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The Impact of Knowledge Management Models for the Development of Organizations

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Abstract

Knowledge is an essential item in our daily activities to perform the works efficiently. It is considered as the most important asset for every organization. Knowledge management is a system of acquiring, capturing, sharing, storing, developing, capitalizing, disseminating, and utilizing knowledge efficiently in organizations. This paper discusses some of the widely used knowledge management models (KMMs). The aim of KMMs is the substantial development of the organizations. Due to recent global economic competition they become essential to all communities. KMMs play vital roles for the rapid development in technology, and the emergence of new products and services in the society. The intention of this study is to investigate the theory and practice of the emerging and existing KMMs.

Keywords: KMMs, knowledge creation, organization, sense-making

1 Introduction

In 1597, Francis Bacon wrote, "Knowledge is power" [3]. At present knowledge and knowledge management (KM) become essential elements to both employees within organizations and to all global researchers. Interest on knowledge and KM has been seen in economics, management, information technology, anthropology, sociology, epistemology, psychology, and other disciplines [77].

Knowledge is a fluid mix of experience, related information and expert insight that offers a structure for evaluating and integrating new experiences and information. It initiates and is applied in the mind of a knower. In organizations, it often becomes entrenched not only in documents but also in organizational routines, practices, methods, progressions, and norms [28]. Knowledge can be viewed as individual or collective. Individual knowledge exists in the heads of individuals, while collective knowledge exists in the collective actions of the groups and organizations [70].

Knowledge can be divided into two types: i) tacit knowledge, and ii) explicit knowledge. The tacit knowledge is the best practices, hands-on skills, intuitions, special know-how, heuristic, and so on. It is individual knowledge that is hard to formalize or articulate. The explicit knowledge can be codified and transmitted in recognized and systematic language [76].

KM is a fast-moving field created by the collision of several others, including human resources, organizational development, change management, information technology, brand and reputation management, performance measurement, and evaluation [14].

Knowledge management models (KMMs) are the combination of data or information into a reusable format for the purpose of preserving, improving, sharing, aggregating and processing knowledge to stimulate intelligence. These are used for the organizations to collect, store and analyze knowledge to have an advantage over their competitors. These models are integral parts of organizations that have the desire to establish KM systems.

KMMs are presented here from Choo [17], Weick [106], Nonaka and Takeuchi [71], Hedlund and Nonaka [41], von Krogh and Roos [100], Wiig [111], Boisot [9], Lave and Wenger [56], Kakabadse [47], Edvinsson [33], Stankosky and Baldanza [91], Kogut and Zander [51], Demerest [29], Frid [36], Hariharan [39], etc.

2 Literature Review

Chun Wei Choo [17] has mentioned that the organizations use information strategically in sense making, knowledge creation, and decision making. Karl Weick is a primary author on sense-making as a socio-cognitive process within organization research [106]. Ikujiro Nonaka and Hirotaka Takeuchi [71] have developed the knowledge creation model which is the interaction between tacit and explicit knowledge in an organization. Georg von Krogh and Johan Roos [100] model provides a clear distinction between individual knowledge and social knowledge.

Karl M. Wiig's KMM indicates how knowledge is built and used as individuals or as organizations [111]. Max H.

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Boisot provides a three-dimensional KKM with three axes uncodified to codified, concrete to abstract and undiffused to diffused [9]. Etienne Wenger stated that the structure of the communities of practice (CoP) is based on three components; domain, community and practice, and the CoP unifies three components, knowledge, people, and experience [108]. The Skandia Intellectual Capital KMM is developed by Leif Edvinsson [33] which is extensively referred to in IC measurement and research. M. Stankosky and C. Baldanza [92] have developed a conceptual framework for KM with four pillars organization, technology, leadership, and learning.

Bruce Kogut and Udo Zander KKM provides that there is a close connection between the nature of knowledge and the way of growth a company efficiently [51]. M. Demerest identifies four phases of KM within an organization; knowledge construction, knowledge dissemination, knowledge use and knowledge embodiment [29]. R. Frid has divided the KMM into five levels as; knowledge chaotic, knowledge aware, knowledge focused, knowledge managed, and knowledge centric [36]. Arun Hariharan discussed 360-degree model on six *how* themes. He showed that the 360-degree approach to KM is about unleashing the combined power of knowledge and expertise from within and outside the organization along six interrelated dimensions for each of top priority business measures [39]. The 7-circle model is given by Andrew C. Ologbo and Khalil Md Nor [72] with components as: KM initiative, KM culture, KM people, KM mechanisms, KM technology, KM interaction, and KM motivation.

