotiation process involves an interactive process of offers and counteroffers in which each agent chooses a deal which maximizes its expected utility value. There is an implicit assumption that each agent in the negotiation process is an expected utility maximizer. At each step in the negotiation, an agent evaluates the other’s offer in terms of its own negotiation strategy. The assumptions of game theory-based negotiation are untenable in real applications, and it is unlikely to suffice for industrial agent-based applications. Game theory-based negotiation assumes that two agents are interacting. In addition, it only considers the current state when deciding on their deal; past interactions and future implications are simply ignored.

AI-based negotiation: [47] considered negotiation as an iterative activity and she explored case-based reasoning in this iterative process. She argued for a case-based approach, since human negotiators draw from the past negotiation experiences to guide present and future ones. [48] view negotiation as a constraint-direct search of a problem space using negotiation operators. These operators are drawn from human negotiation studies. They are used for relaxation. In their approach, negotiation involves two stages: a communication phase where all information is communicated to participating agents and a bargaining phase where deals are made between individuals or within a group. Agents negotiate via the relaxing of conflicts and constraints until agreement is reached. Alternatively, solutions may be modified until acceptable. The main limitation of this iterative approach stems from the fact that selecting relaxations to achieve a compromise is a major problem as no criteria are provided, and hence agents easily get caught in an infinite loop of exchanging offers.

D3. COMMUNICATION

In multi-agent systems, as with human beings, communication is the basis for interactions and social organizations. Communication enables the agents to cooperate, coordinate their actions, and carry out tasks jointly resulting in systems that are more coherent. A number of communication languages have been developed for inter-agent communication, and the most widely used ones are KIF (Knowledge Interchange Format) [49], KQML (Knowledge Query and Manipulation Language) [50], and ACL (Agent Communication Language) [51]. KQML uses KIF to express the content of a message based on the first-order logic. KIF is a language intended primarily to express the content part of KQML messages. ACL is another communication standard emerging in competition with KQML since 1995. Nowadays, XML (Extensible Markup Language) started to show its performance as a language to encode the messages exchange between the agents, in particular in agent-based e-commerce to support the next generation of Internet commerce [14][17][11][19][53][12].

E. INFORMATION EXCHANGES THROUGH A SHARED DATA REPOSITORY

A common shared data repository, i.e. a blackboard, is used by the agents to write messages or to post partial results on, and obtain information from. This mode of communication is used in blackboard architectures.

E1. MESSAGE PASSING

Communication via some form of message passing is a widely used approach. In the message-passing approach, agents communicate with each other by sending asynchronous messages. Asynchronous communication is the primary mode of interaction in most agent-based applications. There are two basic message types [18]: assertions and queries. Every agent, whether active or passive, must have the ability to accept information. In its simplest form, this information is communicated to the agent by means of an assertion. In order to assume a role in a dialog, an agent must additionally be able to answer questions, i.e. it must be able to accept a query from another agent and send a reply to the agent by making an assertion. In order to assume an active role in a dialog, an agent must be able to issue queries and make assertions. With these capabilities, the agent then can potentially control another agent by causing it to respond to the query or to accept the information asserted. There are several methods of communication:

• Point-to-point: one agent sends a message to another specific agent.
• Broadcast: one agent sends out a message to all other agents in the system.
• Multi-cast: one agent sends out a message to a selected group of agents.

E2. SPEECH ACT THEORY

Formalisms for representing communication in agent theory have tended to be based on speech act theory [6][9][19][11][18][50] as originated by Austin in 1962, and further developed by Searle in 1969. The key axiom of speech act theory is that communicative utterances are actions, in just the sense that physical actions are. They noticed that a certain class of natural language utterances or speech acts had the characteristics of actions, in the sense that they change the state of the world in a way analogous to physical actions. They observed that most things people say are not simply propositions that are true or false, but performative that succeed or fail. Thus the sentences uttered by humans during communication do not always simply assert a fact, but actually perform some action. Speech act theory uses performatives to identify the illocutionary force of the utterance. Austin identified a number of performatives including: request, promise, and inform.
The categorization of speech act by message types was initially motivated by Searl’s classification of illocutionary forces into four categories in 1969:

- **Assertive**: providing information that affirms something (e.g., the machine is turned off).
- **Directive**: sending directives to receivers (e.g., turn off the machine).
- **Commissive**: accomplishing certain action in the future (e.g., I will turn the machine).
- **Declaratives**: declaring a decision or an announcement (e.g., I name this machine A).

Since the early 1990s, Speech act theories have directly informed and influenced a number of languages that have been developed for agent communication, such as KQML and ACL. In KQML and ACL, each message has a performatIVE (a class of the message) and a number of parameters to describe the format of the message (sender, receiver, content, etc.). The most important differences between these two languages are in the collection of performatives they provide.

In this section we have seen the concepts of Multi agent system and requirement of Multi agent based framework. Based on that we think why we are not using these concepts for most valuable assets ‘Knowledge’ for organization development, so we identified some agents for organizational knowledge management especially for software companies or engineering. After integration of various identified agents known as Multi agent based knowledge management (MABKM) [1]. Now we are dealing some concepts MABKM at it’s integration.

III MABKM

In my research context ‘Lettature Studies and survey [1], [2], [3]’ we strongly observed the need of integrated concepts for Multi agent and Knowledge Management. Here in this section we bring the MABKM concepts for knowledge management. The details of this architecture are discussed here. Knowledge management (KM) is widely recognized as a critical issue in any kind of organization. “Knowledge is a mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information.” i.e., it is “the task of developing and exploiting an organization’s tangible and intangible knowledge resources. It has to do with structuring information, ensuring that it is available to all potential users, easily accessible, and presented in such a way that all data relevant to the requesting users are effectively returned in a reasonable amount of time. When dealing with such issues one technology that comes in handy consists of software agents. Agents are software components featuring some nice properties that prove quite helpful to perform routine tasks, which are normally carried out by human users. These include processing of large quantities of information, searching over multiple sources spread all over the world, extracting selected portions of documents and so on. Agents can even move on the network carrying along the tasks they were assigned; they can even reduce processing times by self-organizing into societies by spawning children agents acting in parallel [3]. We are now focusing on various agents and their contribution in KM practices. In the knowledge management domain, agents have been largely used in a multiplicity of projects and applications, to address a number of functions, roles and activities. So, we are introducing agents for the effective utilization of knowledge at various step of software engineering. Here, we are discussing agents and their characteristics in context of KM. We have identified knowledge agent as per my research finding.

A. DOMAIN KNOWLEDGE AGENT

‘DK, as the name suggests, is associated with capturing, storing that information which is related to domain. Domain Expert stored their knowledge and expertise the database with the help of DKA into OKB. New Users can assess the experience and information here. Domain knowledge is that valid Knowledge used to refer to an area of human Endeavour, an autonomous computer activity, or other specialized discipline. Domain knowledge is knowledge about the environment in which the target system operates, for example, Software Agents. Domain knowledge is important, because it usually must be learned from software users in the domain (as domain specialists/experts), rather than from software developers. Expert’s domain knowledge (frequent informal and ill structured) is transformed in computer programs and active data. For example in a set of rules in knowledge bases, by Knowledge Enablers. Communicating between end-users and software developers is often difficult. They must find a common language to communicate in. Developing enough shared vocabulary to communicate can often take a while. The same knowledge can be included in different domain knowledge. Knowledge which may be efficient in every domain is called domain-independent knowledge, for example logics and mathematics. Operations on domain knowledge are performed by Meta-Knowledge.

B. ORGANIZATIONAL KNOWLEDGE AGENT

OKA work as per the information carried out by the knowledge enabler on pro rata basis. This information can be used for internal monitoring purpose and organizational process to be improved.

C. PROCESS KNOWLEDGE AGENT

Process Knowledge Agent (PKA) record, evaluate and stored information into OKB. And this information is then utilized by the knowledge enabler as well as decision maker. The role of a process agent is a vital important service for many businesses dealing with suppliers or tenders in the worldwide. Process agents accept service of notices, proceedings or documents on behalf of their overseas clients in situations where, usually because of contractual obligations, it is not possible for them to be served abroad. A process agent can act in a broad capacity for this company including but not limited to; acting as a process agent for court actions, receiving documents in connection with arbitration proceedings and receiving notices under contracts where an independent party is needed. A typical example of a process agency arrangement is where an overseas entity raises a loan from a city institution. Immediately the lending bank will require the appointment of a UK based process agent to receive formal notices should the borrower default on the loan.
D. DISTRIBUTED CASE BASED AGENT

Distributed Case base Agent Stores the information as per the Situation and case based scenario. This agent is responsible for Store, Monitor and Evaluate information into OKB and help to the Knowledge Enabler and well as Decision maker in the future project and its effectiveness. In information technology a reasoning system is any software application, hardware device or combination of software and hardware whose computational function is to generate conclusions from available knowledge using logical techniques of deduction, induction or other forms of reasoning. Reasoning systems are a subset of a broader category of intelligent systems. They play an important role in the practical implementation knowledge engineering and artificial intelligence. A reasoning system manipulates previously acquired knowledge in order to generate new knowledge. Knowledge is typically represented symbolically as informational facts and propositional statements that capture assertions, assumptions, beliefs and other premises. Sub-symbolic (connectionist) knowledge representations may also be used (e.g., trained neural nets). Reasoning systems automate the process of inferring or otherwise deriving new knowledge via the application of logic. In a concrete implementation, reasoning systems may support procedural attachments and built-in actions to process or apply knowledge within some given domain or situation. Reasoning systems have a wide field of application that includes scheduling, business rule processing, problem solving, complex event processing, intrusion detection, predictive analytics, robotics, computer vision and natural language processing. Reasoning systems apply logic in order to generate knowledge. However, they demonstrate significant variation in terms of systems of logic and formality. Most reasoning systems implement variations of propositional and symbolic (predicate) logic. These variations may be mathematically precise representations of formal logic systems (e.g., FOL), or extended and hybrid versions of those systems (e.g., Courteous logic). Reasoning systems may explicitly implement additional logic types (e.g., modal, deontic, temporal logics). However, many reasoning systems implement imprecise and semi-formal approximations to recognised logic systems. These systems typically support a variety of procedural and semi-declarative techniques in order to model different reasoning strategies. They emphasise pragmatism over formality and may depend on custom extensions and attachments in order to solve real-world problems. Many reasoning systems employ deductive reasoning to draw inferences from available knowledge. These inference engines support forward reasoning or backward reasoning to infer conclusions via modus ponens. The recursive reasoning methods they employ are termed 'forward chaining' and 'backward chaining', respectively. Although reasoning systems widely support deductive inference, some systems employ abductive, inductive, defeasible and other types of reasoning. Heuristics may also be employed to determine acceptable solutions to intractable problems. Reasoning systems may employ the closed world assumption (CWA) or open world assumption (OWA). The OWA is often associated with ontological knowledge representation and the Semantic Web. Different systems exhibit a variety of approaches to negation. As well as logical or bitwise complement, systems may support existential forms of strong and weak negation including negation-as-failure and 'inflationary' negation (negation of non-ground atoms). Different reasoning systems may support monotonic or non-monotonic reasoning, stratification and other logical techniques. Many reasoning systems provide capabilities for reasoning under uncertainty. This is important when building situated reasoning agents which must deal with uncertain representations of the world. There are several common approaches to handling uncertainty. These include the use of certainty factors, probabilistic methods such as Bayesian inference or Dempster–Shafer theory, multi-valued ("fuzzy") logic and various connectionist approaches.

E. ONTOLOGY AGENT

An ontology formally represents knowledge as a set of concepts within a domain and the relationships between those concepts. It can be used to reason about the entities within that domain, and may be used to describe the domain. In theory, ontology is "formal, explicit specification of a shared conceptualization" ontology renders shared vocabulary and taxonomy, which models a domain with the definition of objects and/or concepts, and their properties and relations. Ontology's are the structural frameworks for organizing information and are used in artificial intelligence, the Semantic Web, systems engineering, software engineering, biomedical informatics, library science, enterprise bookmarking, and information architecture as a form of knowledge representation about the world or some part of it. The creation of domain ontologies is also fundamental to the definition and use of an enterprise architecture framework. There is also generally an expectation that there be a close resemblance between the real world and the features of the model in ontology. Contemporary ontologies share many structural similarities, regardless of the language in which they are expressed. As mentioned above, most ontologies describe individuals (instances), classes (concepts), attributes, and relations. In this section each of these components is discussed in turn. Common components of ontologies include:

Individuals: instances or objects (the basic or "ground level" objects)

Classes: sets, collections, concepts, classes in programming, types of objects, or kinds of things

Attributes: aspects, properties, features, characteristics, or parameters that objects (and classes) can have

Relations: ways in which classes and individuals can be related to one another

Function terms: complex structures formed from certain relations that can be used in place of an individual term in a statement

Restrictions: formally stated descriptions of what must be true in order for some assertion to be accepted as input

Rules: statements in the form of an if-then (antecedent-consequent) sentence that describe the logical inferences that can be drawn from an assertion in a particular form

Axioms: assertions (including rules) in a logical form that together comprise the overall theory that the ontology describes in its domain of application. This definition differs from that of "axioms" in generative grammar and formal logic. In those disciplines, axioms include only statements asserted as a priori knowledge. As used here, "axioms" also include the theory derived from axiomatic statements
Events: the changing of attributes or relations Ontology engineering (or ontology building) is a subfield of knowledge engineering that studies the methods and methodologies for building ontologies. It studies the ontology development process, the ontology life cycle, the methods and methodologies for building ontologies, and the tools and languages that support them. Ontology engineering aims to make explicit the knowledge contained within software applications, and within enterprises and business procedures for a particular domain. Ontology engineering offers a direction towards solving the interoperability problems brought about by semantic obstacles, such as the obstacles related to the definitions of business terms and software classes. Ontology engineering is a set of tasks related to the development of ontologies for a particular domain.

F. USER INTERFACE AGENT

It is one of the important agents this agent stores the User Interface worked performed by the previous personal and stored it into as a template of reference as per particular project as well as client interest areas. Marketability and good visibility need concepts and vision for user interface. The user interface is the space where interaction between humans and machines occurs. The goal of interaction between a human and a machine at the user interface is effective operation and control of the machine, and feedback from the machine which aids the operator in making operational decisions. Examples of this broad concept of user interfaces include the interactive aspects of computer operating systems, hand tools, heavy machinery operator controls, and process controls. The design considerations applicable when creating user interfaces are relation to or involve such disciplines as ergonomics and psychology. A user interface is the system by which people (users) interact with a machine. The user interface includes hardware (physical) and software (logical) components. User interfaces exist for various systems, and provide a means of: Input, allowing the users to manipulate a system, and/or Output, allowing the system to indicate the effects of the users' manipulation.

Generally, the goal of human-machine interaction engineering is to produce a user interface which makes it easy, efficient, and enjoyable to operate a machine in the way which produces the desired result. This generally means that the operator needs to provide minimal input to achieve the desired output, and also that the machine minimizes undesired outputs to the human. Ever since the increased use of personal computers and the relative decline in societal awareness of heavy machinery, the term user interface has taken on overtones of the (graphical) user interface, while industrial control panel and machinery control design discussions more commonly refer to human-machine interfaces.

G. WORKFLOW AGENT

Workflow agent is responsible to monitor the various workflow activities and this activity and can be utilized to KM practices. Then after it can be utilize for further decision making. A workflow consists of a sequence of operations, declared as work of a person, a group of persons, an organization of staff, or one or more simple or complex mechanisms. Workflow may be seen as any abstraction of real work. For control purposes, workflow may be a view on real work under a chosen aspect thus serving as a virtual representation of actual work. The flow being described may refer to a document or product that is being transferred from one step to another. A workflow is a model to represent real work for further assessment, e.g., for describing a reliably repeatable sequence of operations. More abstractly, a workflow is a pattern of activity enabled by a systematic organization of resources, defined roles and mass, energy and information flows, into a work process that can be documented and learned. Workflows are designed to achieve processing intents of some sort, such as physical transformation, service provision, or information processing. Workflow concepts are closely related to other concepts used to describe organizational structure, such as silos, functions, teams, projects, policies and hierarchies. Workflows may be viewed as one primitive building block of organizations. The relationships among these concepts are described later in this entry. The term workflow is used in computer programming to capture and develop human-to-machine interaction. The term workflow is more commonly used in particular industries, such as printing, and professional domains, where it may have particular specialized meanings.

Processes: A process is more specific notion than workflow, and can apply to physical or biological processes, for instance. In the context of concepts surrounding work, a process may be distinguished from a workflow by the fact that it has well-defined inputs, outputs and purposes, while the notion of workflow may apply more generally to any systematic pattern of activity (such as all processes occurring in a machine shop).

Planning and scheduling: A plan is a description of the logically necessary, partially-ordered set of activities required to accomplish a specific goal given certain starting conditions. A plan, when augmented with a schedule and resource allocation calculations, completely defines a particular instance of systematic processing in pursuit of a goal. A workflow may be viewed as an (often optimal or near-optimal) realization of the mechanisms required to execute the same plan repeatedly.

Flow control is a control concept applied to workflows to divert from static control concepts applied to stock, that simply managed the buffers of material or orders, to a more dynamic concept of control, that manages the flow speed and flow volumes in motion and in process. Such orientation to dynamic aspects is the basic foundation to prepare for more advanced job shop controls, as just-in-time or just-in-sequence. In transit visibility is a monitoring concept that applies to transported material as well as to work in process or work in progress, i.e., workflows.

A workflow management system is a computer system that manages and defines a series of tasks within an organization to produce a final outcome or outcomes. Workflow
Management Systems allow you to define different workflows for different types of jobs or processes. So, for example, in a manufacturing setting, a design document might be automatically routed from designer to a technical director to the production engineer. At each stage in the workflow, one individual or group is responsible for a specific task. Once the task is complete, the workflow software ensures that the individuals responsible for the next task are notified and receive the data they need to execute their stage of the process. Workflow management systems also automate redundant tasks and ensure uncompleted tasks are followed up. Workflow management systems may control automated processes in addition to replacing paper work order transfers. If for example the above design documents are now available as AutoCAD but the workflow requires them as Catia an automated process would implement the conversion prior to notifying the individual responsible for the next task. This is the concept of dependencies. A workflow management system reflects the dependencies required for the completion of each task.

II. TOOLSET AGENT
These agents capture various toolset. Various toolset are available for Knowledge management like Document Project. This toolset agent capture information via GUI based Application. The aforesaid groups of agent possess some specific feature. They are autonomous, social, Objected oriented and Interactive. These agents are capable to communicate either for the performance of any tasks. These agents, when put together accomplish particular task. They are able to perform their part and release the task from complexity in effective manner. The figure 5 explains that multi agents are combined together to perform a task in effective ways. Shared knowledge space/Communication controls center are the areas through which these agents communicate with each other to perform the action. This multi agent’s architecture provides assistance to users by performing the task in effective manner by the help of managing knowledge.

IV. OPERATIONAL IDEOLOGY OF MABKM
We have already discussed various agents and there functionalities and this section we are going to present the work currently underway for Multi Agent based Knowledge Management, whose purpose is to realize an information management and knowledge sharing system that allows users with different perspectives on a common set of concepts to access heterogeneous information spread over a number of distributed sources on the Intranet as well as Internet. MABKM is a process to manage Information as well as knowledge at effective manner for future needs of organizational development. In this part of the thesis we are dealing a combinational approach of agent discuss earlier in Figure 5 are discussing multi agent architecture for knowledge management that will known as Multi agent based Knowledge management architecture. In this architecture user will access the knowledge from database with personalization approach [4]. Every agent like DKA: Domain Knowledge Agent OKA: Organization Knowledge Agent (OKA), Process Knowledge Agent (PKA), Distributed Case Base Agent (CBA), Ontology Agent (OA), User Interface Agent (UIA), Workflow Agent (WA) and Toolset Agent (TA) will work for Knowledge capture, Distribution and Evaluation.

V. SE-MABKM
The discussion made in previous Section of this paper relates us to software engineering organization where knowledge is considered as a main resource and various process applied to manage such ‘resource’ (Knowledge management)[1][2][3][4]Software engineering Organization is typical knowledge-intensive discipline that evolves very fast and involves a large number of people, different phases and different activities. Under this discipline knowledge and experience gained during the course gives basic fundamental support to any project undertaken. Here changes are very fast and new technology and methods constantly appear and modified existing knowledge. The knowledge flows with high ‘bandwidth’ in SEO. Therefore such organization is very much benefited from Knowledge management. The Surrounding of SEO is termed as Software Engineering environment. SEO Comprises of various life cycles these life cycles describe the working of SEO. Under these life cycles knowledge and experience are captured, explicit and structured. The knowledge related to the any project is collected here. Such Knowledge is managed and thus making it more useful in accordance with the need of that project. This way knowledge management provides the organization with considerable benefit.

![Figure 6: Software Engineering organizational life cycle](image)

In this Section we are integrating the MABKM Architecture in SEE. Such Integration of MABKM into SEE is termed as SE-MABKM[2][3]. Before we discuss SE-MABKM and its Objective it is necessary to go through SEE. So, we discuss the working of SEE first. Among all the life cycle of SEE, we are focusing on the the only because these life cycles have direct impact on management policy and productivity. These life cycles are[3]: Management Life Cycle (MLC), Organizational Process Improvement Life Cycle (OPILC) and System Development Life Cycle(SDLC) The details study of these life cycles we are dealing one by one.

A. MANAGEMENT LIFE CYCLE (MLC)
Management Life cycle perform management function. It controls the organization. This life cycle ensure that things are going as they should. Actual performance is compared with previously set goal here. Monitoring, Comparing and Potential Connecting is Covered under MLC. This ways MLC is very important part of SEO. Under MLC planning function encompasses defining the organizational goals.

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Establish an overall strategy for achieving these goals and developing the comprehensive hierarchy of plans to integrate and coordinate activities. MLC are responsible for designing the organizational structure. This includes determination of what tasks are to be done, who is to do them, how the tasks are to be grouped, who reports to whom and when decisions are to be made. We know that Knowledge is a valuable resource in planning. Under MLC Knowledge and its management rotates from implementation to the end. MLC begins from Various Information ([Knowledge]). Knowledge received here is huge in amount. It is not necessary that all received information is always useful, sometimes it is worthless, also may be, it is so that information received is not properly structured. So a need of knowledge management arises. Knowledge management includes exploration, analysis and evaluation of knowledge. Management life cycles received information, explore, make analysis and evaluate (collectively called Process). These processes convert the information into useful knowledge. Such knowledgeable information provides help in decision making. The winning strategy for any knowledge management needs to be one that addresses many different organizational requirements: fiscal, cultural and operational, and yet has virtue of simplicity. Since, the flow of knowledge is very much wide at MLC here KM requires a strategy focus on valuable knowledge. Concentrating on knowledge that will contribute to the improvement of organizational performance. That is to say KM strategy comes with certain complexity. The MABKM Architecture can be useful to tackle these complexities. The MABKM Architecture suggests KMS along with Multi agent System. Multi agents are the Group of Intelligent agents that allows each user involve in SEo, to assess the possible available information at the time of requirement. In MABKM Architecture, all agents autonomously collect and refine knowledge as information. This would provide the assistance and exploration of knowledge under MLC. Again these agents are capable of communicating with each other to achieve a common objective, this feature would help in analysis and evaluation of information and thus providing help in decision making [3].

B. ORGANIZATIONAL PROCESS IMPROVEMENT LIFE CYCLE (OPILC)

Process is termed as collection of activities that takes one and more kind of input and creates an output that is of value to customer. Examples of some process are procurement, sales and product development. A process is followed while managing organization where knowledge (as Information), as a right time plays a vital role in business activities. Knowledge has come to play an important role and regarded as a critical resource in view of contemporary, fiercely competitive business environment, both local and global. It is therefore, imperative that organization develop and continue to have ‘current and appropriate knowledge’ to ensure organizational effectiveness, efficiency and competitiveness. Knowledge systems have, therefore to be developed in the peculiar and specific organizational context. These activity related with development of knowledge are refer as process development[2][3]. The organizational process life cycle involves development of process. The OPILC begins from collection of various information. This information is updated in terms of Exploration, analysis and evaluation. By all this process knowledge become current and appropriate for decision making. These are then release as decision as per desired requirement. Today we are the part of global world where knowledge is everything. We need to make this knowledge current and appropriate for better survival; accordingly OPILC is responsible for doing so. We have various processes Improvement Concept like TQM, Six Sigma, ISO, CMMI and BS etc. All these are providing guideline for process improvement in organization. It is known that OPILC was process development. Under this life cycle there is introduction of New Process (Knowledge) and deletion of obsolete one. OPILC rely on decision makers to produce mission critical decision on the basis of input from multiple domains. The decision makers’ need an understanding of many specific sub domains that influence decision-making, coupled with the experience that enable quick decisive and action based on such knowledge. This might be benefitted form MABKM Architecture. The MABKM Architecture can help to determine where expertise resides in the organization. It can (MABKM Framework) create social environment. This would leverage recent advances in social network analysis. This analysis is based on observation of people, interaction patterns, communication and workflow. MABKM Architecture is design so that it identify expert by revealing the organizational knowledge network.

C. SYSTEM DEVELOPMENT LIFE CYCLE (SDLC)

System development life cycle is responsible for development of New and/or Legacy product or application. This is an era of globalization and organization needs to cope up with the dynamic and inevitable changes which takes place very often. Because of this change the competition among organization is becoming intense. The SDLC has been built around the organism metaphor in which organizations are analysis as if they were leaving organism operating in an environment which they need to adapt to ensure survival. The SDLC involves people, technology, information, Communication, Competition and social trends. System Development life cycle evolve planned change and improvement of organizations through the application of knowledge of behavioral science. This cycle is based on the systematically changes of processes. It focuses on managing the culture of organizations, working of SDLC involves many teams and numerous processes. It starts from communication among various teams. The process of communication under SDLC covers survey, feedback technique; involve gathering data, analyzing and Summarizing. The second phase of SDLC is planning. Here the gather data is bought again in front of employee and group for discussion to identify and solve problem and hence get solution (Software Requirement Specification). The planning also covers preparation of a roadmap for entire project, which include cost monitoring, scheduling and many more. The third phase of SDLC Covers Designing of Solution (SRS). Here solution or new application or development of legacy application is converted in the form of prototype, Forms/Function Design etc. The fourth phase is construction of proposed Solution (Front end and Back End) with the help of Desired Language and Database. In parallel testing is also there (what is going too developed and is Work is going on) as per the desired. It's also known as Implementation. SDLC Involves systematic application.
of knowledge at various levels. SDLC runs with an objective to bring higher quality, productivity, adaptability and its effectiveness. SDLC encompasses all the activities which go into producing/providing knowledge when organization's problem and opportunity. Here knowledge management is a structured problem solving endeavor consisting of distinct activities, which generally takes place in sequential and chronological order.

VI. INTEGRATION OF MABKM INTO SEO
While discussing the above cycles of SEO we have seen that these encompasses all the activities, which go into producing/providing knowledge when organization's problem and opportunity. Here knowledge management is a structured problem solving endeavor consisting of distinct activities, which generally takes place in sequential and chronological order.

Life cycles begins with the collection of knowledge from various sources for instances people mind. If the organization could capture the mind of intelligent people, all it would need is a better knowledge management strategy. Management of knowledge is art of creating and processing knowledge. We use the term 'art' because some companies do a very good job of creating, processing and managing their information, other do such a poor job that these tasks become a deteriorating factor for the successes of the organization. The proposed MABKM Architecture can be useful for better knowledge management Strategy. Life cycle under SEO starts from acquisition of knowledge. Here tacit knowledge came to be regarded as a challenge for knowledge acquisition. It implies that human to human transfer (through collaboration and storytelling) would remain necessary because knowledge management software can represent only codifiable knowledge. If knowledge acquisition procedure provides proper scaffolding, expert can verbalized their tacit knowledge and express concepts that they had never explicitly express before, including information about their procedure and strategy. In other word, verbalizing ability does not seem to be unavoidable problem in knowledge gathering practice. Life cycle includes decision making. Also here knowledge intensive organization relies on decision makers to produce critical decision on the basis of inputs from various areas. The decision maker needs to have an understanding of many specific sub areas that influence making of a decision. Again the decision makers need to couple with the experience that enables quick and decisive action based on received information. In this context MABKM architecture has been proposed. MABKM Architecture when integrated to different life cycles of Software Engineering Organization can provide solution to tackle the above problem. The MABKM Architecture contains a set of Multi agent System that offers a new dimension for cooperation and coordination in distributed collaboratively environments. Under this architecture each agent is autonomous in making decision on behalf of each function. This means that each agent can autonomously collects and process knowledge. We have already said that integration of MABKM into various life cycles i.e. SE is Called SE-MABKM. In further section of this paper we are going to discuss the regulatory framework of SE-MABKM. Before regulatory framework it is necessary to get familiar with all the term used in SE-MABKM Architecture.

VII. SE-MABKM ARCHITECTURE
SE-MABKM architecture is designed to store any type of data needed to convey that context of decision and the discussion involved in making decision. The various components of SE-MABKM Architecture are discussed herein under.

A. ORGANIZATIONAL LIFE CYCLE
In SE-MABKM, Organizational Life Cycle is a structure imposed on the development of a software product. It is often considered a subset of Management Life Cycles, Organizational Process Improvement Life Cycles and systems development life cycle. There are several models for such processes and Practices, each describing approaches to a variety of tasks or activities that take place during the process of Product Development. Responsibility of this life cycle to monitor the whole activity of Organization and try to improve it in unfavorable condition.

B. WORKSTATION
In SE-MABKM, workstation is a high-end User Interactive system for Organizational Users. Within these environments organizational users can interact, share and perform work as per assigned role and responsibility. They are commonly connected to a local area network and run multi-user operating systems and/or Wide area Network. The term workstation (group of heterogeneous and/or homogeneous member of organization life cycle) has also been used to refer to a terminal or a PC connected to a network. The workstation can be understood as a platform where users share their knowledge (Whether explicit or tacit).

C. INTERFACE LAYER
The top most of SE-MABKM is interface layer. It shows information in and out of the Knowledge management System. When this information is relevant, timely and actionable it represents knowledge. At the interface layer the KM System Users interact with the system to create explicit use, retrieve, and shared knowledge. The interface layer provides a universal mechanism for assessing all the layers
and underlying processes for delivering the information. Agents present in this layer gradually learns how to better assist the user by observing and imitating the user, understanding user’s interest and need.

D. INTELLIGENCE LAYER
This layer consists of multi-agent Middleware Infrastructure which remains active all the time and behaves concurrently in an autonomous manner to achieve a common goal regarding consistently changing user interest and heterogeneous knowledge resources. Agent can check the dynamic condition of Knowledge management Environment, reason to interpret those perception, solved problem, determine action and finally act accordingly. Some agent have an ability to learn from past mistakes at an explicit level which is something very much in line what a SE-MABKM is intended to help with.

E. RESOURCE LAYER
The bottom-most layer in a SE-MABKM architecture is the one which contains organization intellectual assets (Knowledge and Experience). The considerable size of an information space and variety of resource residing in it, make network information assets a daunting task. Therefore, knowledge should be organized by an appropriate taxonomy for the ease of its retrieval. By enhancing the existing information sources with Meta data, the agents are able to recognize about information. This is because agents understand and agree on the meaning of the term the other agent is speaking because the term is officially described in a public ontology that can be referred to.

F. ORGANIZATIONAL KNOWLEDGE BASE (OKB)
We observed through a survey counts that in last few years, companies have downsized and flattened their organization. Many of the employees who were laid off had been with the company for years. When they walk out the door, took experience, education, contacts and information with them. The companies have to put effort again to train the new employee. Maintaining organizational knowledge is a key management factor in retaining and promoting key employee but certain factors like distance, turnover and challenges of finding experts can make it difficult to maintain and share the knowledge. In this context, SE-MABKM brings the concepts of OKB. Organizational Knowledge base (OKB) can be understood as a giant database which is included in SEE. OKB is designed to store any type of decision and knowledge involves in making decision. It combines all knowledge of various life cycles of SE. It represents the combinational approach of all database (where refine knowledge is available) of various life cycle. The next section of this paper brings the theory based concept of working of SE-MABKM under various life cycles.

VIII. REGULATORY FRAMEWORK OF SE-MABKM
The working strategy of SE-MABKM can be divided into three layers. These are interface, intelligent and structured resource layer. All these layer of SE-MABKM contain set of multi-agents which are identified by their active roles that is serving user, cooperating work and etc. The collected information comes with the contact of interface layer. In
the same difficult decision every month and every year. Difficult decision can require the participant of dozens of employees and analysis of terabytes of data it would be nice if the organization could keep the knowledge gained from every decision and applied to the similar problem in future. SE-MABKM Framework is design to store any type of data needed to convey the context of the decision and the discussion involves in making decision. SE-MABKM is a theoretical framework for organizational knowledge management. This framework is proposing a combinational approach. Previously we have seen that MABKM Architecture can help to convert knowledge from distributed environment into useful information collaboratively. Now, SE-MABKM is combining all the useful information from various life cycles into OKB. OKB is primarily a giant database. SEO Always seeks for a better management Policy to get optimum ROI and Maximize the effect of Balance sheet with the help of this SE-MABKM framework, organization can get right information at the right time to right people. As OKB Contains already processed information from various life cycles it can be very much helpful in performance of any task in a short time. Even new user can avail benefit from this because it contains experience of previous task. Under SE-MABKM Framework all life cycles stores information about task (to be performed or have already been performed) together into OKB. If management needs to provide any 'knowledge' (which is related to any task) can take reference from decision of same kind of task available in OKB. SE-MABKM is providing theoretical concepts from knowledge base framework where every single data is collected by agent to store in a centralized way. There are some benefits of this theoretical framework, these are listed below:

- From SE-MABKM Framework, it is easier to developer to create new knowledge. In this ways the organizational memory is not closed, it is always evolving.
- A major concern for SE-MABKM is to capture information during software process without developers extra efforts. Thus, the SE-MABKM is actively into work process.
- SE-MABKM offers and open environment. Close system do not give organizational control over their own knowledge, since gap between knowledge creation and integration.
- SE-MABKM Users are no longer passive receiver of knowledge, but are active researchers, constructors, and communicators of knowledge.
- In SE-MABKM knowledge can be constructed collaboratively in the context of the work. Attention of Knowledge requires attention to people, including their task, motivation, and interest in collaboration. The heart of intelligent human performance is not the individual human mind but groups of mind interacting with each other along with tools and artifacts.
- The SE-MABKM Provides information according to workers needs and at the time when they need it. It plays an active role in knowledge dissemination.
- SE-MABKM monitors the actions of users as they work, and inform about potentially relevant knowledge for work.

The next section of this paper we are discussing the factors that should be taken into consideration while implementing SE-MABKM.

X. IMPLEMENTATION OF SE-MABKM

Simply throwing a computer on an employee's Desk does not make him or her instantly more productive or instantly smarter. We have to train people on the best use of the system. Prior to implementation of SE-MABKM we have to take a proper feedback from the working people. Feedback will show trained and untrained people of the organization. If more people are untrained regarding computational skill then we would trained first through internal trained people or outsource the trained people from remote organization. After the training completion take a exam of Computational skill and if people get or secured more then 60% or equivalent Grade then implement application into software Engineering environment. After implementation we have to prepare a questionnaire in fortnightly basis to get People mind Knowledge. It will help to understand management regarding what is going on within the organization. Based on that information they can take appropriate decision or action to improvement in the organizational policies. After the storing information compare it from previous or old information and if any improvement then update otherwise wait from another forth nightly. And at the end of the month analyze it for appropriate decision. However, there are some factors that should be taken into consideration while implementing SE-MABKM. These factors leading to organizational success.

A. EMPLOYEE TRAINING

Numerous studies have pointed out on the importance of employee training to knowledge management implementation success. So, if a company wants to become a truly knowledge-based organization, it must start with quality training. This is true because in virtually every market, customers are demanding high quality, lower costs and faster cycle times. To meet these requirements, firms must continually improve their overall organizational performance. Rapid advances and technology and improved processes have been important factors helping businesses meet this challenge. However, the most important competitive advantage to any firm is its workforce - one that must remain competent through continuous training and development efforts. Training provides employees and managers the skills and information to fulfill their responsibilities. Improved performance is a strategic goal for organizations in order to achieve the bottom line purpose through training and development. For the same reason, a number of organizations have become or are striving to become learning organizations. This is because one of the reasons for the failure in effective work-behaviors would be insufficient training to support knowledge management principles.

B. EMPLOYEE INVOLVEMENT

Employee involvement in making organizational decisions is a well-researched area. It describes how employees can contribute effectively to meeting the organization's objectives. It refers to the degree that employees share information, knowledge, rewards and power throughout the organization. Creating a high involvement organization involves making choice about organizational design that creates a world in which individuals know more, do more
and contribute more. The recognition of the importance of employee tacit knowledge is based on the assumption that successful performance improvement may not only depend on how work is organized, and the skill of the worker, but on the willingness of employees to convert tacit knowledge of the work process into continuous process improvement and innovation. Employee involvement is an array of techniques aimed at sharing information, knowledge, rewards and authority. It is thus the right way to gather knowledge from various levels of management and essential for an organization to survive.

**C. OPEN AND TRUSTWORTHY SPIRIT OF TEAMWORK**

Another factor for successful implementation of SE-MABKM is creation of Open and trustworthy spirit within team member. Teams are the units that actually carry out the work in many knowledge-intensive organizations. They are the ones that must access and apply distributed knowledge effectively. Teamwork is an essential source of the knowledge generation process. A well staffed team is crucial for successful implementation of SE-MABKM. This is because knowledge that individuals possess may be difficult to articulate because it is so deeply embedded in routines and practices that are taken for granted. By creating teams, it allows organizations to apply diverse skills and experiences towards its processes and problem-solving. After all, the focus of business and knowledge management application is on providing an environment in which knowledge workers of various disciplines can come together and create new knowledge.

**D. EMPOWERMENT**

Empowerment refers to a feeling of control and self-efficacy that emerges when people are given power in a previously powerless situation. It means eliminating the bureaucratic controls and creating a sense of freedom so that people can commit all their talents and energies to accomplish their shared goals. Empowered employees are given autonomy 'the freedom', independence and discretion 'over their work activities'. They are assigned work that has high levels of task significance important to themselves and others. Empowered employees also have control over performance feedback that guides their work and also a feeling of self-efficacy; that is, they believe that they are capable of successfully completing the task. Empowerment is regarded as one of the critical factors for successful implementation of SE-MABKM. If employees are to feel empowered, they need knowledge that will enable them to comprehend and contribute to the performance of the organization. This is because when individuals are empowered, they begin to take extra responsibilities to solve organizational problems by learning new skills in their jobs, which will eventually lead to them being more competent. Effective creation and sharing of knowledge will fail if employees do not have a sense of ownership in the overall aim of the organizational knowledge management system. After all, most organizational knowledge comes from the expertise, learning and experience of their employees. Through empowerment, employers can value their employees' expertise and help them communicate their knowledge by creating ways to capture, organize and share knowledge.

**E. TOP MANAGEMENT LEADERSHIP AND COMMITMENT**

Top management leadership and commitment are the most critical factors for a successful SE-MABKM, particularly in knowledge creating and culture sharing activities. Top management is increasingly recognizing that the knowledge inherent in an organization is an extremely valuable asset, and that it is no longer sufficient to leave it unmanaged and underleveraged. The effective management of knowledge is increasingly seen as an important basis for competitive advantage. In fact, poor leadership quality has been identified as a threat to successful implementation of SE-MABKM. Leadership commitment to the knowledge management process is essential. Leadership is responsible for creating the knowledge vision of the organization, communicating that vision, and building a culture that regards knowledge as a vital company resource. It is therefore important that senior management recognizes its importance. Without the support of top-level managers, the success of SE-MABKM activities is cumbersome. Only strong leadership could provide the necessary direction, where an enterprise will need to implement and effectively deploy SE-MABKM. To realize the potential of SE-MABKM, enterprise leadership must provide the proper environment to motivate its workers to enable the creation, organization and sharing of knowledge.

**F. INFORMATION SYSTEMS INFRASTRUCTURE**

Many researchers have supported the notion that effective and efficient knowledge management is unthinkable without information systems. A majority of business managers believe in the powers of computers and communication technologies that lead to knowledge management implementation success in organizations. An effective information systems infrastructure is necessary for the organization to implement the SE-MABKM. Information technology can provide an edge in harvesting knowledge Structural capital includes the databases, organizational charts, process manuals, strategies and routines and anything whose value to the company is higher than its material value. As a matter of fact, in literature it is also points out two most critical factors for the successful knowledge management project, one is the establishment of a broad information computing and communications. The second is being the utilization of the network technology infrastructure such as the Internet, Lotus Notes and global communications systems for effective transfer of knowledge. Knowledge bases and intranets are the most popular ways of implementing knowledge management. Reports Information systems have provided knowledge management with capabilities that were not possible before. It has helped an organization to manage and leverage its knowledge systematically and actively. Without information technology and computers, knowledge cannot be stored. As storage forms an important part of knowledge management activities, the inefficiency of this part will disable knowledge management.

**G. PERFORMANCE MEASUREMENT**

Performance measurement is another milestone in SE-MABKM. Success factors Performance measurement as the collection of information about effectiveness and productivity of individuals, groups and larger organizational
Knowledge can be created individually, in groups and on an organizational level. Specifically, reliable, useful, up-to-date organization.

Knowledge creation can be based on numerous sources. An open culture built around implementing SE-MABKM. An open culture built around integrating individual skills and experiences into organizational knowledge will be more successful. A culture of confidence and trust is required to encourage the operations of an organization, which includes the brain of its employees, their knowledge, the processes and customer knowledge that they create. Thus, it is clearly necessary to include performance measurement system as a key factor for the successful SE-MABKM implementation.

H. KNOWLEDGE-FRIENDLY CULTURE

In organization or at the time of SE-MABKM implementation a knowledge culture should be created. Due to Culture is a set of beliefs, which provides an identity for the organization, which in turn defines how the organization runs day to day. The set of beliefs includes organizational purpose, criteria of performance, the location of authority, legitimate base of power, decision-making orientation, leadership style, compliance, evaluation and motivation. There is a general agreement that a knowledge-friendly culture must be present or nurtured in order for knowledge management implementation success, after having primarily focused efforts on information technology, practitioners are now realizing the importance of the "soft" aspects of knowledge management initiatives. Culture practices reflect how the organizations view and facilitate both learning and innovation, including how it encourages employees to build the organizational knowledge base in ways that enhance values for the customers. Organizational culture as a concept is considered to be a key element of managing organizational change and renewal. Thus, since knowledge management is a radical innovation or changes the operations of an organization, it is regarded as an intervention to the organization’s culture. It has been identified that the biggest challenge in knowledge management is not a technical one but a cultural one. To create a knowledge friendly culture, it is important to consider the cultural environment of a company before implementing SE-MABKM. An open culture built around integrating individual skills and experiences into organizational knowledge will be more successful. A culture of confidence and trust is required to encourage the application and development of knowledge within an organization.

J. ELIMINATION OF ORGANIZATIONAL CONSTRAINTS

Successful SE-MABKM implementation may not be achievable if organizations cannot eliminate organizational constraints that present in an organization. This is because organizational constraints can affect negatively the perception and/or attitudes toward knowledge management success. Organizational constraints lead to inefficiency, ineffectiveness and powerlessness. They tend to create hierarchical bureaucracy with few incentives to innovate. Hierarchical bureaucracy means every task is broken into simple parts; each has the responsibility of a different level of employees, and each defined by specific rules and regulations. Organizational constraints result in not only a rigid preoccupation with standard operating procedures, but vertical chains of command and slow response as well. Rigid regulations, lack of incentives to be creative and lack of commitment in budgeting and funding would be problems for the SE-MABKM implementation. Thus, for a SE-MABKM to be successful, organizations must strive to eliminate all the constraints that impede SE-MABKM.

Till now, we have discussed our research finding in terms of MABKM and SE-MABKM concepts and their implementation strategy, Regulatory Framework and its implementation factor. In next chapter we are presenting the discussion and analysis of our research.

XI. DISCUSSION AND ANALYSIS

We will now discuss the results of our studies. We return to our research themes and discuss how our studies have contributed towards these. We will not discuss the concrete research questions, since those discussions have been covered in the individual papers[1][2][3][4]. For discussions on the validity of our contributions we also refer the reader to the reference part. For each research theme we discuss which of our contributions have an impact on it. We relate these contributions to the state-of-the-art, both showing how they fit with existing literature, and how they have extended the field.
A. EXPLORATORY STUDY OF SOFTWARE ENGINEERING AND KNOWLEDGE MANAGEMENT

Software Engineering is a discipline where 'knowledge' is considered as the most valuable asset. Knowledge carries some characteristics that make it different from any other assets. Some important of them are [2]:

- **Extraordinary:** Knowledge is not subject to diminishing return when it is use, it is not consumed. Its consumers can add more to it, and thus increases the value.
- **Uncertain Value:** It is difficult to estimate the impact of an investment in knowledge and
- **Rooted in time:** the utility and validity of knowledge varies with the time.

In software engineering, the knowledge and experience, acquired, during the course of many years play a vital role. The software engineering is mostly benefited from knowledge; therefore, the management of knowledge is very much essential ingredient. The management of knowledge i.e. knowledge management is the process that helps organization to identify, select, organize, disseminate and transfer important information and expertise that are part of the organization memory and that typically resides within the organization in an unstructured manner. This structuring of knowledge enables effective and efficient problem solving, dynamic learning, strategic planning and decision making. The areas of KM, Which is often called knowledge management initiatives are

- Knowledge creation
- Knowledge sharing
- Knowledge seeking.

Before discussion of KM initiative it is necessary to have a look at various Kind of knowledge they are:

- **Tacit Knowledge:** These kinds of knowledge are usually in the domain of subjective, cognitive, and experimental learning. It is very much personal and difficult to formalize.
- **Explicit Knowledge:** Explicit knowledge, on the other hand deals with more objective, rational, and technical knowledge.

Various initiatives have taken in the same theme these are:

- **Knowledge creation:** Knowledge creation is the generation of new insights. There are four mode of knowledge creation they are:
  - Socialization: It refers to the conversion of tacit knowledge to new tacit knowledge through social interaction.
  - Combination: It refers to the creation of new explicit knowledge by merging, categorizing, reclassifying, synthesizing existing explicit knowledge.
  - Externalization: it refers to creating new tacit knowledge into explicit knowledge and finally.
  - Internalization: It refers to create new tacit knowledge into explicit knowledge.

- **Knowledge Sharing:** Knowledge Sharing is a will-full exploitation of one's ideas, insight, solution, and experience to other individual through intermediary.

- **Knowledge Seeking:** It is often called knowledge sourcing. It refers to search of organizational knowledge by any mode.

Knowledge management approaches of knowledge management can be broadly classified into two categorized they are process and practice. the former approach attempts to codify organizational knowledge through formalized control process and technology and later approach assumed that the great deal of organizational knowledge is tacit in nature and that format controls process and technology.

In other side the knowledge management life cycle under software engineering undergoes 6 processes (Create, Capture, Refine, Store, Manage and Disseminate).

The knowledge in good knowledge management system never finished as, over the time the knowledge is updated. The knowledge management framework in SE. Lots of models have been provided in relation with knowledge management. Some of them are [1][2][3]: Biosets Knowledge Category models, Nonaka’s Knowledge management models, Headland and Nonaka’s Knowledge management Model, Skandia intellectual capital model of knowledge management, Demarest’s Knowledge management model, Frid’s Knowledge management models, Stankosky and baldanza’s knowledge management framework, Cought and Zander’s knowledge management model. All the models are common in their perspective areas of creation, exploration and management of knowledge. By this exploratory study of Knowledge management and Software Engineering, we think the goal of knowledge management is for an organization to aware to individual and collective knowledge so that it may make the most effective use of the knowledge it has. So in software engineering optimum knowledge practice can be occur if multi agent based knowledge management practices can be carried out for whole organizational life cycle.

The emergent general understanding is that systems, more than effective technology, represent indeed a novel general purpose paradigm for software engineering. Agents carried out all the actions and exhibit all the behavior within the knowledge flow. Agent can be placed into three categorized individual Agent, automated agent and Organizational agent based. Chapter 4 includes deep studies of these agents and their operational ideology (which results MABKM Framework) as well.

B. MULTI AGENT BASED KNOWLEDGE MANAGEMENT

Previous discussion of my research work relates with exploratory study of Software engineering and Knowledge management. This study is discussing about software engineering which includes software design, construction, testing and maintenance tasks. All these sector of SE required 'Knowledge'. So Knowledge is considered as a Valuable asset. Thus, the management of such valuable asset is very important. The management of knowledge often said knowledge management includes a lot of challenges and issues. These challenges and issues can be tackle by the use of multi agent in knowledge management framework. This multi agent based knowledge management framework has been discussed in this section. This section explains multi agent based knowledge management model, Operational ideology of MABKM and its framework. The section has presented different issues in knowledge that required to be managed and therefore leads to the concepts of KM, these issues are: Knowledge creation, Knowledge Storage, Knowledge Distribution, Knowledge Application.