3 Methodology

The article is prepared on the basis of secondary data. We have used websites, books, previous published articles, conference papers, and various research reports to prepare this paper. Throughout the paper we have tried to discuss the existing KMMs in some details.

4 Objective of the Study

The objectives of the study are:

- To discuss various KMMs.
- To improve the quality of the organizations.
- To the development of KMMs.

5 The Choo KMM

Chun Wei Choo [17] has described a model of KM that stresses sense making, knowledge creation and decision making. The Choo KMM focuses on how information elements are selected and subsequently fed into organizational actions (Figure 1). Organizational action results from the concentration and absorption of information from the external environment into each successive cycle [24]. Every organization practices information to make sense of its environment, to make new knowledge, and to take decisions. These three highly interconnected processes play a strategic role for the unfoldment of the organization's knowledge vision [69].

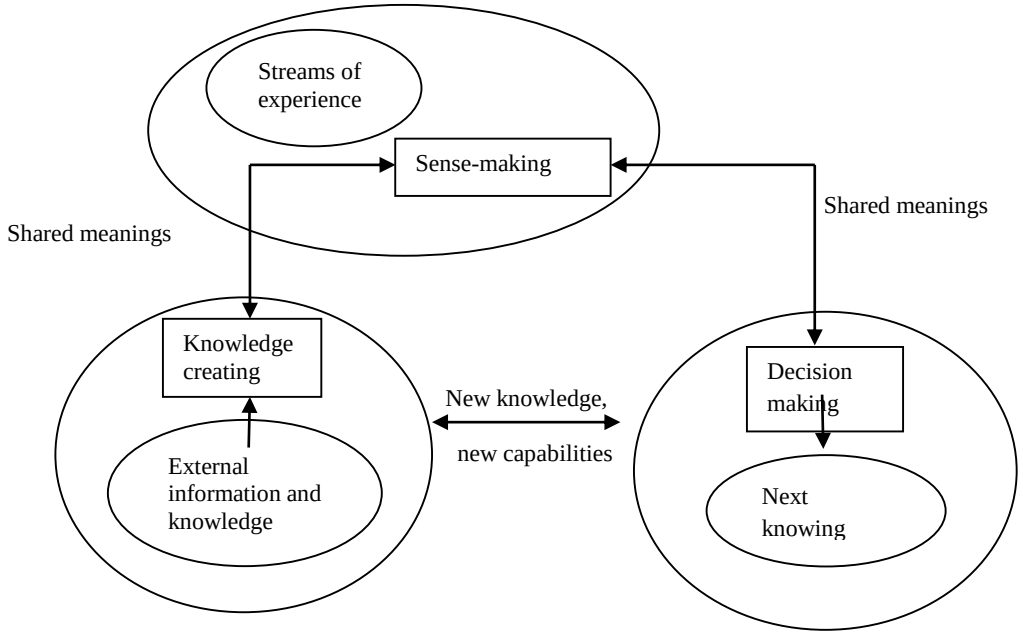

Figure 1: Choo's KMM. Source: [17].

5.1 Weick's Sense-making KMM

Karl Edward Weick introduced the concepts of loose coupling, mindfulness, and sense-making into organizational studies [106]. Sense-making is an imaginative concept and a micro level theory coined by Weick, which is widely used in organizations. This theory described how performance could be improved within well-structured and relatively stable organizational environments [105]. It is developed with the field of social psychology and has spread to a number of fields, including management and organization theory [102]. Sense-making is interruptions of events that individuals take for granted. They make sense of events by becoming aware of cues related with the interruptions, and the actively categorizing them into an

internal frame of references. Their frames enable them to grasp what is actually happening [7]. It is then followed by processes of understanding, explaining, attribution, extrapolation and prediction until they can finally derive some meaning from the disruption [93]. Hence, the concept sense-making refers to the process by which individuals and organizations work out uncertainties, ambiguities, confusing, seeking information, ascribing meanings, inventions, and new situations which is involved in the human propensity with environmental stability [37, 81]. Weick et al. [107] define sense-making as being about "The interplay of action and interpretation rather than the influence of evaluation and choice." They show reason that sense-making is not a conscious human process, but a process that will come into play as an intuitive reaction.

According to Weick [105], sense-making is based on seven properties as "i) grounded in identity construction, ii) retrospective, iii) enactive of sensible environments, iv) social, v) ongoing, vi) focused on and by extracted cues, and vii) driven by plausibility rather than accuracy."