We can also, Say that all the above are different phases of Knowledge Life cycle. The management of all these phases of knowledge is really a tough one. So, there are various models in this context (As Discussed earlier). They all focus on the fact that why knowledge management is necessary.
but still many work is required on how management of knowledge can be done in that way so that the knowledge is utilized to full extent. One of the solutions can be addition of intelligent Multi agent to knowledge management. The Multi agent technology is the emerging event in management of intelligent resources like knowledge. Multi agents System are the group of Smart agents. These agents are capable of defining their goals and action. They flow themselves as an effective key source to perform large complex task. Such as, workflow control, Knowledge search, and many more especially in distributed collaboratively environment. The multi agent systems have recently emerge as a powerful technology to face the complexity of a variety of tasks. The concepts of multi agent system are very much wide, and there are number of agent. In this Section, Light is thrown in few of them. Reason behind it is that, they all have contributed significant role in MABKM Framework architecture (Discussed in chapter 4) that is the part of my research areas. They are:

Domain Knowledge agent: these are responsible for capturing, storing Information related to domain. Travels, Banking etc are its example.

Organizational Knowledge Agent: These agent work for organizational internal knowledge and it’s effective utilization

Process Knowledge agent: These agents record, evaluate and store information into organizational knowledge base.

Distributed case base agent: These agent stored information as per the situation and case based scenario.

Ontology agent: They offered a way to cope-up with heterogeneous representation of web resources.

User Interface Agents: These agent stores the user Interface work perform by previous user and stores it as a template of references.

Workflow agent: These agents are responsible for monitor the various workflow activities.

Toolset agents: These agents capture various agent and toolset.

In software engineering the knowledge is treated as 'resource' and its management i.e. 'knowledge management' is consider as a concept in which organization gather, organizes, shared and analyze its 'resource'. Such concepts can become clearer when it constitutes these aforesaid agents. In other words, if knowledge management framework is added to these agents it gives worth to the MABKM Architecture. Under this architecture Distributed knowledge management Structure constitutes a set of agent. These agents are recognized by their active function (their functions have been already explained). The MABKM is the concepts in which knowledge management is based on agent system. The operational ideology of MABKM architecture includes these agents which is Autonomous in making decision on behalf of each function. These agent autonomously gather, refine knowledge information in accordance with the requirement of a user. Share knowledge space and communication control center in the architecture, are the principle area of knowledge exchange and interaction during development task. The Agent under MABKM architecture is very important as they work for the said task and provide an effective platform for coordination and co-operation to help the team members to manage knowledge. The details structure of operational ideology of MABKM Framework Splits it into three layer, they are Interface layer: Under this layer, the personal knowledge based agent intimate user interest and build up user profile. Through, this layer, a virtual work environment is created which enables tacit learning.

Intelligent Layer: This layer consists of Multi-agent Middleware Infrastructure. The agents here, remain active all the time and behaves concurrently in an autonomous manner to achieve a common goal in consist with consistently changing user interfaces and heterogeneous knowledge resources.

Structure Layer: Such layer contains organizational intellectual assets. By enhancing the existing information source are with Meta data, the agent are able to recognized and understand about information.

The MABKM Framework supports the design and implementation of Multi agent module of flexible distributed system. It (MABKM Framework), Consists of there sub systems they are workspace (WAS), repository (ARS) and design supports (ADS). Workspaces (WAS): is an agent’s operational environment on a distributed platform. According to the structured and function of MABKM to be design a lot of AWS can be installed on many platform. Repository (ARS): is a mechanism to manage and utilize the reusable agents.

Design Support (ADS): Provides the facilities for designers to design and implement various agents that are based on MABKM Model. From a view point of implementation of MABKM the agents are classifying as repository and workplace agents. These agents that is to say ARS and AWS work together. The working strategy of MABKM is discussed as under: The AWS sends a message of requesting a service to ARS. In the ARS, the received message is sent to the repository agents to construct an organization of agents through AORP, to attend to the requested service. In this way, workplace agents are instantiated on a designated AWS as an instance of repository agents in ARS, to realize an executable component of MABKM. Thus, activating the workplace instance agents, the requested service is provided dynamically to the user. The workplace agents which run on the AWSs can communicate with each other by using the Communication/Cooperation Protocol (ACCP) which has a set of customized per formats of the agent communication protocol of KQML. A multi-agent system is an ideal structure to support knowledge management, since each typical service required by the system can be implemented as a service agent, and each user can be assigned a personal assistant agent. The GUI (Graphical User Interface) enables the communication between the user and workplace agents. The agent comes under the name of workplace agents are discussed below:

Personal Agent (PA): The main functions of such agent are - collaboration with other agents and reasoning over suggested information.

Task Management agent: the function of these agent includes behaving like a manager agent to handle to organization of all other agent which take part in some specific knowledge management task.

Information processing agent: they perform retrieving and merging information from heterogeneous distributed information sources.

Resource agent their function comprises of protocol agents through which knowledge resources accept queries. The regulatory framework or we can say working structure or
operational ideology of MABKM is discussed. The above discussion brings the idea that creation, storage, distribution, and application of knowledge can give better return on yield when the information is properly managed. The agents are used to manage the personal and group knowledge in KM model it becomes Multi agent based Knowledge management. The MABKM can be treated as theoretical concepts that can be used as a solution in relation of KM. The objective behind introducing such framework is the use of every segment of knowledge whenever required. MABKM Framework is given to support Software Engineering. This is because it is SE where knowledge is treated as the key resource. As discussed earlier the discipline of software engineering includes development, testing, implementation, Maintenance and whole management. All these discipline includes tools, methods and most important knowledge. Therefore MABKM Framework can prove its worth in SE. So here brings the concepts of SE-MABKM. SE-MABKM stands for support for Software Engineering via Multi agent Based Knowledge management.

C. SE-MABKM

SE-MABKM as the name suggests is a theoretical framework which is design to provide assistance in relation of knowledge management at SEO. SE-MABKM brings the concepts of Integration of MABKM architecture into various life cycles of SE. There are number of life cycles under SEO which describe working of SE, but concentration have been made in three of them mainly, this is because these life cycles have direct impact on Management Policy and Productivity. A brief Introduction of these life cycle are given below[2][3]:

Management life cycle: the management life cycle is responsible for the performance of management function in an organization. MLC is very much important, as it covers the broad areas of plan, organize, co-ordinate, control and command of information. The MLC under SEO is always put effort to gather information and make it useful further for other life cycles. The noteworthy point here is all the received information by the segment is really authenticated or just a waste. The MABKM Approach works here. It is discussed earlier that agent used in MABKM Architecture are vary much smart. So they provide help to put a line of demarcation in the information which is useful in accordance with the need. Therefore MABKM architecture is to be added in SEO to give SE-MABKM.

Organizational Process Improvement Life Cycle: The process Improvement is another milestone for SEO. The knowledge information plays a significant role under this cycle. These cycles involves introduction of advanced processes and deletion of obsolete one. The MABKM can be useful here this is because the agents introduced under MABKM Architecture are intelligent (As Explained Earlier). These agent processes the information accordance with the need.

System Development Life cycle: these life cycles involves development of new and legacy application and product such application is based on approaches even the product that develops in SDLC begins from communication between various teams. The team includes development, planner, tester and more according to the project requirement. The MABKM Framework significantly acts on gathering all the present and past expert opinions. The intelligent agent, under the MABKM Architecture stores such information. These stored data can be utilized at the time when needed most.

The integration of MABKM Architecture into various organizational life cycle of SEO (SEE) is known as SE-MABKM Framework. The SE-MABKM Framework includes following components:

Organizational Life cycle (OLC): in can be understood as a group of various life cycle under software engineering environment. The working of SEO is regulated and monitored by these life cycles. These life cycles covers all the activities of collecting and processing knowledge. OLC runs with an objective to control whole activity of SEO to provide better and improved service/Product.

Workstation: It can be understood as an effective platform where user communicate and shared the knowledge.

Interface layer: it is topmost layer of SE-MABKM Framework. It takes information in and out of Knowledge management system. Here the users interact with system to create explicit use, retrieve and shared knowledge.

Intelligent layer: this layer is present in Middle of SE-MABKM Framework. This layer consists of a set of MAS which remain active all the time and behave concurrently in autonomous manner to achieve in a common goal.

Resource layer: it is the third layer. It is available in bottom of SE-MABKM. The resource layer consists of Set MAS that are able to evaluate the information.

OKB: OKB is a giant database which is design to store any type of decision and knowledge involve in making decision with effective reporting structure for organizational development. It includes the information of all life cycle under SEE. It contains knowledge and experience of various domain of SEO. So it is very helpful in performance of any task.

We have discussed the various components of SE-MABKM Framework. Now we are looking at the regulatory framework of SE-MABKM. Working of SE-MABKM can be categorized into three layers namely interface, Intelligence and Resource layer. Various MAS are present in these layers. These MAS are sets of smarts agent which are identified by their active contribution in serving users and cooperating work. These agents provide assistance in Managing knowledge. When the users share knowledge at workstation he comes with the contact of interface layers. Interface layers consist of personal agents. These personal agents intimate user interest and build up user's profile. All the knowledge received is taken into intelligent layers from interface layers. Intelligent layers included MAS namely TPA, IPA and RA. These agents are remain active all the time and behave concurrently in autonomous manner to achieve a common goal. The information is processed through various agents in intelligent layers. New information again taken into structured resource layers. Here the information is evaluated. The present in this layers recognized, Understand and extract relevant information. Now the information became Manage knowledge and is stored into OKB. OKB Stores these process information from various life cycles. OKB includes new knowledge one by one in also exclude the information which is no longer required.

SE-MABKM framework is helpful in managing knowledge at software engineering organization in efficient ways. From
SE-MABKM it can easier for developer to create new knowledge, in this ways organizational memory is not closed, it is always evolving. Well, success factors of SE-MABKM depend upon the successful implementation of it. So, we have to consider some factors while implementing SE-MABKM. Some important among them are listed below:

**Employee training:** Training provides employee and managers the skills and information to fulfill their responsibility. Failure in effective work behavior would be insufficient training to support SE-MABKM. Therefore, Employee training is the most important factors while implementing SE-MABKM.

**Employee involvement:** Employee involvement is an array of techniques aimed at sharing information, knowledge, rewards and authority. It is thus the right ways to gather knowledge from various levels of management and essential for an organization to survive.

**Open and trustworthy spirit of team work:** Creation of team allows organization to apply diverse skills and experience towards organization process and problem solving. After all SE-MABKM Focuses on Knowledge management application in which knowledge workers of various discipline can came together and create new knowledge.

**Empowerment:** through empowerment, employers can value their employee’s expertise and help them communicate their knowledge by creating ways to capture, organize knowledge and shared knowledge.

**Top Management Leadership and Commitment:** to realize the potential of SE-MABKM, Enterprise leaderships must provide the proper environment to motivate its workers to enable the creation, organization and sharing of knowledge.

**Information system infrastructure:** an effective information system infrastructure is necessary for the organization to implement the SE-MABKM. Without information technology and computers knowledge can not be stored. As storage forms are important part of SE-MABKM Framework, the inefficiency of this part will disable SE-MABKM.

**Knowledge Structure:** Knowing the importance of vendor and vendors, there must be a well established knowledge structure, which include knowledge about internal and external organizational work group in order to implement SE-MABKM Successfully.

**C1:** An extensive literature studies on knowledge management in software engineering

Through a systematic review we created an overview of the research literature to identify what had been investigated and where the holes in the field were. We overviewed number of work have published in relation with Knowledge management framework, approaches to knowledge management, knowledge management initiative, factors that are taken into consideration when implementing knowledge management strategy. Comparing the rest of our studies to the framework we used for implementation of the concepts of Multi agent systems to knowledge management strategy, we also discovered that agents have possible goal in common, which know agent could achieve in isolation and their action tends to achieved goal.

**B. MULTI AGENT SYSTEM**

Our Second research theme overviewed the use of multi agents in KMS in SE. We focused on the functions and special features of multi agents within this theme. This lead the following

**C2:** Concept of MABKM

Through an action research study, we gained deep insight into the process of ‘KM’ with MAS in SEO. Our result where contrasted and strengthen by online survey, interview and systematic literature studies. Through this contribution, we realized the importance of focus on particular agents group properly to achieve satisfactory results.

**C3:** Proposal of Multi agent architecture for Organizational Knowledge Base (OKB).

We proposed the use of multi agent architecture for organizational knowledge base. The most important improvement was to increase optimum knowledge management practice.

**C. SE-MABKM**

Our third research theme investigated the SE-MABKM. In this context we investigated three specific life cycles in SEO, leading to the following contribution.

**C4:** Proposal of MABKM Architecture for Management life cycle (MLC)

Through, the action research studies; where, MABKM Architecture was applied to define the Management Life Cycle of Software engineering organization (SEO). We gained a deeper understanding of how the MLC affected the results of this architecture. Our main finding related to MABKM Architecture was its active contribution for managing knowledge in SEO, MABKM Produced list and description of activities.

**C5:** Proposal of MABKM Architecture for Organizational Process improvement life cycle (OPILC)

Through the action research studies where MABKM was applied to define the objective of OPILC in SEO, we gained the deeper understand of how OPILC affected the result of this architecture. Our main finding was the effect of MABKM Architecture in OPILC.

**C6:** MABKM Framework in System Development Life Cycle

Through an action research study, we gained a deeper understanding of SDLC in SEO. We also discovered how the SDLC affected the result of MABKM Architecture. The main finding related to MABKM Architecture was that the level of Knowledge management strategy in SEO affected
and consequently the final documented results. They produced list and description of activities.

C7: Design a model for Software engineering organization life cycle for effective utilization of organizational knowledge.

We proposed to design a model for software engineering life cycle to make their optimum knowledge management practice of internal knowledge. We prepared an open qualitative questionnaire to find out the general view of person working in knowledge communities via Open online survey. The result was more effective. It discovered deeper and more explicit cause which explained clearly the requirement of such kind of model. This model was named as SE-MABKM.

C8: Overview of Propose SE-MABKM Model along with it's utility.

Through the action of research studies we brought the concepts of SE-MABKM on the basis of analytical survey and research work. We discovered that SEO always looks for More ROI and better management policy. We concluded that SE-MABKM Could get right information to right people at the right time and thus contributing to increase ROI, Which were considered as the base line of knowledge management.

D. RESEARCH GOAL

Returning, finally, to our research goal for this thesis: How can Multi Agent Based Knowledge Management are applied to Software Engineering organizational life cycle for effective utilization of organizational knowledge? We found that by taking a Multi Agent Based knowledge management perspective on software Engineering life cycle, we could identify and increase learning effects, a key factor in getting developers to improve their practices. Our studies also showed that most research within software engineering has been directed towards the codification strategies, and that research on transfer of tacit knowledge through multi agent perspective is lacking even though the learning effect on the individual level seemed greater through these. Further, our studies showed that communities of practice sprung up around OPILC, MLC, SDLC efforts. Participation in these communities seemed to be the key factor for the impact of the Organizational Knowledge base. A key challenge is to involve and keep the developers in these communities and make sure they don't drift out of them, once their involvement has ended. As we have seen there are many possible applications of knowledge management in software engineering, and we have tested but a few during the work on this thesis. But, as previous researchers have pointed out, there are many possible routes to the goal, and no single approach is necessarily the best for all possible contexts. Our studies have contributed towards the state-of-the-art by contextualizing some methods, but there are still a lot of possibilities for research within the field.

E. FUTURE WORK

Our three research themes lend themselves nicely to possible future directions for research we have started in this thesis. Our overview of the field does currently only include studies in industrial contexts, and can be greatly expanded by adding prescriptive studies from academia. There are also possibilities in extracting more information from the studies already identified, concerning contexts and method impact. As we found in our literature study on knowledge management and Software engineering organization, Software Organization likes to create Organizational Database and few have created in this direction but still some work is there. In further this work can be utilize by the knowledge management Communities to it practical implementation for Industrial purpose. In future we will design and develop this work 'MABKM and SE-MABKM framework' for it's practical implementation and issues and challenge at the time of implementation. In our point view in this knowledge economy environment, every organization needs SE-MABKM concepts for their knowledge base design i.e. OKB based on Multi agent based Knowledge management. We are concluding this research but still lot's of scope are there of MABKM and SE-MABKM model, at the time of Implementation it may be some challenge in terms of Infrastructure, technical storage, Technical Infrastructure like Bandwidth as well as some Security scope are also be considered. We are including some recent paper in terms of Nobel Data Encryption Algorithm (NDEA)[54] for security aspect of SE-MABKM as well as Integrated Web Enabled System for web based personalization approach for application development 'combinational approach', so management communities as well as research world can utilize this research work in their future application development or if they can like to create new and/or upgrade legacy system for Knowledge management Practices.

XIII. REFERENCES


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Knowledge Management and Software Engineering: an exploratory Study

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Abstract: Nowadays, Knowledge became superpower for organizational growth and software is the tools which can manage knowledge with efficient manner; if application framework is appropriate made by the software engineering practices. Many knowledge management frameworks and tools are available in the form of software but still need a theoretical framework for organizational knowledge by the knowledge communities. In this global business economy era each and every activity to be recorded for future reference and this reference leads better decision for organizational growth. In this paper we are doing exploratory study for the organizational knowledge management and software engineering. The basic reason of this study is to find out the appropriate way to make a theoretical framework for Knowledge management prop up for software engineering.

Keywords: KM, SE, MAS, MABKM, OKMP

I. INTRODUCTION

Knowledge management (KM) is a process that helps organizations identify, select, organize, disseminate, and transfer important information and expertise that are part of the organization’s memory and that typically reside within the organization in an unstructured manner. This structuring of knowledge enables effective and efficient problem solving, dynamic learning, strategic planning, and decision making. Knowledge management initiatives focus on identifying knowledge, explicating it in a such a way that it can be shared in a formal manner, and leveraging its value through reuse. Through a supportive organizational climate and modern information technology, an organization can bring its entire organizational memory and knowledge to bear upon any problem anywhere in the world and at any time. For organizational success, knowledge, as a form of capital, must be exchangeable among persons, and it must be able to grow. Knowledge about how problems are solved can be captured, so that knowledge management can promote organizational learning, leading to further knowledge creation. In the information technology context, knowledge is very distinct from data and information (see Figure 1). Whereas data are a collection of facts, measurements, and statistics, information is organized or processed data that are timely (i.e., inferences from the data are drawn within the time frame of applicability) and accurate (i.e., with regard to the original data) [1]. Knowledge is information that is contextual, relevant, and actionable. For example, a map giving detailed driving directions from one location to another could be considered data. An up-to-the-minute traffic bulletin along the freeway that indicates a traffic slowdown due to construction several miles ahead could be considered information. Awareness of an alternative, back-roads route could be considered knowledge. In this case, the map is considered data because it does not contain current relevant information that affects the driving time and conditions from one location to the other. However, having the current conditions as information is useful only if the individual has knowledge that will enable him or her to avert the construction zone. The implication is that knowledge has strong experiential and reflective elements that distinguish it from information in a given context. Having knowledge implies that it can be exercised to solve a problem, whereas having information does not carry the same connotation. An ability to act is an integral part of being knowledgeable. For example, two people in the same context with the same information may not have the same ability to use the

![Figure 1: Data, Information and Knowledge](image-url)

Information to the same degree of success. Hence there is a difference in the human capability to add value. The differences in ability may be due to different experiences, different training, different perspectives, and so on. While data, information, and knowledge may all be viewed as assets of an organization, knowledge provides a higher level of meaning about data and information. It conveys meaning, and hence tends to be much more valuable, yet more ephemeral. Knowledge has the following characteristics that differentiate it from an organization’s other assets [1]:

a. Extraordinary Leverage and Increasing Returns. Knowledge is not subject to diminishing returns. When it is used, it is not consumed. Its consumers can add to it, thus increasing its value.

b. Fragmentation, Leakage, and the Need to Refresh. As knowledge grows, it branches and fragments. Knowledge is dynamic; it is information in action. Thus, an organization must continually refresh its knowledge base to maintain it as a source of competitive advantage.
d. Uncertain Value of Sharing. Similarly, it is difficult to estimate the value of sharing the knowledge, or even who will benefit most.

e. Rooted in Time. The utility and validity of knowledge may vary with time; hence, the immediacy, age, perishability, and volatility of knowledge are important attributes.

There is a vast amount of literature about what knowledge and knowing means in epistemology (study of the nature of knowledge), the social sciences, philosophy, and psychology[2]. Though there is no single definition of what knowledge and knowledge management specifically mean, the business perspective on them is fairly pragmatic. Information as a resource is not always valuable (i.e., the business perspective on them is fairly pragmatic). Knowledge and knowing means in epistemology (study of the nature of knowledge) is a resource when it is clear, relevant, and experience that can discriminate between its use and misuse. Over time, information accumulates and decays, while knowledge evolves. The word knowledge tends to carry positive connotations [3]. However, because knowledge is dynamic in nature, today's knowledge may well become tomorrow's ignorance if an individual or organization fails to update knowledge as environmental conditions change. For more on the potential drawbacks of managing and reusing knowledge, Intellectual capital (or intellectual assets) is another term often used for knowledge, and it implies that there is a financial value to knowledge[4]. Though intellectual capital is difficult to measure, some industries have tried. For example, the value of the intellectual capital of the property casualty insurance industry has been estimated to be between $270 billion to $330 billion [5]. The Organization for Economic Cooperation and Development (OCED) has scored its 30 member nations according to their investments in intellectual capital such as R&D, education, and patents. According to OCED, those countries with the most intellectual capital activities will be the winners of future wealth [5]. Knowledge evolves over time with experience, which puts connections among new situations and events in context. Given the breadth of the types and applications of knowledge, we adopt the simple and elegant definition that knowledge is information in action [6].

A. Tacit and Explicit Knowledge

Polanyi [4] first conceptualized and distinguished between an organization's tacit and explicit knowledge. Explicit knowledge deals with more objective, rational, and technical knowledge (data, policies, procedures, software, documents, etc.). Tacit knowledge is usually in the domain of subjective, cognitive, and experiential learning; it is highly personal and difficult to formalize[7]. Explicit knowledge is the policies, procedural guides, white papers, reports, designs, products, strategies, goals, mission, and core competencies of the enterprise and the information technology infrastructure. It is the knowledge that has been codified (documented) in a form that can be distributed to others or transformed into a process or strategy without requiring interpersonal interaction. For example, a description of how to process a job application would be documented in a firm's human resources policy manual. Moreover, there is a simple relationship between the codification of knowledge and the costs of its transfer: the more that knowledge is made explicit, the more economically it can be transferred[8]. Explicit knowledge has also been called leaky knowledge because of the ease with which it can leave an individual, document, or the organization, after it has been documented [9]. Tacit knowledge is the cumulative store of the experiences, mental maps, insights, acumen, expertise, know-how, trade secrets, skill sets, understanding, and learning that an organization has, as well as the organizational culture that has embedded in it the past and present experiences of the organization's people, processes, and values. Tacit knowledge, also referred to as embedded knowledge [10], is usually either localized within the brain of an individual or embedded in the group interactions within a department or a branch office. Tacit knowledge typically involves expertise or high skill levels. It is generally slow and costly to transfer and can be plagued by ambiguity[8]. Sometimes tacit knowledge is easily documentable but has remained tacit simply because the individual housing the knowledge does not recognize its potential value to other individuals. Other times, tacit knowledge is unstructured, without tangible form, and therefore difficult to codify. Polanyi [2] suggests that it is difficult to put some tacit knowledge into words. For example, an explanation of how to ride a bicycle would be difficult to document explicitly, and thus is tacit. Tacit knowledge has been called sticky knowledge because it may be relatively difficult to pull it away from its source. Successful transfer or sharing of tacit knowledge usually takes place through associations, internships, apprenticeship, conversations, other means of social and interpersonal interactions, or even through simulations[11]. Takeuchi (1995) claim that intangibles like insights, intuitions, hunches, gut feelings, values, images, metaphors, and analogies are the often-overlooked assets of organizations. Harvesting this intangible asset can be critical to a firm's bottom line and its ability to meet its goals.
Indeed, this model suggests that there is a spread or diffusion of knowledge across organization as reflected in the horizontal dimension of the model. However, the codified and uncodified categories in the model are discrete categories of knowledge. In addition, the concept of diffused knowledge is rather general and lack clarity if it includes gathering knowledge within the organization or the idea of spreading it.

**Nonaka’s Knowledge Management Model**

Nonaka’s knowledge management model (Nonaka & Takeuchi, 1995) presumes that knowledge consists of tacit and explicit elements. In this aspect, tacit knowledge is defined as nonverbalised, intuitive and unarticulated, whilst explicit knowledge is articulated and can be specified in writing, drawing, computer programming and others. This model believes tacit knowledge can be transferred into tacit knowledge in others by socialization and tacit knowledge can be transferred into explicit knowledge by formalizing a body of knowledge or through externalization process. The model also believe that explicit knowledge can be transferred into tacit knowledge in others by translating theory into practice also known as a process of internalization and explicit knowledge can be transferred to explicit knowledge in others by combining various existing theories - known as combination process. This simple matrix model presume that transfer of knowledge in organizations is simple and straightforward but it was argued that it can be complicated and complex than it seems (McAdam & McCreedy, 1999). Even though, each of these modes may independently create knowledge, the organizational knowledge creation processes only occur when all the four modes are organizationally managed and dynamically interacted. This process which is highly iterative constitutes ‘knowledge spiral’ which happens mainly through informal networks of relations in the organization starting from the individual level, then moves up to the group (collective) level and eventually to the organizational level. It creates a ‘spiralizing effect’ of knowledge accumulation and growth which promotes organization innovation and learning (Nonaka, 1994; Nonaka and Takeuchi, 1995). There are several similarities between Nonaka’s and Boisot’s knowledge management models. First, Boisot’s codified and uncodified knowledge has some degree of similarity with Nonaka’s category of tacit and explicit knowledge. Second, both models assume that there is a spread or diffusion of knowledge across the organizations as indicated by the horizontal dimension of the model. Finally, in correspondence with Boisot’s model, Nonaka’s tacit and explicit knowledge are two separate categories of knowledge.

**C. Hedlund and Nonaka’s Knowledge Management Model**

Knowledge transfer in organizations is not as simple as Nonaka’s simple matrix suggests. Knowledge transfer can be very complicated and complex hence, a more elaborate version of Nonaka’s model was developed to describe the four levels of carriers or agents of knowledge in organizations. This four levels of ‘carriers’ perspective assumes that knowledge is categorized into the individual, the group, the organization and the interorganizational domains. In this aspect, the interorganizational domain includes important customers, suppliers, competitors and others. Even though, this model is supportive as it relates the carriers to the types of knowledge, it is complicated as the carriers are segregated and related with the limited types of knowledge, which is consistent with Nonaka’s externalization and combination knowledge management process (McAdam & McCreedy, 1999). Indeed, Hedlund and Nonaka (1993) argue that knowledge management characteristics can have serious implications for the various types of activities such as innovation and strategies and this can affect organizations’ success or failures. Hence, this suggests that the essence of organizations’ survival and success can depend on how they create, transfer and exploit their knowledge resources.

**D. Skandia Intellectual Capital Model of Knowledge Management**

Knowledge management was not only seen as the transfer of tacit and explicit knowledge but it has also been argued as intellectual capital (Chase, 1997; and Roos and Roos, 1997). The intellectual capital model of knowledge management was developed by a Swedish firm called Skandia as an approach for measuring its intellectual capital. The model focuses on the importance of equity, human, customer and innovation in managing the flow of knowledge within and externally across the networks of partners. Lank (1997) suggests that this model assumes a scientific approach to knowledge and assumes that intellectual capital can be transformed into commodity or assets of organizations but unfortunately, this intellectual view of knowledge management ignores the political and social aspects of knowledge management. Indeed, this is consistent with Nonaka’s view of knowledge management. Skandia intellectual capital model of knowledge management gives a strong emphasis to measurement associated with each of the decomposed elements (human, customer and structure) of
knowledge management assuming that it can be tightly controlled. However, this approach can result in attempts to fit objective measures to subjective elements. Hence, this mechanistic approach to measurement is more consistent with Nonaka's process of externalization and combination (Lank, 1997).

Figure 5: Skandia Intellectual Capital Model of Knowledge Management

**E. Demerest's Knowledge Management Model**

Demerest's knowledge management model emphasize on the construction of knowledge within an organization. This construction is not limited to scientific inputs but is seen as including the social construction of knowledge. The model assumes that constructed knowledge is then embodied within the organization, not just through explicit programs but through a process of social interchange (McAdam and McCreedy, 1999) Figure 4 showed that there is a process of dissemination of the espoused knowledge throughout the organization and its surrounding. Ultimately the knowledge is seen as being of economic use in regard to organizational outputs. The solid arrows in figure 1 show the primary flow direction while the plain arrows show the more recursive flows. The model is attractive in that it does not assume any given definition of knowledge but rather invites a more holistic approach while, in reality, the flows of knowledge transfer may be extremely rapid and circulatory, as in the case for some forms of action learning. Demerest's model has been slightly modified of which seeks to address these limitations by explicitly showing the influence of both social and scientific paradigm of knowledge construction. The model also extends the "use" element to cover both business and employee benefits. If knowledge management is to have the support and commitment of all stakeholders in an organization then employee emancipation must be addressed along with the business benefits. These issues should not be seen as mutually exclusive but as complementary. Also more recursive arrows are added to figure 5 to show that knowledge management is not seen as simple sequential process. Figure 6 is a useful means for structuring further research into field of knowledge management as it represents a balanced view. It allows knowledge management to be associated with the emerging social paradigm while at the same time contributing to the current paradigm.

Figure 6 Demerest’s Knowledge Management Model

**F. Frid’s Knowledge Management Model**

According to Frid's (2003) knowledge management framework, the knowledge management maturity assessment levels and knowledge management implementation can be divided into five levels. The five maturity levels are knowledge chaotic, knowledge aware, knowledge focused, knowledge managed, and knowledge centric. The first level - knowledge chaotic suggests that organizations at this level are in the process of understanding and implementation of Frid framework for knowledge management which encompasses knowledge management vision, knowledge management objectives and knowledge management indices. Organization should focus on advocating and adapting departmental knowledge management vision and goals as well as performing Frid's framework knowledge management maturity assessment. Whereas level two - knowledge aware suggests that organizations at this level are a step higher than those at knowledge chaotic. Also, to understand and implement Frid's framework for knowledge management; advocating and adopting departmental knowledge management vision and goals; and performing Frid framework maturity assessment, organization at this point should focus on developing a knowledge management road map and working collaboratively with the knowledge management office. At the third level - knowledge focused indicated that organizations should have covered the implantation aspects as in the lower two levels and start focusing on five new activities. Organizations at this point should embed knowledge...
management into process engineering; provide initial knowledge management infrastructure, services and training; support early adopters and knowledge community; monitor and report on management indices and finally include knowledge management in budgets. However, the fourth level termed as knowledge managed adopt the fundamental activities suggested in level one, two and three other than organizations should attempt to embed knowledge management in performance reviews and also in business plans apart. Finally, knowledge centric as the last level is the highest of all knowledge management implementation maturity level based on Frid’s model. The distinctive and differentiating activities that organizations should focus on are institutionalizing successful initiatives and valuing intellectual assets. These activities differentiate knowledge from other levels. Moreover, all knowledge management activities should be given equal emphasis at this level.

G. Stankosky and Baldanza’s Knowledge Management Framework

Stankosky and Baldanza (2001) developed a knowledge management framework which addresses enabling factors such as learning, culture, leadership, organization and technology. This framework presents that knowledge management encompasses a wide range of disciplines that include cognitive science, communication, individual and organizational behavior, psychology, finance, economics, human resource, management, strategic planning, system thinking, process reengineering, system engineering, computer technologies and software and library science.

In addition, it was suggested that the four major foundations of an organization which is important for knowledge management are leadership, organization structure, technology infrastructure and learning. First, leadership is responsible for practicing strategic planning and systems thinking approaches, making best use of resources, fostering a culture that encourages open dialogue and team learning, and for encouraging and rewarding risk taking, learning and knowledge sharing. Key element for leadership is strategic planning, communication, system thinking and business culture. Second, organization structure should facilitate personal interactions and support communities of practice to capture tacit and explicit knowledge within the organization. Organizational structure in an organization should instill trust among people within the organization and encourage free exchange of knowledge. It should also be concerned with managing change in order to achieve better results. The key elements of organizational structure are processes, procedures, performance management system and communication. Third, technology infrastructure makes it possible to exchange information without formal structures. Technology infrastructure should promote the efficient and effective capture of both tacit and explicit knowledge. It should also support knowledge sharing in the entire organization. Communication, electronic mail, intranet, internet, data warehousing and decision support systems are some of the key elements. Fourth and final pillar of learning is leveraging knowledge. The role of learning is to manage information in order to build enterprise wide knowledge and use that knowledge to organizational learning, change and performance improvement. Learning communities, virtual teams, communication and a culture of trust can be identified as some of the key elements.

H. Kogut and Zander’s Knowledge Management Model

Kogut and Zander (1992) are among the first researchers who established the foundation for the knowledge-based theory of the firm when emphasizing the strategic importance of knowledge as a source of competitive advantage. Their work is focused on the idea that “what firms do better than markets is the creation and transfer of knowledge within the organization”. Knowledge, which consists of information and know-how, is not only held by individuals but is also expressed in regularities by which members cooperate in a social community. Firms as social communities act as “a repository of capabilities” determined by the social knowledge embedded in enduring individual relationships structured by organizing principles (Kogut and Zander, 1992). The organizing principles refer to as “the organizing knowledge that establishes the context of discourse and coordination among individuals with disparate expertise and that replicates the organization over time in correspondence to the changing expectations and identity of its members” (Kogut and Zander, 1996). This view was further articulated and empirically tested in Kogut and Zander (1993). They assert that 1) firms are efficient by which knowledge is created and transferred, 2) a common understanding is developed by individuals and groups in a firm through repeated interaction to transfer knowledge from ideas into production and markets, 3) what a firm does is not depending on the market's failure rather the efficiency in the process of transformation relative to other firms, and 4) the firm’s boundary is determined by the difference in knowledge and the embedded capabilities between the creator and the users (possessed with complementary skills) and not market failure. Kogut and Zander (1996) further extend their discussion on the concept of identity by
asserting that individuals are "unsocial sociality" where they have both a desire to become a member of community and at the same time also have a desire to retain their own individuality (Kogut and Zander, 1996). As firms provide a normative territory to which members identify, costs of coordination, communication, and learning within firms are much lower which allow more knowledge to be shared and created within firms.

**III. THE NEED FOR KNOWLEDGE MANAGEMENT SYSTEMS**

The goal of knowledge management is for an organization to be aware of individual and collective knowledge so that it may make the most effective use of the knowledge it has [12]. Historically, MIS has focused on capturing, storing, managing, and reporting explicit knowledge. Organizations now recognize the need to integrate both explicit and tacit knowledge in formal information systems. Knowledge management systems (KMSs) refers to the use of modern information technologies (e.g., the Internet, intranets, extranets, LotusNotes, software filters, agents, data warehouses) to systematize, enhance, and expedite intra- and interfirm knowledge management[9]. KMSs are intended to help an organization cope with turnover, rapid change, and downsizing by making the expertise of the organization's human capital widely accessible. They are being built in part from increased pressure to maintain a well-informed, productive workforce. Moreover, they are built to help large organizations provide a consistent level of customer service.

**IV. KNOWLEDGE MANAGEMENT SYSTEM CYCLE**

A functioning knowledge management system follows six steps in a cycle (see Figure 10). The reason the system is cyclical is that knowledge is dynamically refined over time. The knowledge in a good KM system is never finished because, over time, the environment changes, and the knowledge must be updated to reflect the changes. The cycle

![Figure 10: Knowledge Management System Cycle](image)

_works as follows:

A. Create knowledge. Knowledge is created as people determine new ways of doing things or develop knowledge. Sometimes external knowledge is brought in.

B. Capture knowledge. New knowledge must be identified as valuable and be represented in a reasonable way.

C. Refine knowledge. New knowledge must be placed in context so that it is actionable. This is where human insights (tacit qualities) must be captured along with explicit facts.

D. Store knowledge. Useful knowledge must then be stored in a reasonable format in a knowledge repository so that others in the organization can access it.

E. Manage knowledge. Like a library, the knowledge must be kept current. It must be reviewed to verify that it is relevant and accurate.

F. Disseminate knowledge. Knowledge must be made available in a useful format to anyone in the organization who needs it, anywhere and any time.

As knowledge is disseminated, individuals develop, create, and identify new knowledge or update old knowledge, which they replenish into the system. Knowledge is a resource that is not consumed when used, though it can age. (For example, driving a car in 1900 was different from driving one now, but many of the basic principles still apply.) Knowledge must be updated. Thus, the amount of knowledge grows over time.

**V. KNOWLEDGE MANAGEMENT INITIATIVES**

When asked why the organization was building a worldwide knowledge management system, the Chief Knowledge Officer (CKO) of a large multinational consulting firm replied, “We have 80,000 people scattered around the world that need information to do their jobs effectively. The information they needed was too difficult to find and, even if they did find it, often inaccurate. Our intranet is meant to solve this problem.” [13]. A survey of European firms by KPMG Peat Marwick in 1998 found that almost half of the companies reported having suffered a significant setback from losing key staff [14]. Similarly, a survey conducted in the same year by Cranfield University found that the majority of responding firms believed that much of the knowledge they needed existed inside the organization, but that finding and leveraging it were ongoing challenges. It is precisely these types of difficulties that have led to the systematic attempt to manage knowledge. Most knowledge management initiatives have one of three aims:

1. to make knowledge visible mainly through maps, yellow pages, and hypertext,
2. to develop a knowledge-intensive culture, or
3. to build a knowledge infrastructure [15].

These aims are not mutually exclusive, and indeed, firms may attempt all three as part of a knowledge management initiative. There are several activities or processes that surround the management of knowledge. These include the creation of knowledge, the sharing of knowledge, and the seeking and use of knowledge. Various terms have been used to describe these processes. What is important is an understanding of how knowledge flows through an organization, rather than any particular label assigned to a knowledge activity.
A. Knowledge Creation

Knowledge creation is the generation of new insights, ideas, or routines. It may also be referred to as knowledge acquisition[12]. It is helpful to distinguish between the creation of fundamentally new knowledge versus the acquisition of existing knowledge [16]. [7] describes knowledge creation as an interplay between tacit and explicit knowledge and as a growing spiral as knowledge moves among the individual, group, and organizational levels. There are four modes of knowledge creation: socialization, combination, externalization, and internalization. The socialization mode refers to the conversion of tacit knowledge to new tacit knowledge through social interactions and shared experience among organizational members (e.g., mentoring). The combination mode refers to the creation of new explicit knowledge by merging, categorizing, reclassifying, and synthesizing existing explicit knowledge (e.g., statistical analyses of market data). The other two modes involve interactions and conversion between tacit and explicit knowledge. Externalization refers to converting tacit knowledge to new explicit knowledge (e.g., producing a written document describing the procedures used in solving a particular client’s problem). Internalization refers to the creation of new tacit knowledge from explicit knowledge (e.g., obtaining a novel insight through reading a document). These final two modes of knowledge creation deal less with the creation of new knowledge than with the conversion of existing knowledge to a new mode. [12] suggest that there are two important dimensions to the acquisition of knowledge: one is the identification of existing knowledge from external sources and the other, the selection of needed knowledge from an organization’s existing knowledge resources. These two activities require different skills, levels of effort, and costs.

B. Knowledge Sharing

Knowledge sharing is the willful explication of one’s ideas, insights, solutions, experiences (i.e., knowledge) to another individual either via an intermediary, such as a computer-based system, or directly. However, in many organizations, information and knowledge are not considered organizational resources to be shared, but individual competitive weapons to be kept private [15]. Organizational members may share personal knowledge with a certain trepidation—the perceived threat that they are of less value if their knowledge is part of the organizational public domain. Also, a primary constraint on individual’s knowledge sharing behaviors might simply be time. Moreover, sharing knowledge is a risky proposition since one does not know how that knowledge might be reused [16]. Research in organizational learning and knowledge management suggests that some facilitating conditions include trust, interest, and shared language (Hanssen-Bauer and [17], fostering access to knowledgeable members (Brown and [18]), and a culture marked by autonomy, redundancy, requisite variety, intention, and fluctuation [7]. Several organizations have made knowledge sharing a guiding principal for the organization [19]. Johnson & Johnson has knowledge fairs designed to promote new relationships among colleagues in order to facilitate knowledge transfer. The World Bank includes such factors as openness to new ideas, continual learning, and sharing of knowledge as part of their annual performance evaluation of employees [19].

C. Knowledge seeking

Knowledge seeking, also referred to as knowledge sourcing [20], is the search for and use of internal organizational knowledge. While the lack of time or the lack of reward may hinder the sharing of knowledge, the same can be said of knowledge seeking. Individuals may sometimes feel compelled to come up with new ideas, rather than use tried-and-true knowledge, if they feel that their own performance review is based on the originality or creativity of their ideas. Such was the case for marketing employees in a global consumer goods organization described in Alavi et al. (2003). Individuals may engage in knowledge creation, sharing, and seeking with or without the use of information technology tools. We next describe two common approaches to knowledge management.

VI. APPROACHES TO KNOWLEDGE MANAGEMENT

There are two fundamental approaches to knowledge management: the process and the practice approaches.

A. Process Approach

The process approach attempts to codify organizational knowledge through formalized controls, processes, and technologies (Hansen et al., 1999). Organizations adopting the process approach may implement explicit policies governing how knowledge is to be collected, stored, and disseminated throughout the organization. The process approach frequently involves the use of information technologies to enhance the quality and speed of knowledge creation and distribution in the organizations. These technologies may include intranets, data warehousing, knowledge repositories, decision support tools, and groupware (Ruggles, 1998). There are several different levels of the process approach (van der Spek et al., 2003). At the most rudimentary, knowledge may be codified in project descriptions, stories, or other forms of documentation, but limited filtering has been done. At the next level, knowledge may be codified into structured concepts, frameworks, and theories. At the highest level, knowledge is embedded into work practices that give direction to employees (van der Spek et al., 2003). The main criticisms of the process approach are that it fails to capture much of the tacit knowledge embedded in firms and that it forces individuals into fixed patterns of thinking (DeLong and Fahey, 2000; Brown and [18], 2000; Von Krogh, 2000; Hargadon, 1998). The process approach is favored by firms that sell relatively standardized products that fill common needs. Most of the valuable knowledge in these firms is fairly explicit because of the standardized nature of the products and services. For example, a kazoo manufacturer has minimal product changes or service needs over the years, and yet there is steady demand and a need to produce the item. In these cases, the knowledge is typically static in nature. Even large firms that utilize tacit knowledge, such as Ernst & Young, have invested heavily to ensure that the process approach works efficiently. The 250 people at Ernst & Young’s Center for Business Knowledge manage an electronic...
Repository and help consultants find and use information. Specialists write reports and analyses that many teams can use. And each of Ernst & Young's more than 40 practice areas has a staff member who helps codify and store documents. The resulting area databases are linked through a network (Hansen et al., 1999). Naturally, people-to-documents are not the only way consultants in firms like Ernst & Young and Accenture share knowledge; they talk with one another as well. But they do place a high degree of emphasis on the codification strategy (Hansen et al., 1999).

B. Practice Approach

In contrast, the practice approach to knowledge management assumes that a great deal of organizational knowledge is tacit in nature and that formal controls, processes, and technologies are not suitable for transmitting this type of understanding. Rather than building formal systems to manage knowledge, the focus of this approach is to build the social environments or communities of practice necessary to facilitate the sharing of tacit understanding (Brown and Duguid, 1991; Burgelman and Fahey, 2000; Gupta and Govindarajan, 2000; Wenger and Snyder, 2000; Hansen et al., 1999).

Communities of practice are groups of individuals with a common interest who work together informally. Within such a community, individuals collaborate directly, teach each other, and share experiences (Smith and McKen, 2003). The practice approach is typically adopted by companies that provide highly customized solutions to unique problems. The valuable knowledge for these firms is tacit in nature, which is difficult to express, capture, and manage. In this case, the environment and the nature of the problems being encountered are extremely dynamic. For these firms, knowledge is shared mostly through person-to-person contacts. Collaborative computing methods (for example, Lotus Notes/Domino Server or e-mail) help people communicate. Because tacit knowledge is difficult to extract, store, and manage, the explicit knowledge that points to how to find the appropriate tacit knowledge (people contacts, consulting reports) is made available to an appropriate set of individuals who might need it. To make their practice approach work, firms like Bain invest heavily in building networks of people and communications technology such as telephone, e-mail, and videoconferencing. Also they commonly have face-to-face meetings (Hansen et al., 1999).

Figure 11 summarizes the process and practice approaches. In reality, a knowledge management initiative can, and probably will, involve both process and practice approaches. The two are not mutually exclusive. Alavi et al. (2003) describe the case of an organization that began its KM effort with a large repository but evolved the knowledge management initiative into a community-of-practice approach that existed side-by-side with the repository. In fact, community members would pass information from the community forum to the organizational repository when they felt that the knowledge was valuable outside their community. Figure 12 illustrates how Monsanto successfully manages its knowledge using a combination of the two approaches.

VII. KNOWLEDGE MANAGEMENT IN SOFTWARE ENGINEERING

SE (Software Engineering) knowledge is dynamic and evolves with technology, organizational culture and the changing needs of an organization's software development practices. Kess and Haapasalo [22] argue that software processes are essentially knowledge processes, structured within a KM framework. Aurum et al. (2013) point out that software development can be improved by recognizing related knowledge content and structure. As well, appropriate knowledge and engaging in planning activities. Basili et al. [24] acknowledge that for an organization to implement the 'Experience Factory' (EF) approach for KM, a number of potential barriers to success must be overcome. They argue that while the EF is aimed at instituting a learning organization, it requires a significant investment of time and effort. They stress the need to leverage alternate approaches to distribute knowledge quickly. The 'Answer Garden' approach is depicted as a short-term solution to questions that may not require extended responses. Johansson et al. [26] apply an 'Experience Engine' approach to KM in SE, as a subset of the EF. They list problems identified with the EF approach, such as its experimental nature, the organizational restructuring it prompts as well as its reliance upon an experience base containing a vast amount of written documentation. They assert that experience is best transferred when the receiver is "actually doing something related to the experience being transferred" [27]. The researchers claim that written documentation is generally not referred to when problems occur, as well as emphasizing the short life span of software engineering knowledge. Kess and Haapasalo [28] advocate the use of project reviews to improve software quality. The results of a case study into a telecommunications organization are disclosed, revealing the centrality of knowledge creation and sharing to improving the software development process. It is argued that project reviews enable both tacit and explicit knowledge to be managed effectively. Inspection metrics are portrayed as being integral to brainstorming sessions, which in turn deliver feedback to various phases in the software development process. Dingxu et al. [29] provide an insight into problems faced by small to medium organizations in addressing KM in SE. They consider postmortem reviews and experience reports as two approaches suitable for collecting software development knowledge. They conclude that lightweight postmortem reviews perhaps reveal more about software development practices, while experience

Figure 11: Process and Practice Approaches to knowledge Management
focus on knowledge management. There are many opportunities for software development projects, and are packaged and stored in an experience base. By packing, we mean generalizing, tailoring, and formalizing experience so that it is easy to reuse. In 1999, the first workshop on "learning software organizations" was organized in conjunction with the SEKE conference. This workshop has been one of the main arenas for empirical studies as well as technological development related to knowledge management in software engineering. The May 2002 issue of IEEE Software [36] was devoted to knowledge management in software engineering, giving several examples of knowledge management applications in software companies. In 2003, the book "Managing Software Engineering Knowledge" [37] was published, focusing on a range of topics, from identifying why knowledge management is important in software engineering [38], to supporting structures for knowledge management applications in software engineering, to offering practical guidelines for managing knowledge. However, Edwards notes in an overview chapter in the book on Managing Software Engineering Knowledge [39] that knowledge management in software engineering is somewhat "distanced from mainstream knowledge management. Several PhD theses have also been published on aspects of knowledge management that are related to software engineering [40, 41, 42, and 43]. In addition, a number of overviews of work on knowledge management in software engineering have previously been published. Rus et al. [44] present an overview of knowledge management in software engineering. The review focuses on motivations for knowledge management, approaches to knowledge management, and factors that are important when implementing knowledge management strategies in software companies. Lindvall et al. [45] describe types of software tools that are relevant for knowledge management, including tools for managing documents and content, tools for managing competence, and tools for collaboration. Dingsøyr and Conradi [46] surveyed the literature for studies of knowledge management initiatives in software engineering. They found eight reports on lessons learned, which are formulated with respect to what actions companies took, what the effects of the actions were, what benefits are reported, and what kinds of strategy for managing knowledge were used. Despite of the previously published overviews of the field, there is still the lack of broad overviews which involves the concepts of multi-agent as a tool of knowledge management that leads to the efficient working of Software engineering organization. Our motivation for this study was thus, to give a more thorough and broader overview in the form of a systematic review for multi agent. This study also covers recent work, and assesses the quality of the research in the field.

VIII. KNOWLEDGE MANAGEMENT FRAMEWORK FOR SOFTWARE ENGINEERING

As those who work in organizations know, organizations are not homogeneous entities where grand theoretical systems are easily put in place. Change is difficult. A special challenge in deploying knowledge management is that it requires systemic change. Isolated initiatives fail, but are also impossible to revive the whole organization in one sweeping wave of change. A consideration for a knowledge management framework, therefore, is that it needs to address systemic change in organizations. In practice, the framework has to provide a coherent language and a point of view that enables the various organizational actors to see their activities within the overall effort to develop organizational knowledge management. This requires that the current state and the vision of the organization can be seen together, in a way that enables the organization developers to bridge the gap. Moreover, we need to take into account the simultaneous existence of several competing frameworks. In any large organization, it is impossible to develop one single approach to knowledge management and simply roll it out. Knowledge management is already happening, and much of the organizational development is working on solutions to its problems. When we deploy knowledge management, we have to be able to show how it relates to the ongoing initiatives in the organization, as well as to point out those areas where new thinking is required. Those frameworks that do not take into account change or address issues of migration and co-existence of old and new concepts, practices, and tools, rarely generate major impact. In practice, knowledge management can be viewed as consisting of several dimensions where change is needed, and we have to address all these to get knowledge management deployed. To understand and manage knowledge in organizations, we need to understand what knowledge is, how it is used, what does its management
consist of, and how we could improve organizational knowledge processes. The first dimension, therefore, is conceptual. We have to develop a set of integrated constructs that can be used to discuss knowledge in organizations. The theoretical and conceptual basis for knowledge management requires a multi-disciplinary approach and rather sophisticated theoretical discussion. Therefore, a knowledge management framework has to say something about institutions and their evolution. Before new knowledge changes knowledge structures and systems of activity within an organization, knowledge has to be accessed, understood, and accepted. Knowledge management framework, to change the organization, needs to include concepts for change management. One major aspect of change management is migration of old forms of activity into new forms. This requires coexistence of activities that are different versions of each other. In most cases this means that new activities are piloted as limited and isolated experiments, which in due course can be deployed more extensively within the organization. Change often creates resistance. I would argue that in many cases this resistance actually, in itself, is a knowledge management problem, which results from problems with accessibility, acceptability, understanding, but also from problems in the management of attention. In effective organizations, people are busy doing those activities that they have understood to be the most relevant and urgent. Therefore any suggestions for new activities are competing with an existing set of relevant and urgent activities. In many cases, the newness of novel contributions of knowledge management is sufficient to make them less relevant and less urgent than items on the current agenda. This means that in practice there has to be some re-evaluation of priorities in the organization if the organization is going to deploy knowledge management practices. This, in turn, requires that the organization changes its vision so that it explicitly includes some aspects of knowledge management. For example, the organization can relate a vision of itself as an intelligent organization, and look back from its strategic needs to see how it should prioritize its organizational development activities. In research organizations, one commonly used approach to deal with the problem of change is to keep the number of possible projects so large that there exists an alternative if the priorities change. This approach is used to make it easier for the researchers to develop their work identity around a strategic vision of the organization instead of specific "pet-projects" that for various reasons may change their priority. A similar management problem exists also for organizational development and innovation. To overcome this problem, the organization may develop a strategic vision from which manageable portfolios of knowledge development projects are selected. At the sometime there have to be processes that re-evaluate priorities from time to time. In knowledge management programs it is often reasonable to generate a set of high-priority implementation projects, and develop organizational knowledge management systems using a portfolio of strategically selected projects. Within each such project, change management, however, needs also to be addressed separately. When organizations need to change, often the most scarce resource is time. Knowledge management is therefore also about management of time. This is so both at the macro-level and at the micro-level. At the organizational level, there has to be time to reflect on the organizational priorities and practices.

If the organization is overloaded with current activities and existing initiatives, there is not much that can be done to manage organizational attention, and focus it toward knowledge management. Time is critical also at the individual level. Learning requires that there is time for cognitive re-arrangement. Often, however, the drive for efficiency means that there is not much time devoted for reflection in other side various knowledge artifacts way in which they are rendered, their degree of abstraction and their ability to enable actions and decisions. Knowledge artifacts also vary in their degree of articulation, simple knowledge artifacts can be explicit, implicit or tacit. Most artifacts, however, are not simple but complex, and contain a combination of explicit, implicit and tacit components. As per the information concern Knowledge artifacts do not perform actions and make decisions. Actions and decisions are undertaken by agents: people, organizations, or in some cases, technology. Agents carry out all the actions and exhibit all the behaviors within a knowledge flow. And knowledge flow depends the organization face value. Often, analysts attempt to apply the same behavioral models to all agents in a system. More appropriately, agents can be placed in three categories:

a. Individual agents
b. Automated agents
c. Organizational agents.

A. Individual Agents

These agents sit at the center of almost every knowledge flow. For most analysts, the individual (human) serves as the prototypical active force for affecting change. In this paper, the term individual is used in the collective sense and is not meant to imply that every specific individual is capable of the full range of behaviors attributed to this class of agent. Individual agents are capable of working with knowledge and knowledge artifacts in all degrees of abstract articulation. They are limited, however, in their ability to deal with artifacts that are codified in ways that falls outside the range of human perception (radio waves, for example). The individual agent is the only agent capable of performing all aspects of knowledge development, retention, transfer and utilization without the need for intervention by either of the other two agents.

B. Automated Agents

These agents can include any human construct that is capable of retaining, transferring or transforming knowledge artifacts. They are not exclusively computerized processes, as is often assumed in discussions of knowledge management. A conventional camera that encodes a
representation of the visual world through chemical changes to the surface of a film could act as an automated agent, supporting knowledge creation and capture.

C. Organizational Agents

These agents exist in situations in which knowledge retention and transfer cannot be fully attributed to individuals or specific automated agents. In these cases, the organization itself serves as an agent in the retention and dissemination of knowledge. As with tacit knowledge artifacts, current tools and concepts do not account very well for the roles of organizational agents in knowledge flows. Organizational value systems provide strong evidence for the existence of organizational agents. Much has been written about the ability of organizations and communities to establish value systems that outlive the involvement of specific individuals and the power that these value systems have to influence the behavior of individuals and groups (Krogh and Roos, 1995; Kuhn, 1996). The principles and practices that make up these value systems are almost never codified. In fact, when individuals attempt to describe the organization's value system, the descriptions are usually incomplete, reflecting either an interpretation of the organization's values or a blending of organizational and individual values. The terms acknowledge that organizations are repositories of tacit knowledge. Individual, organizational and automated agents have different behavioral models. Unlike computerized agents, for example, most individuals don't perform a given task exactly the same the way every time. If human-based knowledge transfer processes are designed to work as software processes do and the designers fail to leave sufficient room for the factor of human variability, the system is unlikely to perform as intended. Individual and automated agents also differ in their ability to handle implicit knowledge artifacts. For example, the ability of individuals to infer meaning of book titles usually allows them to accept a wide variety of formats and styles and even recognize titles inside streams of text (for example, The Bible). Anyone who has built filters to convert documents knows that automated agents are not skilled at supplying context. Agents also differ in the how well they use tacit knowledge. Individual and organizational agents can handle tacit knowledge, but because automated agents can only deal with codified artifacts, tacit knowledge by definition defies codification, automated agents seem destined to be unable to follow suit.

IX. CONCLUSION

Software engineering has long recognized the need of knowledge management. We have various knowledge management practice for information retrieval, reuse and apply in this elaborate environment information is prime concern and organization need to store and search data captured by the organizational people should be stored in knowledge base of the organization. Knowledge base to be monitored by the Management or as per the authority issued by the management. In the software engineering many life cycle approach run parallel like Software development life cycle, Software test Life cycle, Organizational process Improvement Life cycle and management life cycle itself. So, it is very difficult to manage organization knowledge life cycle flow. So we need a frame work of knowledge management which should be based on the multi agent system(MAS). These multi agents can act as an organizational activity monitor and it should be responsible for knowledge management practice like identify, capture, store, reuse etc for entire organizational life cycle in individual and after collaboratively manner. In my previous Study[21] we have already explain the meaning of knowledge and it's important and requirement of multi agent system through online survey as well as importance of knowledge management practice and in this paper after exploratory study many of researcher and industry personal have long recognized the importance of multi agent concepts in software engineering. In software engineering knowledge or optimum knowledge management practice (OKMP)can be occur if multi agent concepts based knowledge management practice (MABKM)carried out for whole organization life cycle and information of organization life cycle to be stored in the center database or organizational knowledge base. In further work we would like to create a theoretical framework for knowledge management based on the multi agents for the support of software engineering as well as its operational ideology.

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Operational Ideology of SE-MABKM for Prop up of Software Engineering

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Abstract: Knowledge management is widely recognized as a critical issue in any kind of organization. It has to do with structuring information, ensuring that it is available to all potential users, easily accessible, and presented in such a way that all data relevant to the requesting users are effectively returned in a reasonable amount of time. When dealing with such issues one technology that comes in handy consists of Multi agents. Agents may be software components featuring some nice properties that prove quite helpful to perform routine tasks, which are normally carried out by human users. Whereas, in digital world where everything is inter-dependent on the software its principle and application. But, software engineering are changing dynamically manner due to global working environment. These environment lead’s a problem to manage knowledge in-front of knowledge communities. For that we are proposing a MABKM model for knowledge communities that will worked as a solution for Knowledge communities. In This paper we are elaborating the MABKM Model and their working principle within a phased manner. First we will start from various issues in knowledge management then after a approach of knowledge management based on the agents that will known as MABKM. Then after integrating this MABKM Model into Software Engineering organizational life cycle then we get a model that will known as SEMABKM (i.e Support of software engineering based on the multi agent based Knowledge management principle. operational ideology of SE-MABKM and finally we will compare it with real software engineering environment.

Keywords: MABKM, SE-MABKM, SEE, MAS, OPILC, SDLC

I. INTRODUCTION

Knowledge management (KM) is widely recognized as a critical issue in any kind of organization. “Knowledge is a mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information.” (Agresti, 2000) Knowledge management is a term that has a variety of definitions. Here we choose to present two definitions, one by Agresti and another by a knowledge management tool developer, Hyperwave, to compare the different viewpoints in research and industry. Agresti defines knowledge management as “the practice of transforming the intellectual assets of an organization into business value” (Agresti, 2000). The developers of Hyperwave present an alternative definition of knowledge management, i.e., it is “the task of developing and exploiting an organization’s tangible and intangible knowledge resources. It has to do with structuring information, ensuring that it is available to all potential users, easily accessible, and presented in such a way that all data relevant to the requesting users are effectively returned in a reasonable amount of time. When dealing with such issues one technology that comes in handy consists of software agents. Agents are software components featuring some nice properties that prove quite helpful to perform routine tasks, which are normally carried out by human users. These include processing of large quantities of information, searching over multiple sources spread all over the world, extracting selected portions of documents and so on. Agents can even move on the network carrying along the tasks they were assigned; they can even reduce processing times by self organizing into societies by spawning children agents acting in parallel. In This paper we are elaborating the SE-MABKM Model and their working principle within a phased manner.

First we will start from various issues in knowledge management then after a approach of knowledge management based on the agents that will known as MABKM and then after operational ideology of SE-MABKM and finally we will compare it with real software engineering environment.

II. ISSUES IN KNOWLEDGE MANAGEMENT

In organization the management of information and knowledge is a major issue to be dealt with. In most cases, single and separated pieces of information, contributing to form a specific knowledge in any field, are available on a multitude of sources, ranging from traditional; old-style relational database management systems up to repositories structured with XML and derived technologies. If left apart, such pieces of information would be difficult to use. Once put together, they may respond to complex requests, targeting goals that could otherwise be reached only through a long and boring analysis of all information pieces.

Figure: 1 Knowledge Life Cycle (Wig 1999)
A. Knowledge Creation/Acquisition

Knowledge is captured only in explicit form. Tacit knowledge resides in the minds of people and has to be made explicit in order to be captured. This is accomplished with the aid of knowledge acquisition tools or knowledge creation tools. Knowledge is developed through learning, innovation and creativity, as well as imported from external sources. Knowledge acquisition evolves and builds the knowledge base of an organization (Sestito and Dillon, 1994). A new knowledge item can be captured when it is shared electronically, either by e-mail, on-line chat, or documented. Therefore, tools that support authoring and documentation also help capture knowledge. All document-creating tools like word processors or scanners come into this category. An interesting group of tools that belong in this category are collaboration tools that possess a feature for saving conversations or chats. Logging chats, threaded discussions, or instant messages help capture knowledge. Once a document is created it must be integrated into the repository. All document management tools support this operation.

B. Knowledge Organization/Storage

Activities through which knowledge is organized, classified and stored in repositories comprise this category. Explicit knowledge needs to be organized and indexed for easy browsing and searching. It must be stored efficiently to minimize storage space. All indexing tools, search tools and document management tools support these activities. Tools in this category include SemioJ4 and VerityJ5, which are indexing tools. An indexing tool automatically indexes the various items in the knowledge base and makes searching through the knowledge base easy and efficient. Storage of information is crucial issue due to if we stored information in the effective manner then we can retrieve it in the effective manner otherwise it will be garbage and time consuming task.

C. Knowledge Distribution

Individual knowledge has to be shared to enrich organizational knowledge. When knowledge is distributed, more users can access and internalize that knowledge; hence, there is a growth in organizational knowledge. A variety of tools have been developed to distribute or deploy knowledge. Agresti refers this to as “push and pull technology” (Agresti, 2000). Knowledge can be distributed thorough training programs, automatic knowledge distribution systems and expert systems. Making the knowledge base of the organization available to the users who require it, and delivering the right knowledge at the right time, are the basic goals of knowledge distribution. All portals, content delivery systems, e-mails, FAQ lists, etc, which can deliver knowledge to employees fall in this category. Examples include OptimalviewJ6 and Axiele, which are portals.

D. Knowledge Application

Through application, knowledge becomes the basis for further learning and innovation. Applying knowledge (from the knowledge base) to benefit the organization is the payoff for knowledge management (Rus, et. al., 2001). Tools with “Find similar” features fall into this category (for example, document management tools). The software tool can provide a similar template or a knowledge item for a particular task.

III. AGENTS IN KNOWLEDGE MANAGEMENT

In the knowledge management domain, agents have been largely used in a multiplicity of projects and applications, to address a number of functions, roles and activities. In this paper we are introducing agents for the effective utilization of knowledge at various step of software engineering here we are discussing agents and these agent will work as organizational knowledge management force.

A. Domain Knowledge Agent

Domain Knowledge agent is responsible for capturing, storing information related to domain. As a domain expert they will provide experienced information to the new people and person as per the specialized project. Domain expert will store their knowledge and expertise the database with the help of appropriate User Interface into OKB and providing this information as per the authorization issues by the management. Personal domain knowledge and their expertise and why to get this expertise can be identified by the query generated by the management at periodically manner. This domain knowledge can be travel, Banking etc.

B. Organizational Knowledge Agent

This knowledge agent will work for organizational internal knowledge and its effective utilization. OKA will work as per the information carried out by the knowledge enabler a pro rata basis. This information can be used to internal monitoring purpose and organizational process to be improved.

C. Process Knowledge Agent

Process Knowledge Agent (PKA) will record, evaluate and stored information into OKB. And this information to be utilized by the knowledge enabler as well as decision maker.

D. Distributed Case Based Agent

Distributed Case based Agent will store the information as per the Situation and case based scenario. This agent is responsible for Store, Monitor and Evaluate information into OKB and help to the Knowledge Enabler and well as Decision maker in the future project and its effectiveness.
E. **Ontology Agent**

Ontology’s offer a way to cope with heterogeneous representations of web resources. The domain model implicit in an ontology can be taken as a unifying structure for giving information a common representation and semantics. The ontology representation in semantic web started with XML, RDF and continued with DAML and currently ends up with OWL – Web Ontology Language. HTML -> XML -> RDF -> RDFS -> DAML+OIL -> OWL. Ontology in XML form thus comes from semantic web community. Knowledge as represented so far in MAS comes from Artificial intelligence (AI) – Logic programming and Experts Systems. While in the semantic web you describes domain as objects related to problem domain, in logic you describes formulas or rules valid for such objects. AI field is based on Lisp structures and Prolog like expressions but it became to define ontologies for entities, which defined rules are about. Ontology’s used in Agents systems so far are weak and are more thesaurus like or some protocol defined, where we know what the words mean but we don’t know and we don’t need to know relations etc. Even FIPA [FIPA02] has no definition about how ontology model of agent should look. There are several standards of FIPA [FIPAONTOO] related to ontology - agent for ontology sharing and special service. There are several standards of FIPA [FIPAONTOO] related to ontology - agent for ontology sharing and special service.

On the other hand the semantic web tries to include more reasoning over a created model – to include some rule based inference and other AI results. Thus those 2 fields are merging. Basically we can say that currently semantic web wants to include AI results in XML way and MAS research ontologies as in the semantic web in LISP or Description Logic way (FIPA-SL[FIPASL]) So the difference is that both fields need something but are not merging. There are also many common points such as OWL-DL, which is subset of OWL compatible with Description Logic. Since XML is a widely used commercial standard and new web services technologies like WSDL, UDDI and SOAP are dealing with XML, we think that results of semantic web should be included in the Agent area. Even if any MAS researcher can say that the web service technology is only a subset of power which ACL and FIPA communication standards give us.

The problem why FIPA standards were not used is in lack of ontology models. WSDL is nothing else than a simple ontology and SOAP is just a subset of what ACL can do but they well cover current e-business needs and MAS can not ignore commercial standards and go different direction if some research results should be used. Here ontology agent will work for capture information from various ways and store it into OKB.

F. **User Interface Agent**

User Interface is very crucial agent due to for the marketability and good visibility need a concepts and vision for user Interface. This agent will store the User Interface worked performed by the previous personal and stored it into as a template of reference as per particular project as well as client interest areas.

G. **Workflow Agent**

Workflow agent is responsible to monitor the various workflow activities and this activity to be stored in the OKB. Then after information to be utilized in the effective manner.

H. **Toolset Agent**

This agent will capture various agent and toolset. Various tool set are available for Knowledge management life Document Manager Etc. this toolset agent will capture information via GUI based Application.

IV. OPERATIONAL IDEOLOGY OF MABKM

At section 3 we have discuss various agent and there functionalities and This section presents the work currently underway in the context of the my research work on MABKM for My PhD Degree, whose purpose is to realize an information management and knowledge sharing system that allows users with different perspectives on a common set of concepts to access heterogeneous information spread over a number of distributed sources on the Web. MABKM is a process to manage Information as well as knowledge at effective manner for future needs of organizational development. In this section we also deals a combinational approach of agent discuss in fig 1 to fig 8 and In figure 9 we have also discussing a multi agent architecture for knowledge management that will known as Multi agent based Knowledge management architecture.

![Multi Based Knowledge Management Architecture](image)

Figure 10 Multi Based Knowledge Management Architecture

V. MULTI AGENT BASED KNOWLEDGE MANAGEMENT MODEL

In the section 3 figure 10 are discussing the concepts of Multi agent based Knowledge management. MABKM is the Concepts to for Organizational Knowledge Management based on the agents system in this section we are going to explore the concepts and architecture of Multi agent based Knowledge Management. After that functional overview of MABKM System and before end of this section we are discussion the concepts of Multi agent based Knowledge management Framework.
In figure 10 architecture user will access the knowledge from database with personalization approach. Every agent like DKA: Domain Knowledge Agent OKA: Organization Knowledge Agent (OKA), Process Knowledge Agent (PKA), Distributed Case Base Agent (CBA), Ontology Agent (OA), User Interface Agent (UIA), Workflow Agent (WA) and Toolset Agent (TA) will work for Knowledge capture, Distribution and Evaluation. Basically means of this research work to provide a theoretical framework for knowledge management architecture for prop up for software engineering that will known as SE-MABKM.

A. Functional Overview of Proposed MABKM System

Proposed MABKM System is divided into three layer architecture namely: Interface layer where personal knowledge based agent intimate user's interest and build up user profile, intelligence layer: Multi Agent Based Knowledge Management: Flexible Middleware Infrastructure Resource Layer Machine Process able, Meta data based on the ontology Active knowledge management resource facilitates multi agent interaction Management: Flexible Middleware Infrastructure

![Figure 11: Functional Architecture of Multi agent Based Knowledge Management Model]

B. Functional Overview of Proposed MABKM System

Figure 11 shows a three layered functional architecture of the multi agent based generation knowledge management system. A knowledge architecture consisting of the interface, intelligence, and resource layers, once in place, there is a federation of technologies running on the top of the existing network [6]. The benefits of layered architecture are: The ability to flexibly apply tools, to keep overhead to a minimum.

A1. Interface Layer

The top layer moves information in and out of the knowledge management system. When this information is relevant, timely, and actionable, it represents knowledge. At the interface layer, the KM system users interact with the system to create, explicate, use, retrieve, and share knowledge. The interface layer provides a universal mechanism for accessing all the layers and underlying processes for delivering the information.

The Personal Assistant (PA) agent represents the interests of the user and provides the interface between user and the system. It gradually learns how to better assist the user by observing and imitating the user, understanding user's interests and needs, and building up user's profiles. Through this layer, a virtual work environment is created which enables tacit knowledge sharing.

A2. Intelligence Layer

This layer consists of multi-agent middleware infrastructure which remains active all the time and behaves concurrently in an autonomous manner to achieve a common goal regarding constantly changing user interests and heterogeneous knowledge resources. Agents can check of the dynamic conditions of the knowledge management environment, reason to interpret those perceptions, solve problems, determine actions, and finally act accordingly. Some agents have an ability to learn from past mistakes at an explicit level which is something very much in line what a KM system is intended to help with.

A3. Structured Resource Layer

The bottom most layer in a knowledge management system architecture is the one which contains organization's intellectual assets. The considerable size of the information space and the variety of resources residing in it, make network information access a daunting task. Therefore, knowledge should be organized by an appropriate taxonomy for the ease of its retrieval. By enhancing the existing information sources with meta-data, the agents are able to recognize and understand what information is and what it is about. This is because every agent understands and agrees on the meaning of a 'term' the other agent is speaking because the term is officially described in a public ontology that can be referred to.

VI MULTI AGENT-BASED KNOWLEDGE MANAGEMENT FRAMEWORK

An agent-based framework provides a methodology and tools for supporting a life cycle of an agent-based system. The MABKM framework supports the design and implementation of multi-agent module of flexible distributed systems. The MABKM framework consists of three subsystems: 1) Workspace (AWS) is an agent's operational environment on a distributed platform. According to the structure and functions of an MABKM to be designed, a lot of AWS can be installed on many platforms. 2) Repository (ARS) is a mechanism to manage and utilize the reusable agents.

3) Design Support (ADS) provides the facilities for designers to design and implement various agents, based on MABKM model. From a viewpoint of the implementation of MABKM Framework, the agents are classified as repository agents, and workplace agents. The ARS and AWS work together cooperatively based on the MABKM Organization/Reorganization Protocol (OARP).

The AWS sends a message of requesting a service to ARS. In the ARS, the received message is sent to the repository agents to construct an organization of agents through OARP, to attend to the requested service. In this way, workplace agents are instantiated on a designated AWS as an instance of repository agents in ARS, to realize an executable component of MABKM. Thus, activating the workplace instance agents, the requested service is provided dynamically to the user. The workplace agents which run on the AWSs can communicate
with each other by using the Communication/Cooperation Protocol (ACCP) which has a set of customized per formatives of the agent communication protocol of KQML [7].

A. Organization of a Bevy of Agents

Figure 2 represents the technical architecture of an SEMABKM based Multi Agent Based KM system. A multi-agent system is an ideal structure to support knowledge management, since each typical service required by the system can be implemented as a service agent, and each user can be assigned a personal assistant agent. The GUI (Graphical User Interface) enables the communication between the user and workplace agents.

A1. Workplace KM-Agents

Personal Assistant Agent (PA) - Its main functions are: collaboration with other workplace agents and reasoning over the suggested information. Responding to user's query proactively (based on its knowledge of prior requests of user). Actively updating its knowledge based on the information fetched and user's response. Making decisions under certain conditions that some specific information should be pushed to the user although it isn't demanded explicitly.

Task Management Agent (TMA) - The functionality of this agent includes: behaving like a manager agent to handle the organization of all other agents which take part in some specific KM task. Administrating and controlling the collaboration among users and agents during the execution of a task.

Information Processing Agent (IPA) - Its main functions are: retrieving and merging information from heterogeneous distributed information sources. Filtering irrelevant content under information overflow condition.

Resource Agents (RAs) - Their functionality comprises of: protocols availability through which knowledge resources accepts queries. Extracting relevant information for a given request. Managing the status of whole knowledge repository. actively proposing resources to other agents based on their knowledge of other agent's needs. From a practical point of view, it is convenient to have a separate source agent for each source, for that it is easy to include new sources one by one and also to exclude sources that are no longer required.

A2. Interaction among KM-Agents

An example of multi-agent behavior in the proposed design in relation to KM activities is described here.

"Knowledge Retrieval"

1. The user submits a query to PA.
2. First PA attempts to apply its knowledge based on the prior requests for the resources, stored already in its knowledge base. Next it attempts to attend to the user's needs by forwarding the request to MAS based repository agent—TMA.
3. TMA sends task announcement to each RA.
4. RAs which can serve the request send bid to TMA.
5. Based on its knowledge, TMA sends award message to the most appropriate bidding RAs.
6. An agent group of RAs that adapts to the user's request is selected and instantiated onto the agent's workplace.
7. RAs communicate with the ontologically linked knowledge repositories by translating the user's query into the low level query expressed in a format directly understandable by the information resource.
8. Results of information retrieval are forwarded to IPA.
9. Further processing of the results is done by IPA. and context-specific results are forwarded to user through PA.
10. RAs initiate notifications to PA about updates occurring in the resources, which eventually make the user aware of the content changes and software updates.

"Knowledge Creation/Capture"

1. The user sends a request of submitting a newly created piece of knowledge to PA.
2. PA engages TMA in this process which, in turn, issues task announcement to RAs.
3. RAs reply with bid messages, as a result TMA issues "AWARD" message to most suitable ones.
4. Based on its knowledge, TMA sends message to the appropriate bidding RAs.
5. The selected RAs dynamically annotate the knowledge item and integrate it at appropriate locations in the repository.
6. The knowledge created is reused thereby facilitating knowledge creation.

"Knowledge Organization/Modeling"

1. Once a modification (addition/deletion of knowledge items) occurs in the repository, RAs behave like an ontology agent to automatically update the content descriptions of the knowledge resources to integrate the changes.
2. IPA negotiates over the current status of the knowledge resources with RAs, and helps in filtering out the obsolete contents. A remarkable feature of the repository-based ADIPS framework is the centralized management of service functions of agents. That is, if we adjust or tune the agent specification in the repository, then it is possible to change the behavior of the whole multi-agent system. As new services are needed, many other service agents are added to this basic configuration, and when new members are considered, then new personal assistant agents are added.
VII. SE-MABKM

In section 6 we have discussed the various ways of knowledge management using MABKM. Now we are discussing the concept at Software Engineering Environments and after integrating the concept of MABKM into various Life cycle of Software engineering environment (SEO). Organizational knowledge Management for Software Engineering Organization (SEO). SEO always seeking for a better management policy to get optimum ROI and maximize the effect of Balance Sheet. So, with the help of this Framework Model organization can get the right information at right time to right people; which are the base line of knowledge management. SE-MABKM can be useful if whole information to be stored in the database in the effective manner by the internal life cycle of the organization. In this research work we are focusing only those life cycles that are direct affecting the software engineering policy and development from upper level to bottom level of life cycle. Here organizational management is prime concern this department always try to get information from various sources but these information is authentic or not is questionable. So, for authentication purpose management needs to manage itself by the various knowledge management practice as per the multi agent based knowledge management approach. Where agent will work for organization knowledge management and stored this information at Organizational Knowledge Base (OKB). SE-MABKM Architecture are showing how it works for organizational growth. In the below figure MLC is a part and parcel of Business Unit and they have responsibility to manage itself as well as various organizational life cycle which is SDLC, STLC, OPILC. But one point to be remembered each and every life cycle has responsibility to store their work and Activity in the OKB. Which will be Knowledge base of Organization and if management need to provide information to any of the people and person they issued Authorization to Knowledge database manager then after they will create a environment or enable an environment for concern department or person. Based on that stored information management can see the entire organizational activity as whole then after they can analyze, evaluate and take proper decision for organization. In other side organizational process management lead the role of organizational development and their life cycle is prime concern to organizational improvement. We have many process improvement concepts like Six Sigma, TQM (Total Quality Management), ISO, BS as well as CMM and CMMI. Process improvement concepts depend on organization level and standard in terms of goodwill and marketability. In another side system development life cycle are there; where work to be performed at various phases like communication, planning, Designing, and Construction. While, Construction phase is divided into two part one for development whose prime concern is software development at Back end as well as Front end while another side testing team is responsible for test the entire work which is carried out by the system development life cycle.

A. Management Life cycles

Management need a approach to take decision at effective manner for effective decision they always try to get information from various sources after that they explore it for their authentication and then after analyze for better solution in the form of the matrix. Matrix gives a proper path for decision. Based on the Decision outcome decision maker evaluate and release order or information for the entire organization as follow up. Figure 14 are elaborating the concept of Management life cycle.

![Management Life Cycle](image)

B. Organizational Process Improvement Life Cycle (OPILC)

Process improvement is another milestone for Software engineering. Due to it business nature if organization will not follow the path of process improvement then organization will be outdate or obsolete. Today we are crossing the global era where information and knowledge is everything and if we want to survive in this business world we need to adopt the process or improved process. We have various process based concepts like TQM, Six Sigma, ISO, CMMI and BS Standards and every concept are providing guideline of effective functionalities of organization. In the organization and it’s process improvement carried out in the various phases like get information from various sources like stored and unsorted. Stored information give the power of risibility and unsorted information need purification and authentication. After the information which is released by the Management life cycle they explore, analyze, evaluate and release which will be stored in OKB of SE-MABKM.
After the feasibility of the plan design team will design the work in the various phases. Then after are also there who will check their feasibility in terms of preferred language and database while as in another side construction works started parallel. One side software Project management, Marketing personal, Development team as well as testing Team but not only this, many planner are also there who will check their feasibility in terms of Cost and benefit. After the feasibility of the plan design team will design the work in the various phases. Then after construction works started parallel. One side software developer will work from front and back end design with preferred language and database while as in another side testing team will work as per the test plan for authentication of worked performed by the development team. If any deviation happens then they stored this information at bug tracking tools and submit it for rectification. Figure 16 are of worked performed by the development team. If any Communication between various team of Project it’s include development life cycle carried out by the Software Engineering. We are not including the maintenance and Support phase due to this is the responsibility of Quality Assurance team but it is also associated with System Development life cycle. Maintenance and Support work will give the applicability of your product and their feedback issued by the organization.

C. System Development Life Cycle

In the Organization, new application or product to be developed based on the same approach, especially in the software Engineering. Product to be developed in the System Development life cycle which start from Communication between various team of Project it’s include Project management, Marketing personal, Development team as well as testing Team but not only this, many planner are also there who will check their feasibility in terms of Cost and benefit. After the feasibility of the plan design team will design the work in the various phases. Then after construction works started parallel. One side software developer will work from front and back end design with preferred language and database while as in another side testing team will work as per the test plan for authentication of worked performed by the development team. If any deviation happens then they stored this information at bug tracking tools and submit it for rectification. Figure 16 are of worked performed by the development team. If any Communication between various team of Project it’s include development life cycle carried out by the Software Engineering. We are not including the maintenance and Support phase due to this is the responsibility of Quality Assurance team but it is also associated with System Development life cycle. Maintenance and Support work will give the applicability of your product and their feedback issued by the organization.

VIII. IMPLEMENTATION

Prior to implementation of SE-MABKM we have to take a proper feedback from the working people. Feedback will show trained and untrained people of the organization. If more people are untrained regarding computational skill and if people get or secured more than 60% of Grade then implementation application into software Engineering environment. After implementation we have to prepare a questionnaire in fresh nightly basis to get People mind knowledge. It will help to understand management regarding what is going on within the organization. Based on that information they can take appropriate decision or action to improvement in the organizational policies. After the storing information compare it from previous or old information if any improvement then update otherwise wait from another forth nightly. And at the end of the month analyze it for appropriate decision.

IX. SE-MABKM FRAMEWORK

SE-MABKM is a theoretical framework for organizational knowledge Management for Software Engineering Organization (SEO). SEO always seeking for a better management policy to get optimum ROI and maximize the effect of Balance Sheet. With the help of this Framework, organization can get the right information at right time to right people; which are the base line of knowledge management. SE-MABKM can be useful if whole information to be stored in the database in the effective manner by the internal life cycle of the organization. In this research work we are focusing only those life cycles that are direct affecting the software engineering policy and development from upper level to bottom level of life cycle. Here organizational management is prime concern. Department always try to get information from various sources but these information is authentic or not, is questionable. So, for authentication purpose management needs to manage itself by the various knowledge management practice as per the multi agent based knowledge management approach. Where, agent will work for organization knowledge management and stored this information at Organizational Knowledge Base (OKB). SE-MABKM Architecture is showing how it works for organizational growth. Management Life Cycle (MLC) is a part and parcel of Business Unit and they have responsibility to manage itself and simultaneously various organizational life cycles which is SDLC, STLC, and OPILC. But one point to be remember each and every life cycle have responsibility to store their work and Activity in the OKB which will be Knowledge base of Organization and if management need to provide information to any of the people and person they issued Authorization to Knowledge database manager then after they will create a environment or enable a environment for concern department or person. Based on that stored information management can see the entire organizational activity as whole then after they can analyze, evaluate and take proper decision for organizational. In other side organizational process management lead the role of organizational development and their life cycle is prime concern to organizational improvement. We have many process improvement concepts like Six Sigma, TQM (Total Quality Management), ISO, BS as well as CMM and CMMI. Process improvement concepts depend on organization level and standard in terms of goodwill and marketability. In another side system development life cycle are there; where work to be performed at various phases like communication, planning, Designing, and Construction. while, Construction phase is
Management divided into two parts: one for development whose prime concern is software development at the back end, as well as testing the entire work which is carried out by the system's front end. Another side testing team is responsible for ensuring that they explore it for their authentication and then review the solution in the form of a matrix. This matrix gives a proper path for decision. Based on the decision outcome, decision maker evaluate and release order or information for the entire organization as follow up. Process improvement is another milestone for software engineering. Due to its business nature, if organization will not follow the path of process improvement, then organization will become outdated or obsolete. Today we are crossing the global era where information and knowledge is everything and if we want to survive in this business world, we need to adopt the process or improved process. We have various process-based concepts like TQM, Six Sigma, ISO, CMMI and BS Standards, and every concept is providing guideline of effective functionalities of organization. In the organization, it's process improvement carried out in various phases, like getting information from various sources like stored and unsorted. Stored information gives the power of reusability and unsorted information need purification and authentication. After the information which is released by the management life cycle, they explore, analyze, evaluate and release which will be stored in OKB of SE-MABKM.

**X. CONCLUSION AND DISCUSSION**

Knowledge management is one of the fields that is likely to become more and more critical as new and more powerful tools and languages for automating information handling are developed and used. Software agents present a wealth of features, from autonomy, to mobility, from their loosely coupled nature to their very high interoperability with a lot of systems. As such, they may be useful in addressing some of the problems we have to face when striving to realize an efficient and reliable system to manage information in every environment, from a small company to a world-wide setting. So as per my research point and limitation, we are integrating the concepts of multi agent based Knowledge management model into software engineering organizational environment. Software engineering has long recognized the need of experience factory so we are trying to create a theoretical framework of knowledge management based on the multi agent system. After completing the research, I get it a model that is known as SE-MABKM. We tried to point out what are the most crucial issues about knowledge management. We believe that SE-MABKM to be widely used in organization for policy making at software firm. In some time, SE-MABKM era will arrived for organizational policy making as well as its growth. But this is not limit of this work, many organization can use this concept for their practical implementation of SE-MABKM. But we have not adequate amount of resource so we are not going to further implementation.

**XI. ACKNOWLEDGEMENT**

In software organization, the software engineering practice and process improvement practice can be done more efficiently if organizational knowledge management practices merge with multi agent system. These concepts will provide a guideline for the software developer to develop tools in the form of application so that they can achieve desired goal. This will strengthen its economy and makes the human resource more productive. This work is the part of My PhD Programme at NIMS University Rajasthan under the Supervision of Dr. C.S. Lamba.

**XII. REFERENCES**

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SE-MABKM: Support for Software Engineering via Multi Agent Based Knowledge Management

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Abstract
Software engineering is the process of design, develop Implement and Maintenance a particular task with certain goal by the help of logical activity perform by the knowledge communities. Especially, In Knowledge Organization around 80 Percent Problem is recognized by the Knowledge communities i.e. related to the people. Much work is recognized in the field of knowledge management support for Software Organization but knowledge manager are still facing Problem Related to organizational Knowledge management. While, we are crossing the dynamic and multi facet environment where work to be performing 24*7*365 in manner. So, we need an environment which acts as a multi agent for knowledge management communities. In this work we are proposing a Model for Software Companies who are seeking for optimum knowledge management practices (OKMP) at the organization. In order to get this objective we have splitting the work into five phases; Which begins from Identification of the various Problems related to software Engineering or Software engineering Practices (SEP)? To historically these problems we are bringing knowledge management and it’s Various Practices including the consequences of such Practices? Then after we are keeping Multi Agent System in Knowledge Management and then we are putting MAS and KM as a whole in Software Engineering. Finally, we are looking for the result of such merger which would further term as SE-MABKM (Support for Software Engineering via Multi agent based Knowledge Management).

Keywords
OKMP, SEP, MABKM, SEMABKM

I. Introduction
We are working in multi facet era where software became parts and parcel of business environment. The demands of software and its development are increasing. Shorter time-to-market, better quality and better productivity are more and more goals to be achieved. To meet these requirements, software organizations have tried to better use one of its most important resource: the organizational software engineering knowledge. Historically, this knowledge has been stored on paper or in people’s mind. Unfortunately, paper has limited accessibility and it is difficult to update [1]. Knowledge in people’s mind is lost when individuals leave the company. Furthermore, in a large organization, it can be difficult to localize who knows some matter. So, knowledge has to be systematically collected, stored in a corporate memory, and shared across the organization [2]. To put knowledge sharing in practice, organizations should acquire knowledge from their members and formalize it to make it available on an organizational level. In this context, multi agent based knowledge management systems can be very useful. Knowledge management (KM) involves human resource, enterprise organization and culture, as well as the information technology, methods and tools that support and enable it [3]. Based on the online survey conducted by the author and after the response provided by the Knowledge Manager and it enable demand Multi agent based knowledge management system that facilitates creation, access and reuse of knowledge, and its main goals are to promote knowledge growth, communication, preservation and sharing. Below data are showing response and applicability of MABKM. Authors are trying to see the applicability of MABKM in software Engineering Environment.

Abstract
Software engineering is the process of design, develop Implement and Maintenance a particular task with certain goal by the help of logical activity perform by the knowledge communities. Especially, In Knowledge Organization around 80 Percent Problem is recognized by the Knowledge communities i.e. related to the people. Much work is recognized in the field of knowledge management support for Software Organization but knowledge manager are still facing Problem Related to organizational Knowledge management. While, we are crossing the dynamic and multi facet environment where work to be performing 24*7*365 in manner. So, we need an environment which acts as a multi agent for knowledge management communities. In this work we are proposing a Model for Software Companies who are seeking for optimum knowledge management practices (OKMP) at the organization. In order to get this objective we have splitting the work into five phases; Which begins from Identification of the various Problems related to software Engineering or Software engineering Practices (SEP)? To historically these problems we are bringing knowledge management and it’s Various Practices including the consequences of such Practices? Then after we are keeping Multi Agent System in Knowledge Management and then we are putting MAS and KM as a whole in Software Engineering. Finally, we are looking for the result of such merger which would further term as SE-MABKM (Support for Software Engineering via Multi agent based Knowledge Management).

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Query 1: Response: How long you have been employed?

<table>
<thead>
<tr>
<th>Experience</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 Years</td>
<td>61%</td>
</tr>
<tr>
<td>3-6 years</td>
<td>71%</td>
</tr>
<tr>
<td>6-9 years</td>
<td>71%</td>
</tr>
<tr>
<td>More than 9 years</td>
<td>21%</td>
</tr>
</tbody>
</table>

Response are saying information and data availability of experienced personal who have more than 9 years of experience in the field of Knowledge management from Software Companies to Industry but till paper writing more response from beginning In knowledge management practices it is very essential for us to know the people background.

Query 2: Response: your role at organization?

<table>
<thead>
<tr>
<th>Role</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>85%</td>
</tr>
<tr>
<td>Marketing</td>
<td>15%</td>
</tr>
</tbody>
</table>

In general at whole we have only two departments at organization which is separated by Production and marketing here we are focusing on response from only production but we can not neglect response from marketing department. For this research work each and every personal who are managing knowledge and their experience are remarkable here 57% People are participating from production and remaining 7% from Marketing.

Query 4: Response: How Much time you spent on Knowledge Management with in weeks?

<table>
<thead>
<tr>
<th>Time</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hour</td>
<td>0%</td>
</tr>
<tr>
<td>5 Hours</td>
<td>75%</td>
</tr>
<tr>
<td>8 Hours</td>
<td>75%</td>
</tr>
<tr>
<td>More than 10 Hours</td>
<td>21%</td>
</tr>
</tbody>
</table>

Finally, we are looking for the result of such merger which would further term as SE-MABKM (Support for Software Engineering via Multi agent based Knowledge Management).
Other side of questionnaire is based on the time spent by the
knowledge manager more than 10 hour. 14% and 36% of data are
again saying that they spent on knowledge management. So again
a conclusion came that we are spanning more time in knowledge
management it means we need a system or concepts based on that
we can get knowledge management practices.

Query 5 Response: Is Organization are Seeking and or
Using Multi Agent Based Knowledge Management
Approach for Process Improvement?

Yes 11.79%
No 1.75%

This question are validating the research ideas for the response
near by 80% knowledge management people or knowledge
communities are seeking the knowledge management practice
based on the multi agent approach

Query 6 Response: Is Organization are Seeking and or
Using Multi Agent Based Knowledge Management
Approach for Software Engineering Support?

Yes 10.83%
No 2.17%

People may select more than one checkbox, so percentages may
add up to more than 100%. The above bar graph shows that 83%
response favors for Multi agent based knowledge management
approach are required for software engineering Practices

Query 7 Response : Is Organization are Seeking and or
Using Multi Agent Based Knowledge Management
Approach for Effective Utilization for
Organizational Knowledge Management

Yes 7.64%
No 14.36%

People may select more
than one checkbox, so
percentages may add up
to more than 100%

Based on the questionnaire and their response motivate me to do
work on Multi Agent system (MAS) it is widely use to deals with
some problem in the complex environment especially distributive
collaborative environment. MAS are the group of agent that can
define their goal and action and it integrates these functions to
finish a large complex task such as workflow control knowledge
search. Each agent can interact and collaborate with user or other
agents through communication for a special problem. MAS offer
a new dimension for cooperation and coordination in distributed
collaborative environment. It can provide an effective platform
for coordination and cooperation to help the members of team
to manage knowledge. Agent's technology is an appropriate
technology to design and develop a distributed system for
KM. In the context of software development, MABKM (Multi
agent based Knowledge management) can be used to capture
the knowledge and experience generated during the software
process. Although every software development project is unique
in some sense, similar experiences can help developers to perform
their activities. Reusing knowledge can prevent the repetition
of past failures and guide the solution of recurrent problems.

So, to be effective, a knowledge management system should be
integrated to the software process. Since Software Engineering
Environments (SEEs) integrate collections of tools supporting
software engineering activities across the software lifecycle [3], it
is natural to integrate MABKM facilities in a SEE. In this paper, we
propose a Multi agent based knowledge management infrastructure
to enable MABKM in SEEs, which considers knowledge capture,
store, retrieval, dissemination, reuse and maintenance with the use
of multi agent architecture of Knowledge management. Section 2
discusses software engineering practices. In section 3, we present
the OPKM (Optimum knowledge management Practices) who can
overcome the organizational process problem. Section 4 and 5
shows how multi agent system is related to software engineering
and knowledge management. Finally, in section 6, we are going to
proposed a MABKM model for software engineering Practices that
will known as SE-MABKM (Support for Software Engineering
via Multi agent based Knowledge Management)

II. Software Engineering Practice and Process
The Software Engineering term began to be popularized in 1968
at Software Engineering Conference that was held by NATO. A
body of knowledge that discussed all the aspects of the production
of software, starting from the early stage that is the analysis of
the requirement for the user, determined the specification from
the requirement for the user, the design, coding, the testing to the
maintenance of the system after being used. Fig 1 showing the
software development life cycle or practice at the organization.
It is clear that Software Engineering is not only related to the
production method of the computer program. While it has

![Fig. 1: Software development life cycle and phases.](image)

...
engineering tools and methods include the theoretical study on aids and the software engineering method. Software engineering process is concerned with the definition, the implementation, the granting, the management, the change and the improvement of the process software engineering. Software quality is stressed on the quality and the software life-cycle. There were many software development models, including The Waterfall Model, Joint Application Development (JAD), Information Engineering (IE), Rapid Application Development (the COUNCIL) including Prototyping, Unified Process (UP), Structural Analysis and Design (SAD) and Framework for the Application of System thinking (FAST). But is this model are appropriate for knowledge management I think not we need a Multi agent based approach to manage knowledge specially Software engineering due to we unable to manage then they will manage your organization and knowledge.

III. Optimum Knowledge Management Practice
To support the knowledge management process in a SEE, a complete KM infrastructure should be provided. The corporate or organizational memory (OM) must be at the core of this infrastructure, supporting knowledge sharing and reuse. Arranged around the OM, knowledge management services shall actively provide useful information to users working on knowledge-intensive tasks [3]. These knowledge management services correspond to the activities of the knowledge management process: creation, capture, retrieval, access, dissemination, use, and preservation of the organization’s knowledge, as shown in Figure 2. The primary requirement for an OM is to prevent the loss and enhance the accessibility to organizational knowledge by providing a centralized, well-structured knowledge repository. Since workers are often too busy to look for information or do not even know that relevant information exists, proactive services must be provided, actively reminding workers of helpful knowledge. Thus, knowledge distribution may be passive or active, as either the user can search for the required information, or the KM system itself can offer knowledge that seems relevant to the user’s task [3]. To gain user acceptance, a KM system must be integrated into the organization’s process, allowing to collect and store relevant knowledge as they are generated in the work. Consequently, it should be also integrated to the existing work environment [3]. The KM system is to be an assistant to the user, supplying him with relevant organizational knowledge, but leaving him the responsibility of a contextual interpretation and evaluation of this information. In this context, to keep an OM up to date, it is important to get feedback from its users, who must be enabled to point out deficiencies and suggest improvements without significantly disrupting their usual workflow. Therefore, user feedback is essential for OM maintenance and evolution [3]. Even though the advantages of having an OM are generally recognized, organizations are reluctant to invest time and money into a novel technology whose benefits are distant and uncertain. Thus, a KM system must exploit readily available knowledge, provide benefits quickly, and be adaptable to newly arising requirements.

3.1 Knowledge Capture
Since ODE deals with three kinds of knowledge, it must offer facilities to capture each one of these type:

- When dealing with lessons learned, we have to consider that project-level knowledge can be useful, but it is not always the case. Generally, project-level knowledge must be handled to become an organizational knowledge. A tool supporting a workflow for approving a lesson learned was developed in ODE. First, a developer inputs a lesson learned in the OM. At this moment, this knowledge is not available for other developers. The knowledge manager must evaluate and adapt the lesson learned so that it can be considered knowledge at the organizational level. Once approved, the lesson learned is made available.
- The knowledge manager is responsible for creating the instances of the ontology that are useful to the organization. In ODE, for each ontology, there is a tool supporting its instantiation.
- Finally, artifacts created during the software process must also be available as knowledge items. Artifacts must be submitted to configuration management. ODE has a prototypical configuration management system that controls not only artifacts produced by ODE’s internal tools but also artifacts from external tools that are put under version control. So, in the current stage, the ODE’s configuration management system is the base for dealing with artifacts as knowledge items.

3.2 Knowledge Search:
Knowledge management in ODE supports information access through searching. An ODE user can search for any kind of knowledge in the OM: formal knowledge (artifacts and ontology instances) or informal (lessons learned).

3.3 Knowledge Dissemination
While knowledge search is a user-initiated search, knowledge dissemination is initiated by the system, without requiring the user to explicitly formulate a query. Software agents monitor the users’ actions as they work and inform them about potential relevant knowledge. Users can browse the various knowledge items and then select and reuse one of them. Knowledge dissemination is particularly important when users are not motivated to look for information or when they are not aware of the need for information in the first place.

3.4 Knowledge Use
Once a knowledge item is selected for use, the user can identify what part he/she wants to use and a new knowledge item is created based on the previous one. Some reuse information is shown, including when and how often this item has been used and who used it. Finally, the user must evaluate the reused item to help knowledge maintenance. It includes evaluation information about if the item was useful, problems that appeared when reusing it, and solutions which have been applied.

3.5 Knowledge Maintenance
For maintenance and evolution of the OM, it is necessary to take into account users’ feedback. Based on the user feedback, the knowledge manager can decide what knowledge item is obsolete.
In a nutshell, an agent can be seen as a software and/or hardware component of a system capable of acting exactly in order to accomplish tasks on behalf of its user in some environment. Its characterization includes (1) reactivity; (2) autonomy; (3) knowledgebase. Agent technology is one of the most promising technologies for dealing with distributed collaborative environments and social interaction in modern management. MAS is widely used to deal with some problems in the complex application environments, especially distributed collaborative environments. MAS are a group of agents that can define their goals and actions, and it integrates these functions to finish a large complex task such as workflow control, knowledge search. Each agent can interact and collaborate with users or other agents through communication for a special problem. MAS offer a new dimension for cooperation and coordination in distributed collaborative environment. It can provide an effective platform for coordination and cooperation to help the members of team to manage knowledge. Agent technology is an appropriate technology to design and develop a distributed system for KM [7]. The term “knowledge” is sometimes used interchangeably with the term “information”. From views held by some in the knowledge management field, knowledge holds an elevated status compared to information [8]. Knowledge management is the name of a concept in which an enterprise consciously and comprehensively gathers, organizes, shares, and analyzes its knowledge in terms of resources, documents, and peoples skills. Advances in technology and the way we access and share information have changed that; many enterprises now have some kind of knowledge management framework in place [9].

Fig. 3: Multi Agent Architecture for Knowledge Management

Developing KMS is a difficult task; in fact, there are different approaches towards this. For instance, the process/task based approach focuses on the use of knowledge by participants in a project or the infrastructure/generic system based approach focuses on building a base system to capture and distribute knowledge for use throughout the organization [5]. With rapid development of the Internet, the original knowledge management systems which are centralized control can not be adaptive to the distributed environment, especially collaborative environment which brings geographically dispersed teams together, supporting communication, coordination and cooperation. Collaborative environment could not only support the work, but also achieve a seamless knowledge flow among the collaborative team members. In addition, there may be exist more than one knowledge bases including personal knowledge base in the collaborative environment and involve knowledge in each phase of implement process. So the distributed management of knowledge is essential and critical. Currently, to solve the issue of knowledge management in distributed environment, agent and multi-agent technology use and propose the distributed knowledge architecture for knowledge management based on multi-agent. Multi Agent technology is one of the most exciting fields in the intelligent resource management [6]. This review is the different issues and challenges in multi agent based knowledge management using several emerging technologies to support a Knowledge Engineering approach in order to help professional actors to manage knowledge during their projects.

Fig. 4: Architecture of Integration of MABSE

this kind of system it is advisable to study and understand how the transfer of knowledge is carried out by people in real life. However, when developing KMS developers often focus on the technology without taking into account the fundamental knowledge problems that KMS are likely to support [11]. Figure 3 shows the overall architecture of the distributed knowledge management system which is constituted of a set of agents and mainly function modules [12]. These agents are identified by their active roles: serving users, or cooperating work and etc. Each agent is specialized according to its intended roles in the supply chain [12]. KM Each agent is
-autonomous in making decisions on behalf of each function. That is, each agent autonomously collects and processes knowledge information, and cooperative work between these agents according to the practical needs. Share Knowledge Space and Communication Control Center are the main areas of knowledge exchange and interaction during the development project. In this knowledge architecture, some agents are very important for project teams to cooperate design and develop. These agents are named as: Domain Knowledge Agent (DKA), Organization Knowledge Agent (OKA), Process Knowledge Agent (PKA), Distributed Case Base Agent (CBA), Ontology Agent (OA), User Interface Agent (UIA), Workflow Agent (WA) and Toolset Agent (TA).

V. Multi Agent Based Software Engineering

The software engineering process can be greatly enhanced by utilizing agent technology and adopting the architecture of an intelligent, flexible and extensible agent system. The multi-tier architecture of most distributed applications offers a suitable foundation because of its inherent complication that highlights the significant and novel contribution of a multi-agent architecture. The rationale behind utilizing agent technology has to do with the interoperability of the software resources belonging to potentially disparate application components and disparate domains. Towards this direction, agents offer a unified platform of interaction through agent communication. The application of agent technology for the software engineering task is certainly a new and promising research area. However, a variety of approaches that attempt to exploit the benefits of agent technology have already made their appearance and it is expected that this tendency will further evolve. Multi agent can be very useful to store / retrieve information at whole software development life cycle. In this research work I am just integrating the concepts of Multi agent based software engineering. Agent based software engineering is demandable by the customer. It also deals with the employment of software engineering technology for agent systems and applying software engineering methodologies to assist the creation of multi-agent systems; this is realized by suggesting multi-agent frameworks that can be used as a model to build agent systems for testing service-oriented web applications [13]. This research track aims at presenting an agent system for tackling the issues of software maintenance and testing of distributed applications. Some research work focuses on presenting communication and coordination infrastructures for agents engaged in web software testing [14]. Another research direction targets the creation of a multi-agent framework for software testing but the goal is on how an agent infrastructural framework can assist the job of constructing concrete agent systems for service-oriented applications. So figure 3 are showing how agent based software engineering are supporting the management communities problems. Agent-Oriented Software Engineering and gives idea of an agent is being utilized as a generic software engineering model. VISE-MABKM(support for software engineering via multi agent based knowledge management).

Management have responsibility to increase their capacity as well as maximize the Return on Investment so below Proposed architecture of SE-MABKM is showing how MABKM and MABSE to be increase the capacity of Knowledge management at Software companies The Figure 5 shows the how model will covered by the Knowledge management communities for Optimum Knowledge management practice at software engineering Environment (SEE), above figure covers by the software development lifecycle by the multi agent based Knowledge management. Due to the era of global competition SE became more complex so if we will not develop SEE based on the Multi agent the project monitoring and tracking became more hectic. In Other side if we will be unable to proper management practice the management people became failure that will lead to decrease organizational face value as well as end of organizational practice so in this era when we are working in 24*7 then organizational practice like Management, Process and Development is also became 24*7 which lead to complex environment. So we need a complete integrated Tools which can support software companies for its development Practices. This is known as SE-MABKM.

VII. Conclusion

Knowledge management is complex tasks especially in the software organization management communities need to manage people information related to engineering as well as Process improvement. So we need a conceptual framework based on that; knowledge manager can reuse this information in further process in the form of software agents. In this paper we presented an infrastructure for managing knowledge in a software engineering. At the core of this infrastructure there is an organizational memory. Around it, there are knowledge management services supporting OKMPs, such as knowledge capture, retrieval, search, dissemination, maintenance and reuse. We also presented how this to be integrated into MAS. After the integration of this concepts knowledge became MABKM and side by Side if we include this MAS into SDLC as Well as SPI (Software Process Improvement Practice) then we are able to get the SE-MABKM Model. Based on this model if Knowledge Communities to monitor and develop tools to maximize the benefit the communities can get maximum benefit from their resources. In this perspective, knowledge workers constantly create new knowledge as they work. Some benefits of this approach can be pointed out:

- With MABKM integrated to a SE, it is easier for developers to create new knowledge. In this way, the organizational memory is not closed. It is always evolving.
- A major concern for knowledge management in ODE is to capture information during the software process without developers' extra effort. Thus, the KM system is actively integrated into the work process. An isolated KM system, on the other hand, can be a barrier to innovation, because it does not let workers share new ideas with their peers. Closed systems do not give organizations control over their own knowledge, since there is a gap between knowledge creation and integration. Innovations happen outside the KM system, and then it contains information that is chronically out of date and that reflects an outsider's view of work.
- Knowledge management users are no longer passive receivers of knowledge, but are active researchers, constructors, and communicators of knowledge. Knowledge can be constructed collaboratively in the context of the work. Attention to knowledge requires attention to people, including their tasks, motivation, and interests in collaboration. The heart of intelligent human
performance is not the individual human mind but groups of minds interacting with each other and with tools and artifacts.

* A KM system must provide the information workers need, when they need it. ODE's KM system can play an active role in knowledge dissemination.

In other side Software agents monitor the actions of users as they work, and inform them about potentially relevant knowledge for the task at hand. Here we are only proposing the architecture which can help to knowledge management communities to develop application as well as for management communities who is trying to integrate this concept into knowledge management practices. MABKM practice to be integrated into SDL and SPI Then organization monitoring system can be very effective

VIII. Acknowledgments

In software organization the software engineering practice and process Improvement Practice can be done more efficiently if organizational Knowledge management practices merge with multi agent system. These concepts will provide a guideline for the software developer to develop tools in the form of application so that they can achieve desired goal. This will strengthen its economy and makes the human resource more productive .This work is the part of My PhD Programme at NIMS University Rajasthan under the Supervision of Dr. C.S.Lamba.

References


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Novel Data Encryption Algorithm

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Abstract

We always strive to get better algorithms for securing data. A variety of such algorithms are being used in cryptography. Many block and stream ciphers are available and one of them is International Data Encryption Algorithm (IDEA), which was regarded arguably as one of the best for encryption purposes. A considerable time has elapsed since its advent and this period has witnessed a wide development in process approaches and applications. The number of transactions and exchanges of data has increased exponentially. Consequently, better and novel attacks on data evolved. Researchers believe that the security of the algorithm needs to be improved keeping a check on the time and space complexity. Within this research work we are looking for a robust algorithm known as NDEA which can be applied for securing modern environment applications.

Keywords: Novel Data Encryption Algorithm (NDEA), Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), Feistel Structure

1. Introduction

IDEA is an iterated block cipher algorithm based on the Feistel network. It was designed by Xuejia Lai and James Massey in 1991. Feistel network or Feistel cipher is a symmetric structure used in the construction of block ciphers. It was named after the German cryptographer Horst Feistel. A Feistel network is an iterated cipher with an internal function called a round function. Iterated block ciphers are constructed by repeatedly applying the round function. The number of rounds varies from algorithm to algorithm. The general setup of each round is almost the same. A key schedule is an algorithm that, given the key, calculates the subkeys for these rounds. A large number of block ciphers use the scheme, including the Data Encryption Standard (DES), IDEA etc. The advantage of Feistel Cipher is that the operations of encryption and decryption are very similar or even identical. This reduces the size of the code almost by half. The only change required is a reversal of the key schedule and inversion of their values. Hence, the Feistel network model scores over substitution and transposition models as the round function need not be invertible. A block cipher encryption algorithm (E) takes plaintext M of a particular length and key K as an input, and outputs a corresponding ciphertext of the same length. The decryption algorithm (E⁻¹) takes the cipher text as an input together with the key, and yields the original block of plaintext of the same length such that:
Lucifer was the first block cipher developed at IBM in the 1970s. The Data Encryption Standard (DES) appeared in 1976.

1.1 IDEA

- Key size : 128 bits
- Plaintext Block size : 64 bits
- Rounds: 8.5

It provides high level security not based on keeping the algorithm a secret, but by keeping the key secret which makes it suitable for use in a wide range of applications worldwide. It can be economically implemented in electronic components (VLSI Chip).

Plaintext is divided into four 16-bit sub-blocks: X1, X2, X3 and X4 (see fig. 1) and identical operations are performed on the four parts in 8 rounds. The 128-bit key is split into eight 16-bit blocks, which become eight subkeys. The first six subkeys are used in round one, and the remaining two subkeys are used in round two, similarly each round uses six 16-bit sub-keys for 8 rounds while the last half-round uses four, i.e. a total of 52 keys. First 6 keys are extracted directly from the main key. Further groups of keys are created by rotating the main key left by 25 bits.

The mathematical operations involved in each of the rounds are:

- Bitwise Exclusive OR (denoted by ⊕).
- Addition modulo 2^{16} (denoted by ⊕).
- Multiplication modulo 2^{16}+1 (denoted by ⊗).

After the eight rounds there is a half round (as illustrated in fig. 2):

\[ E_K(M) = C : \quad E_K^{-1}(C) = M \]

Bruce Schneier [4] provided a fourteen-step algorithm of IDEA. Here are the fourteen steps of a complete round (multiply means multiplication modulo 2^{16} + 1, and add means addition modulo 2^{16}):

1. Multiply X1 and the first subkey K1.
2. Add X2 and the second subkey K2.
3. Add X3 and the third subkey K3.
5. Bitwise XOR the results of steps 1 and 3.
6. Bitwise XOR the results of steps 2 and 4.
7. Multiply the result of step 5 and the fifth subkey K5.
8. Add the results of steps 6 and 7.
9. Multiply the result of step 8 and the sixth subkey K6.
10. Add the results of steps 7 and 9.
11. Bitwise XOR the results of steps 1 and 9.
12. Bitwise XOR the results of steps 3 and 9.
13. Bitwise XOR the results of steps 2 and 10.
14. Bitwise XOR the results of steps 4 and 10.

For every round except the final transformation, a swap occurs, and the input to the next round is: result of step 11 k result of step 13 k result of step 12 k result of step 14, which becomes X1 k X2 k X3 k X4, the input for the next round. After round 8, a ninth “half round” final transformation occurs:

After the eighth round, there is a final output transformation:

1. Multiply X1 and the first subkey.
2. Add X2 and the second subkey.
3. Add X3 and the third subkey.
4. Multiply X4 and the fourth subkey.

Finally, the four sub-blocks are reattached to produce the ciphertext.

1.1.2 Decryption

Decryption algorithm is exactly the same. The subkeys are reversed and slightly different. The decryption subkeys are either the additive or multiplicative inverses of the encryption subkeys. Table 1 shows the encryption subkeys and the corresponding decryption subkeys.
Table 1: IDEA Encryption and Decryption Subkeys

<table>
<thead>
<tr>
<th>Round</th>
<th>Encryption Subkeys</th>
<th>Decryption Subkeys</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>$K_1^{(1)}, K_1^{(2)}, K_1^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>2nd</td>
<td>$K_2^{(1)} K_2^{(2)} K_2^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>3rd</td>
<td>$K_1^{(1)} K_1^{(2)} K_1^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>4th</td>
<td>$K_3^{(1)} K_3^{(2)} K_3^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>5th</td>
<td>$K_4^{(1)} K_4^{(2)} K_4^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>6th</td>
<td>$K_5^{(1)} K_5^{(2)} K_5^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>7th</td>
<td>$K_6^{(1)} K_6^{(2)} K_6^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>8th</td>
<td>$K_7^{(1)} K_7^{(2)} K_7^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
<tr>
<td>Sth</td>
<td>$K_8^{(1)} K_8^{(2)} K_8^{(3)}$</td>
<td>$K_1^{(1)} - K_2^{(0)} - K_3^{(1)}$</td>
</tr>
</tbody>
</table>

Here, $K_4^{(1)}$ denotes the $4^{th}$ key of the $1^{st}$ round and $K_2^{(1)}$ denotes the multiplicative inverse of $K_4^{(1)}$. $-K_2^{(1)}$ denotes the additive inverse of $K_2^{(1)}$.

1.2 Related Work

IDEA is one of the world’s most secure cryptographic algorithms but many researchers now consider it obsolete and feel a need to modify it. It has been emphasized that the modifications should be such that the algorithm remains efficient i.e. the time and space complexity should not increase too much, so increasing the rounds is not an intelligent approach as per Nick Hoffman [8]. Increasing the plaintext block size is also not feasible as per [9] because unlike 65537 i.e. $2^{16} + 1$, $2^{32} + 1$ is not prime, so IDEA cannot be scaled up to a 128-bit block size.

Joe Daemen, Rene Govaerts and Joos Vandewalle [5], Alex Biryukov, Jorge Nakahara Jr, Bart Preneel [4] and Philip Hawkes [7] have highlighted the need to change the key schedule of IDEA and they have found a number of weak keys through different methods with numbers varying from $2^{51}$ to $2^{64}$.

Kelsey, Bruce Schneier and David Wagner [6] have suggested that the problem of weak keys and key attacks can be minimized in situations where random keys and a secure key distribution system are used.

2. NDEA

After an analysis of IDEA, some viable and feasible changes were made into it and so in this way NDEA came into being.

2.1 Random Number and the Ordering of the subkeys:

A random number is generated. The number of keys required in IDEA is 52, so it is ensured that random number is in the range 1 to 52. The subkey of that number becomes the first subkey. System date-time may also be used to generate the random number as it will always be unique. It acts as a seed for the random function. In the original IDEA, as previously mentioned, the key schedule is static but it becomes dynamic in the NDEA. Hence, the security increases. The NDEA Encryption algorithm requires three inputs — Plaintext, Key and a random number as against only two in the Original IDEA. So even if an eavesdropper is able to lay his hands on the ciphertext and the key, he cannot obtain the plaintext. To make it secure further, the random number can be encoded by a different encryption algorithm say RSA. This will add the complexity of the RSA with that of the IDEA and thus, make cryptanalysis attack even more difficult. So at the receiving end, the decryption process requires the following additional steps: The key has to be first reshuffled back to the original form using the random number and then fed into the decryption algorithm. The random number has to be applied on the key every time before decryption, as it is a different number always, to obtain the subkeys in the correct order. This is illustrated in the operational diagram Fig. 3.

2.2 Operational Diagram

As it is seen in fig. 3, the original key schedule is shuffled by the introduction of the random number. The subkey whose serial number is equal to the random number, becomes the first subkey of the schedule. Now this new ordered schedule is fed into the NDEA along with the plaintext and the ciphertext is generated. While decrypting the reverse procedure is followed. The same random number used in...
encryption is applied to the shuffled key schedule to get the original schedule. This schedule and ciphertext are fed into the NDEA to obtain the plaintext.

2.3 Secure Usage of Keys

Suying Yang, Hongyan Piao, Li Zhang and Xiaobing Zheng [1] have suggested one method in secure usage of keys which has been incorporated in NDEA. This is also in lieu with the Kerckhoff’s Principle.

Keys are kept in a database at a local or a remote host. The user need not carry or remember his key but only a simple key ID. He first needs to validate himself through a username and a password and after successful validation, has to enter the ID of the key. The corresponding key will be available for encryption. In such a system a user can keep several keys with different IDs. The security increases manifold if the sender sends the encrypted data with the key ID instead of the actual key. An eavesdropper’s access to the key ID will not raise any security concern. Of course, sharing of username and password by the sender and the receiver is a priori.

Table 2: Users

<table>
<thead>
<tr>
<th>User Id</th>
<th>User Name</th>
<th>Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>ripu</td>
<td>rl234</td>
</tr>
<tr>
<td>002</td>
<td>rajat</td>
<td>gr7890</td>
</tr>
</tbody>
</table>

Table 3: User Keys

<table>
<thead>
<tr>
<th>ID</th>
<th>User Id</th>
<th>key</th>
<th>Key Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>001</td>
<td>k1</td>
<td>abcd1234efgh5678</td>
</tr>
<tr>
<td>2</td>
<td>001</td>
<td>k2</td>
<td>1234abcd5678efgh</td>
</tr>
<tr>
<td>3</td>
<td>002</td>
<td>k1</td>
<td>abcedfgh12345678</td>
</tr>
<tr>
<td>4</td>
<td>002</td>
<td>k2</td>
<td>12345678abcddefgh</td>
</tr>
</tbody>
</table>

3. Discussion and Results

This section has two parts. The first part compares IDEA with NDEA and the second analyses the cipher texts obtained by both the algorithms.

3.1 Comparisons of IDEA and NDEA

Plaintext : abcd1234
Key : abcedfgh12345678
Random number: 8

Table 4: Comparison of time taken

<table>
<thead>
<tr>
<th></th>
<th>IDEA</th>
<th>NDEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cipher Text</td>
<td>01101000010111</td>
<td>01101000010111</td>
</tr>
<tr>
<td></td>
<td>0101010100110010</td>
<td>0111010101111111</td>
</tr>
<tr>
<td></td>
<td>0010011010010011</td>
<td>0100001110000011</td>
</tr>
<tr>
<td></td>
<td>1001110000000111</td>
<td>1110101010101011</td>
</tr>
<tr>
<td></td>
<td>0011</td>
<td>1111</td>
</tr>
<tr>
<td>Time Taken in</td>
<td>1781 ms</td>
<td>1789 ms</td>
</tr>
<tr>
<td>Encryption</td>
<td>1609 ms</td>
<td>1640 ms</td>
</tr>
<tr>
<td>Time Taken in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decryption</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There is not much difference in time taken by the new IDEA and the original IDEA for shorter plaintexts. For longer plaintexts it is variable.

The time calculated also includes the time for printing the result.

The time varies irregularly with different plaintexts, keys and random numbers. The time consumed increases and decreases by the size of input also. Here, in this application the time calculated also included the time for printing the result.

3.2 Analysis of cipher text of both the algorithms by changing plaintext by a single character

Plaintext : abcd1235
Random number: 28
Key: (same as 3.1)

Table 5: Comparison of ciphertext

<table>
<thead>
<tr>
<th></th>
<th>IDEA</th>
<th>NDEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cipher Text</td>
<td>1011010001101101</td>
<td>1011001000010111</td>
</tr>
<tr>
<td></td>
<td>0101010100110010</td>
<td>0111010101111111</td>
</tr>
<tr>
<td></td>
<td>0010011010010011</td>
<td>0100001110000011</td>
</tr>
<tr>
<td></td>
<td>1001110000000111</td>
<td>1110101010101011</td>
</tr>
<tr>
<td></td>
<td>0011</td>
<td>1111</td>
</tr>
</tbody>
</table>

It is clearly observed that changing a single character in plaintext changes the cipher texts in NDEA drastically (comparing with the result of 3.1) keeping the key same. In IDEA the first 22 characters in both cases (in the example taken) remain the same but in NDEA change in bit pattern is observed from the very first bit. The dynamism introduced is due to the different random numbers generated in both the cases. There is no appreciable difference in time taken for decryption and encryption.
Weak keys are those keys with a certain value for which the block cipher exhibits poor level of encryption. For instance encrypting twice with the same key yields the plaintext itself. In DES, there are four such weak keys. IDEA also has such weak keys whose numbers are found up to $2^4$. The presence of weak keys have an obvious impact on the security of the block cipher and this issue as illustrated in [4], [5] and [7] can also be successfully addressed to by NDEA. If a weak key is used in NDEA then the original key schedule will no longer remain the same as it will be modified by the random number which is generated differently each time the algorithm is run and hence, the same key which is weak in IDEA may not remain so in NDEA.

4. Conclusion and Future Work

NDEA is an algorithm which holds the properties of the block ciphers and aimed to boost up the security of various real life applications. In this work we have tried to incorporate the goodness of IDEA and go even beyond it by introducing randomness and at the same time keeping the time and space constraints to a minimum. Initial experiments show that time taken for encryption and decryption depends on the length of the plaintext. An appreciable security enhancement is observed in the cipher texts obtained by the NDEA while making slight modification in the plaintext. This is in lieu with the confusion and diffusion properties of cryptography. The security can be further increased by using the key ID approach as the user need not remember his keys or carry them. In future intensive analysis is required for its use as an application. The algorithm may be used in encrypting an entire document and in e-mail based applications.

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6. Authors

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Dr. Om Prakash Rishi was born on August 30, 1971, in a small village of Rajasthan (India). Dr. Rishi completed his secondary examinations from the board of secondary education Rajasthan in 1986 and graduation from University of Rajasthan in 1991. He earned his First Class M.Tech degree in Computer Science in 2000 from Birla Institute of Technology, Mesra, Ranchi (India), and Doctor of Philosophy (PhD) in Computer Science in March 2009. Dr. Rishi’s academic credentials were burnished by the years he spent on the faculty of Birla Institute of Technology, Mesra, Ranchi (India), Banasthali Vidhyapeeth, Banasthali Rajasthan (India) and currently working with the Central University of Rajasthan (India) which is one of the most prestigious Universities in India and established by MHRD, Govt. of India. Dr. Rishi’s area of interest is Artificial Intelligence, Intelligent Systems, Cloud Computing and Information Security. He is member of IEEE, Computer Society of India, and several other National and International professional bodies.

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Intelligent Web-Enabled System

I. INTRODUCTION

We have seen the drastic changes in terms of Process, Practices and Product. With the usage of internet and communication technologies practices, our way of business practices and information connection from people keeps on changing for improvement. For survival of business we need to web enable system that can act as resources for organization improvement as well as they may be able to achieve personalized approach. The following figure gives an idea of the aforesaid system [1].

We face a lot of difficulties when we deliver functionality via the Web. To overcome this we need web application instead of plain desktop applications because of the reason that web applications have been user friendly; they have acquired extraordinary popularity because they offer a number of major technological advantages over desktop applications [2].

- Web applications are easy and inexpensive to deliver. With web applications, a company can reduce the costs of the IT department that is in charge of installing the software on the users' machines. With web applications, all that the user needs is a computer with a working web browser and an Internet or Intranet connection.

- Web applications are easy and inexpensive to upgrade. Maintenance costs for software have always been significant. Because upgrading an existing piece of software is similar to installing a new one, the web applications' advantages mentioned above apply here as well. As soon as the application on the server machine is upgraded, everyone gets the new version.

- Web applications have flexible requirements for the end users. Just have your web application installed on a server any modern operating system will do and you will be able to use it over the Internet/intranet on any Mac, Windows, or Linux machine and so on. If the application is properly built, it will run equally well on any modern web browser, such as Internet Explorer, Mozilla Firefox, Opera, or Safari.

- Web applications make it easier to have a central data store. When you have several locations that need access to the same data, having all that data stored in one place is much easier than having separate databases in each location. This way you avoid potential data synchronization operations and lower security risks.

II. NEED FOR WEB INTELLIGENT SYSTEM

We need fast processing, data retrieval, data storage, and data acquisition for development of business globally. So the web development has become key areas of business enhancement but unfortunately the concept to
collaborate intelligent web enabled system development is still lacking. There is a requirement of system or process that designs concepts like Business Intelligence, Data Mining, Artificial Intelligence, Supply Chain Management, Dynamic Enterprise Resource Planning, and Centralized Management Information System. This system will cover various facilities like Pattern Recognition, Image Processing, Fast Data Discovery, Concurrent Electronic Data Transfer, Effective Customer Relationship Management, with Zero Line Flexibility Centralized Information Management System for fast data access, controlling and monitoring worldwide. Dynamic Enterprises Resource Planning for effective customization of intelligent web system.

The besides diagram explains the productivity of searching techniques over available amount of data [1]. The decline red dotted line shows the failure of social web and the introduction of semantic web. The reason behind the failure of social web is that it connects with group and people only, but we need a system which is more targeted, better search, deeper integrated, smarter collaborated, better personalization results. the introduction of semantic web system which bears all the above quality. The semantic search with reasoning ability gives the ideas of intelligent web.

III. INTELLIGENT WEB ENABLED SYSTEM

Intelligence is something by which a person can make perfect decisions. Intelligence is not an instantaneous process but it is an enduring and unending process which can be gained by experience and surroundings. As the real world is dynamic, so we are interested in systems which work intelligently and accurately according to the requirement. Web Intelligence is defined as: "Web Intelligence (WI) exploits Artificial Intelligence (AI) and advanced Information Technology (IT) on the Web and Internet."[2]. Web intelligence is a technique which exploits the various features of advanced technology like artificial intelligence, data mining and data warehousing, ERP and CRM. Besides these it also incorporates business intelligence. Ideally the intelligent web enabled systems will be a combination of a semantic Web and various Web services where the computers can automatically process the Web contents and integrate their services.

The intelligent web enabled system represents the third and fourth (Web 3.0 and Web 4.0) decade of web which is a period in time but not in technology. It enriches the structure of the web by improving the quality of search, collaboration, publishing, advertising and enable application to become more integrated and intelligent. The developed intelligent web enabled system requires the details of web personalization that includes various interrelated technologies and practices discussed below.

A. Business Intelligence

BI is the way to analyze the concepts of product, Process and practices for its implementing staff; Organizational information access needs to grow faster than your IT staff - for that we need to request from outside the company. For controlling the money and time at efficient ways - gives the real presentation of BI. Today web development need fast data access and with optimum utilization to time and money, so if we can integrate the concepts of BI-WP at the time of web development then web system can access smartly. Web personalization includes: Information on how customers are using a Web site is critical information for marketers of e-commerce businesses. Customer relationship life cycle; Customer attraction, Customer retention, Cross sales Customer departure, Can provide information on products bought and advertisement click-through rates. Mining of web usage patterns can help in the study of how browsers are used and the user's interaction with a browser interface. Usage characterization can also look into navigational strategy when browsing a particular site. Web usage mining focuses on techniques that could predict user behavior while the user interacts with the Web [4]. Thus form above Combination of Business Intelligence to Web personalization gives Business Intelligence system.

B. Knowledge Discovery in Database

When we use the concepts of Web Personalization (WP) into Data mining, or Knowledge discovery in databases (KDD), is an interdisciplinary area that integrates techniques from several fields including machine learning, statistics, and database systems or even web system, for the analysis of large volumes of data. In the case of web development if our web system can build
with the concepts of Data Mining with the Personalization and its discovery then organization can fetch information at accurate speed and they respond effectively at right time and right place [5]. In other case, Web Data Mining is the application of data mining techniques to discover and retrieve useful information and patterns from the World Wide Web documents and services. It’s Content, data from Web documents, text & graphics Structure data from Web Structure, HTML or XML tags Usage, data from Web log data, IP addresses, date & time access User Profile, data that is user specific – registration and customer profile. Another important aspect is:

1. Resource finding: The task of retrieving intended Web documents

2. Information selection and pre-processing: Automatically selecting and pre-processing specific information from retrieved Web resources

3. Generalization: Automatically discover general patterns at individual Web sites as well as across multiple sites

4. Analysis: Validation and/or interpretation of the mined patterns

5. Problems with web data mining: The World Wide Web is a huge, diverse and dynamic medium for the dissemination of information—may be too much information to mine, information overload and a lot of this information is irrelevant and not indexed. Other problems with Web Data Mining: Finding relevant information to mine. Personalization & mass customization is difficult, E-commerce businesses have to know what the customers want.

6. Personalization: Personalizing the Web experience for a user is the holy grail of many Web-based applications. Dynamic recommendations to a Web user based on a profile in addition to usage behavior the specification to the individual of tailored products, services, information or information relating to products or service.

C. Artificial Intelligence

Intelligent agents are a new paradigm for developing software applications. Currently, agents are the focus of intense interest on the part of many sub-fields of computer science and artificial intelligence. Agents are being used in an increasingly wide variety of applications, ranging from comparatively small systems such as email filters to large, open, complex, mission critical systems such as air traffic control. At first sight, it may appear that such extremely different types of system can have little in common. And yet this is not the case: in both, the key abstraction used is that of an agent. For smart system we need to include the concepts of AI with Personalization then we will able to design an intelligent System.

D. Supply Chain Management

Increasing implementation of information technology in the manufacturing environment can be considered in all lines of manufacture. Internet introduced heterogeneity of information, such as between supplier and client. The heterogeneity can be data format, representation, and accessing of information. One of the starting point in supply chain management is matching process between suppliers and requirement of a manufacture. However, heterogeneity deliver problems to match between supply and demand, such as different concept of requirement, such as concept RAM, warehose, and container in general remaining is place to save something. Semantic Web and ontology can be considered as an approach to overcome the problem of mating in supply chain management. Discovery and interoperability among parties of information sources in dynamic, open and heterogeneous environment can be improved by the approach. Semantic web is to enhance understanding of meaning between machine-machine and machine-human. Ontology can be applied as a medium to reduce semantic diversity. Semantic interoperability in our approach will be based on semantic similarity by using labeled matching enhanced by internal and external structure comparison [6]. For better system improvement as well as markability we need to include web personalization to SCM.

E. Dynamic Enterprise Resource Planning

Enterprise resource planning (ERP) is a company-wide computer software system used to manage and coordinate all the resources, information, and functions of a business from shared data stored. An ERP system typically has modular hardware and software units and “services” that communicate on an intranet and/or internet. The modular design allows a business to add or reconfigure modules (perhaps from different vendors) while preserving data integrity in one shared database that may be centralized or distributed. But if we include the personalization concept then ERP can be acts as a DERP that build customization approach of Enterprises resource planning. For better controlling enterprise wide infrastructure we need a Dynamic ERP, but system can act’s smartly we need it concepts into web personalization.

F. Centralized Management Information System

Centralized Management Information System (C.M.I.S) is basically concerned with processing data into information centrally. Which is then communicated to the various Departments in an organization for appropriate decision-making. Data Information Communication Decisions Data collection involves the
use of Information Technology (IT) comprising computers and telecommunications networks (E-Mail, Voice Mail, Internet, telephone, etc.) Computers are important for more quantitative, than qualitative, data collection, storage and retrieval; Special features are speed and accuracy; and storage of large amount of data [7]. With the introduction of the Internet and the World Wide Web, students are able to access information faster and more efficiently using modern Computer Systems. In the past, one had to visit national and school libraries and spend large amounts of time accessing information. Presently any individual can quickly access, save and print information from any location. One can access the Internet from Cyber Cafes, schools, mobile phones, at home and even at modern libraries through internet service providers and telecommunication links. Apart from the internet, information e.g. encyclopedias, tutorials and documentaries can be accessed from Compact Discs which are read from computer systems.

V. LOGICAL STRUCTURE OF WIS

Web Intelligence system in this era provides integrated ad hoc query, powerful analysis, and sophisticated managed reporting within one product for both traditional relational databases and online analytical processing (OLAP) servers. Report authors and analysts will appreciate the powerful WYSIWYG report creation environment, flexible drill down techniques, and simple customizability. Casual users and report consumers will benefit from an easy to use product that allows for step-by-step query creation, on-report analysis, and effortless save to Microsoft Excel and Adobe Acrobat PDF formats with a zero footprint product. Whether improving corporate decision-making or sharing information with customers, suppliers, and partners through an extranet - every business needs proven BI solutions that minimize costs and complexity. No matter where your data is stored, Web Intelligence provides flexible access to your information sources. With Web Intelligence, organizations can make more effective decisions by being able to gain insight into mission critical information, analyze trends and spot anomalies. All users benefit from: Powerful integrated query, reporting, and analysis over the web Ease of use with minimal learning curve Best web architecture for enterprise-wide and extranet deployment.

VI. APPLICATION OF WIS

Today we are living in the era of dynamic information system where information and its related product, practices and process can work smartly for gaining optimum profit that can enhance the power of business. The main advantage lying behind this concept is knowledge and experience sharing. This will help the web user to exploit vast information available on the Web. The application of this system lies in each and every web based applications from e-commerce to e-science.
A. Application of Intelligent Web System in educational institution

Currently, educational institutions are using Learning Management System (LMS). LMSs are web based systems that aim at supporting faculty members and administrators in creating, administering and managing online courses. These systems provide a great variety of features which can include in courses such as learning, lecture, quizzes, forums, data, assignments and so on. But such systems provide neither intelligent support nor adaptively for learners.

The Intelligent Web System in any educational institution aims at providing learners with an environment that reacts intelligently to the learner’s needs and incorporates their individual characteristics and situation by presenting suitable suggestions, information and learning material in order to make learning more effective and easier. Such systems must be capable to automatically provide different suggestions, courses or activities to learner with different characteristics and needs. The term ‘intelligent’ here means that a system uses artificial intelligence techniques in order to support learner or identify their characteristics, needs and situations. Such systems focuses on considering and identifying the knowledge state and progress of students in a course. In a broader set of characteristics, needs and states of learners, for example, student’s learning styles, cognitive abilities, learning goals, interests, misconceptions (if any), and so on. System aim at identifying referred characteristics, needs, and states, dynamically by observing the student’s behavior, progress and interaction with the system. Based on output of student’s model, faculty members can provide better guidance to the students. They can easily identify if a student seems to have difficulties in learning process.

VII. Future Scope of WIS

The massive popularity of the World Wide Web is turning the web browser from a document viewing tool into a general-purpose host platform for various types of services, including desktop-style web applications. Web applications require no installation or manual upgrades, and they can be deployed instantly worldwide. This instant worldwide deployment aspect is incredibly powerful, and will dramatically change the way people develop and use software, allowing worldwide application development and instant deployment without middlemen or distributors[11]. The ability to instantly publish software worldwide and the ability to dynamically combine code and content available from countless web sites and developers all over the planet will open up entirely new possibilities for software development. We believe that this will lead to a new software development approach that can be referred to as middleware.

Web search engines have emerged as one of the central applications on the Internet. In fact, search has become one of the most important activities that people engage in on the Internet. Even beyond becoming the number one source of information, a growing number of businesses are depending on web search engines for customer acquisition. Google revolutionized the field by deploying the PageRank technology - an eigenvector-based analysis of the hyperlink structure - to analyze the web in order to produce relevant results. Moving forward, our goal is to achieve a better understanding of a page with a view towards producing even more relevant results.

VIII. Conclusion

In this paper we have discussed how we can utilize the full potential of the Web by incorporating various intelligent technologies. With the emergence of various Web technologies and pioneering concepts of using the Web to its fullest potential, the Intelligent Web enabled System is not far from reach. In this paper we have also discussed the process of designing intelligent web enabled system. This process incorporates various said concepts. If IT Enabled Staff will work accordingly then they can design intelligent web enabled system with the facility like pattern recognition, image processing, fast data discovery, Electronic Data Transfer Customer relationship management, centralized information management system, Dynamic Enterprises resource planning.

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Blending Technology the Real Pinnacle for 21 Century Learning Environment

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Abstract—The educational technology based on computer network becoming popular worldwide because of new inventions in network. E-learning has offered, and will continue to affect teaching and learning contexts in tertiary education. E-learning is one of the fastest growing areas of the high technology sector. A blended learning is a new idea and method for teaching and learning reform. Blended learning is replacing e-learning as the next big thing. Blended learning solves the problem of speed, scale, and impact—and leverages e-learning where it’s most appropriate, without forcing e-learning into places it does not fit.

Keywords—E-learning, Blended technology.

I. INTRODUCTION OF E-LEARNING

Nowadays, web2.0-typed Internet has been increasingly effect people's work, study and lives, especially for younger generations called Digital Natives, who use computing terminals almost every day, such as computers, smart phones, and conduct interpersonal interaction in a virtual world with e-mail and instant message. Web2.0 is a kind of Internet application from learning users creating contents, paying attention to gathering collective wisdoms and users experience, with technologies of RSS(Atom/Jason), Tag and Ajax as basis and Blog, Wiki, Social Networks and Social Bookmarking 11. Internet representative digital experience has become an important part of young people's lives. Instructors need to change teaching from perspectives of teaching methods, resource publishing and the learning supporting services, utilize the ubiquitous resources in digital lives to enhance learners’ learning efficiency.

E-learning is one of the fastest growing areas of high technology sector. It involves the use of ICT such as e-mail, the internet, audio-videos, CD-ROMS, DVDs, video-conferencing, mobile, television, and satellite broadcasting. The use of C1 can remove time and place constraints on teaching and learning to provide the flexibility in many tertiary students are now experiencing.

II. CHALLENGES OF E-LEARNING

As E-learning is one of the fastest growing areas but it has some disadvantages and challenges that affect growth of the E-learning.

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

Lack of customization to students' interest also length instead of modules. Lack of student motivation, Lack of personal community and connection (not blended learning), Its a banking model of education (which is partially inevitable). Not experimentally-based--its simulation based at best. Not necessary based on the best science regarding. Lack of quality assessment and feedback, which hinders learning. Mostly disconnected to the needs of employers, which means its disconnected from the desires of students and parents (this may be the largest criticism). Some self-directed learners is sometimes too random and has no process (too loosely joined—sometimes you need a bridge or a path). Also, some is subject to quality issues. The learner has to self-analyze content without requisite knowledge or criteria (is authority 2.0). Lack of certification (or assessment) for self-directed learning. Tech, toys, and teaching over learning. Focus on memorization over learning core competencies. Time resources at a minimum (students w/ NCLB on the high school
level. And NCEL cuts into the arts in time, funding, and resources.) But some teachers don't know how much time they have; lack of mentorship for self-learners and even some "just the facts ma'am" distance learning. Lack of adoption to learning style of learners. E-learning just textbooks in drag), Better aligning of incentives of teachers and learners (7). Down time = mobile as well as "play" are issues to consider as well. Lack of digital literacy and keeping up with the pace of change and many more are also present as per desire to one.

III. INTRODUCTION OF BLENDED TECHNOLOGY

"Blended Learning" is really the natural evolution of e-learning into an integrated program of multiple media types, applied toward a business problem in an optimum way, to solve a business problem. Blended Learning can be described as a learning program where more than one delivery mode is being used with the objective of optimizing the learning outcome and the cost of program delivery. However, it is not the mixing and matching of different learning delivery modes by itself that is of significance, but the focus on the learning and business outcome. Blended learning focuses on optimizing achievement of learning objectives by applying the "right" learning technologies to match the "right" personal learning style to transfer the "right" skills to the "right" person at the "right" time.

Embedded in this definition are the following principles:

- We are focusing on the learning objective rather than the method of delivery.
- Many different personal learning styles need to be supported to reach broad audiences.
- Each of us brings different knowledge into the learning experience.
- In many cases, the most effective learning strategy is "just-what-I-need, just-in-time."

The experience of pioneers in blended learning shows that putting these principles into practice can result in radical improvements in the effectiveness, reach and cost-effectiveness of learning programs relative to traditional approaches. These improvements are so profound that they have the potential to change the overall competitiveness of entire organizations.

IV. BLESS MODEL

The Blended Learning Systems Structure (BLESS) model addresses both of these dimensions by considering their reciprocal influences. On the one hand, learning technology provides new, enhanced means of learning support, while on the other hand didactic tasks have to be reconsidered accordingly to make situated and targeted use of learning technology.

![Diagram of the BLESS Model](image)

Figure 1 THE BLESS MODEL

As depicted in Figure 1, the gap between these two worlds is closed by a conceptual system of layers and their respective transitions: in brief, concrete blended learning courses (layer 1) are visualized and modeled conceptually as UML activity diagrams (layer 2). These diagrams are decomposed into (or expressed in terms of) self-contained, reusable didactical scenarios - the blended learning patterns (layer 3). Subsequently, the Web template layer (layer 4) shows how to support these patterns on learning technology systems. Here starts the learning-platforn dependent part of the BLESS model, as the transition to the technology layer has to define how the Web templates are instantiated and implemented on top of a concrete learning platform (layer 5).

V. DIMENSIONS OF BLEND

The original use of the phrase "Blended Learning" was often associated with simply linking traditional classroom training to e-learning activities. However, the term has evolved to encompass a much richer set of learning strategy "dimensions." Today's blended
learning program may combine one or more of the following dimensions, although many of these have overlapping attributes.

1) Blending Offline and Online Learning

At the simplest level, a blended learning experience combines offline and online forms of learning where the online learning usually means "over the Internet or intranet," and offline learning happens in a more traditional classroom setting. We assume that even the offline learning offerings are managed through an online learning system. An example of this type of blending may include a learning program that provides study materials and research resources over the Web while providing instructor-led, classroom training sessions as the main medium of instruction.

2) Blending Self-Paced and Live, Collaborative Learning

Self-paced learning implies solitary, on-demand learning at a pace that is managed or controlled by the learner. Collaborative learning on the other hand implies a more dynamic communication among many learners that brings about knowledge sharing. The blending of self-paced and collaborative learning may include review of important literature on a regulatory change or new product followed by a moderated, live, online, peer-to-peer discussion of the material's application to the learner's job and customers.

3) Blending Structured and Unstructured Learning

Not all forms of learning imply a pre-mediated, structured or formal learning program with organized content in specific sequence like chapters in a text book. In fact, most learning in the workplace occurs in an unstructured form such as meetings, hallway conversations, and e-mail. A blended program design may look to capture active conversations and documents from unstructured learning events into knowledge repositories available on-demand, supporting the way knowledge-workers collaborate and work.

4) Blending Custom Content with Off-the-Shelf Content

Off-the-shelf content is by definition generic - unaware of your organization's unique context and requirements. However, generic content is much less expensive to buy and frequently has higher production values than custom content you build yourself. Generic, self-paced content can be customized today with a blend of live experiences (classroom or online) or through content customization, industry standards such as SCORM (Shareable Courseware Object Reference Model) open the door to greater flexibility in blending off-the-shelf and custom content - improving the user experience while minimizing cost.

5) Blending Work and Learning

Ultimately, the true success and effectiveness of learning in organizations is believed to be associated with the paradigm where work (such as business applications) and learning are inseparable, and where learning is embedded in business processes such as hiring, sales, or product development. Work becomes a source of learning content to be shared and more learning content becomes accessible on-demand and in the context of the user's workplace need.

VI. HOW TO SELECT BLEND

To make blended learning more powerful, you can start thinking about all the media as options: classroom training, web-based training, webinars, CD-ROM courses, video, IPSS systems, and simulations. Other media which is less exciting but just as important includes books, job-aids, conference calls, documents and Powerpoint slides. The highest impact programs blend a more complex media with one or more of the simpler media. A web-based course for introduction followed by a real "hands-on" interactive class is an obvious mix.
VII. Benefits of Blending

The concept of Blended Learning is rooted in the idea that learning is not just a one-time event—but that learning is a continuous process. Blending provides various benefits over using any single learning delivery type alone:

1) Improved Learning Effectiveness
Recent studies at the University of Tennessee and Stanford give us evidence that a blended learning strategy actually improves learning outcomes by providing a better match between how a learner wants to learn and the learning program that is offered.

2) Extending the Reach
A single delivery mode inevitably limits the reach of a learning program or critical knowledge transfer in some form or fashion. For example, a physical classroom-training program limits access to only those who can participate at a fixed time and location, whereas a virtual classroom event is inclusive of a remote audience, and when followed up with recorded knowledge objects (ability to playback a recorded live event), can extend the reach to those who could not attend at a specific time.

3) Optimizing Development Cost and Time
Combining different delivery modes has the potential to balance out and optimize the learning program development and deployment cost and time. A hundred percent online, self-paced, media-rich Web-based training content may be too expensive to produce (requiring multiple resources and skills), but combining virtual collaborative learning forums and coaching sessions with simpler self-paced materials such as generic off-the-shelf WBT, documents, case studies, recorded live e-learning events, text assignments, and PowerPoint presentations (requiring quicker turn-around time and lower skill to produce), may be just as effective or more effective.

4) Optimizing Business Results
Organizations report exceptional results from their initial blended learning initiatives. Learning objectives can be obtained in 50% less class time than traditional strategies. Travel costs and time have been reduced by up to 85%. Acceleration of mission-critical knowledge to channels and customers can have a profound impact on the organization's top line.

VIII. Conclusions

Organizations are rapidly discovering that blended learning is not only more time and cost effective, but provides a more natural way to learn and work. Organizations that are in the forefront of this next generation of learning will have more productive staffs, be more agile in implementing change, and be more successful in achieving their goals. Organizations must look beyond the traditional boundaries of classroom instruction by augmenting their current best practices with new advances in learning and collaboration technologies to maximize results. More importantly, organizations must seek to empower every individual in the organization to become an active participant in the learning and collaboration process.

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APPENDIX C: QUALITATIVE QUESTIONNAIRES AND THEIR RESPONSE

C1. Qualitative Questionnaire

Information for Article
Dear Colleague, I am writing a Article for reaching some conclusion. I am sending some question to you please provide me some time and response for the same. I am extremely waiting for your response with regard's Ripu R Sinha.

Question 1: How long you have been employed

☐ 0-3 Years
☐ 3-6 years
☐ 6-9 years
☐ More than 9 years

Question 2: your role at organization

☐ Production
☐ Marketing

Question 3: How do Manage Organizational Knowledge

☐ Via Software
☐ Via Agent
☐ Via Agent Based Application
☐ Above all

Question 4: Organizational Knowledge is Important

☐ 10%
☐ 30%
☐ 50%
☐ 100%

Question 5: How Much time you Spent on Knowledge Management with

in weeks

☐ 1 Hour
☐ 5 Hours
☐ 8 Hours
☐ More Than 10 Hours
Question 6: How you Manage Software Engineers Knowledge after that
- Via Document
- Via Knowledge Base
- Via Tool Base Knowledge
- Via Application Integrated Knowledge Base
- Other

Question 7: How you Create Knowledge at Organization
- Through Online Training
- Interactive training via Trainer
- Via Video Conferencing
- Other Media

Question 8: Is Multi Agent Based Knowledge Management Approach to be effective for Organizational Growth?
- Yes
- No

Question 9: How do You Acquire Knowledge at Organization?
Question 12: How you organize knowledge at organization?

Question 13: Which type of application you use for knowledge management at organization?

No

Yes

Question 14: Is organization seeking and/or using multi-agent based knowledge management approach for process improvement?

Yes

No

Question 15: Is organization seeking and/or using multi-agent based knowledge management approach for software engineering support?

Yes

No

Question 16: Is organization seeking and/or using multi-agent based knowledge management approach for effective utilization for organizational knowledge management?

Yes

No

Question 17: Which factor can increase organizational knowledge?
Question 18: Which type of tool do you use for Knowledge Management?

Question 19: What is Knowledge Enabler at your Organization?

Question 20: What are the Knowledge applications used at organization?

Question 21: Name of Organization

Question 22: Name

Question 23: Designation

C2. Responses of Qualitative Questionnaire
Appendix C3: Report on Open Online Survey

In Consideration of our work, we conducted open online survey in between 29th April 2011 and 29th August 2011 to find out the validity of our research work. This survey was conducted among 64 knowledge enabler from Industry to academia. The main objective of this survey was to discover the requirement of Multi agent based Knowledge management to create organizational knowledge base as well as to find out the current working Scenario of Software Engineering environment. The survey was conducted by means of an open online qualitative questionnaire given to persona that belongs to knowledge enabler to complete. In this context we divided our work into three major sections. The first section of the questionnaire dealt with the background of knowledge enabler as well as their past experience. The second section was concerned with requirement of Knowledge and its management and third section provide the requirement of Multi agent based knowledge management approach and it's effectiveness for organization as well as how we can increase the organizational knowledge management practices for effective utilization of organizational knowledge management.

The first section of questionnaire included set of three questions two out of them was related to role and experience of respondent and left one quarries about the time spent in management of knowledge. From the table of data 25% of participants were having 0-3 years of experience, 13% of Participant were having 3-6 years of experience 44% of participant belongs to 6-9 years of experience and 19% were showing more than 9 years of experience. The data revels, even we exclude the participant with low or no experience we have total 75% experience participant who possess minimum experience of three and maximum of Nine Years. 73% of the experience participant were belongs to production and 8% were that of Marketing and remaining 19% had not filled the column so they were considered as Null. Our 33% participant who filled in questionnaire claimed that to spend more than 10 Hours on Knowledge management Practice within weeks, 39% among them contribute 8 Hours, 23% give 5 Hours to KMP and 3% Spent 1 hour on knowledge management within weeks.