Identity: It is central event in sense-making. People think that they are in their context shapes what they enact and how they interpret events [98, 101].

Retrospection: It provides the opportunity for sense-making. The point of retrospection in time affects what people notice [31].

Enactive of sensible environments: People enact the environments through the dialogues and narratives [22]. When people speak, and build narrative accounts, it helps them to understand what they think, organize their experiences, and control and predict events [1]. As a result they can reduce the complexity in the context of change environment [54].

Social: Sense-making is grounded in both individual and social activity. The reasonable stories are preserved, retained or shared by social activity [61].

Ongoing: Sense-making is ongoing; because the individuals simultaneously shape and react to the environments they face. It is also a feedback process, as individuals deduce their identity from the behavior of others towards them; they also try to influence this behavior [98]. Social sense-making may tend to create communities of practice (CoP) as ongoing venues for identity construction [56].

Extracted cues: People extract cues from the context to help them decide on what information are relevant and what explanations are acceptable [13]. They provide points of reference for linking ideas to broader networks of meaning [105].

Plausibility over accuracy: People favor plausibility over accuracy in accounts of events and contexts [1, 22].

Each of these seven aspects interacts and interlinks as the individuals interpret their events. Their interpretations manifest through written and spoken, which convey the sense they have made of events [22].

Weick suggests that sense-making in organizations consists of four incorporated processes of external changes as [24, 104]: i) ecological change, ii) enactment, iii) selection, and iv) retention (Figure 2).

Ecological change: It is a modification in the flow of experience of social actors, which provides opportunities for social actors to make sense of them [35]. It is external to the organization which disturbs the flow of information to participants and indicates an ecological change in the organization. Weick [104] expresses that, "Ecological changes provide the *enactable environment*, the raw materials for sense-making."

Enactment: It is a concept that captures the role of action in organizing and sense-making. It is a crucial process for individuals and organizations alike, because all social actors are involved in it. It is the intersection between the activities of social actors and the ecological or environmental changes [84]. It indicates that people try to construct, rearrange, single out, or demolish specific elements of content. It clarifies the contents and issues to be used for the subsequent selection process. According to [104], "Enactment is to organizing as variation is to natural selection." [106] indicates "Enactment drives everything else in an organization. How enactment is done is what an organization will know."

Selection: It indicates some kind of arranging of the enacted experiences to reduce their equivocality, which can be represented in the form of causal maps, or sequences, built on the enacted, or past experiences [105]. Later, certain causal maps achieve priority as they reduce equivocality continually than other causal maps in different perspectives.

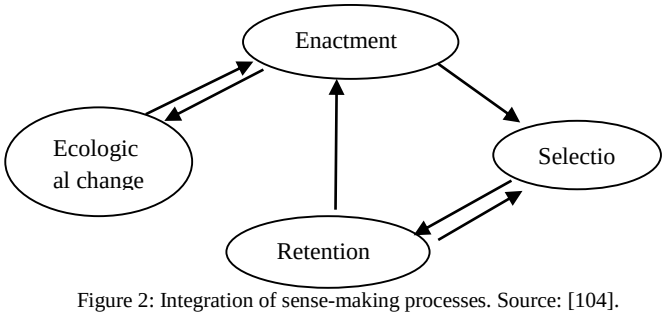

Figure 2: Integration of sense-making processes. Source: [104].

Retention: It involves the storage of the products of successful sense-making and furnishes the organization with an organizational memory of successful sense-making experiences. Weick [104] uses "The terms *enacted environment* and *cause map* to refer to retained content." Hence, causal maps are central to both organizing and sense-making.

N. Wiley [117] indicated that organizations are described under four, mutually-interrelated levels of sense-making frameworks for the construction of integrating with the process of knowledge creation as: i) the level of an

individual who has thoughts, beliefs, feelings, desires, intentions, etc., which is called an intra-subjective level, ii) the level of social interaction at which actors create inter-subjective understandings, iii) the level of social structure where social reality characterized by generic subjectivity is formed and maintained, and iv) the level of organization culture or an extra-subjective level.

Weick's theory could help to interpret the resulting social construction of meta-knowledge about the construction and use of KM artifacts. Sense-making would serve a study in a number of critical ways that could assist the researcher to [50]:

- comprehend what was going on,
- improve the plausibility of alternative explanations and explain anomalies,
- clarify the past events described by the participants,
- suggest future choices and decision streams for other performance management based organizations considering the architecture of a wiki as a KM system,
- explore the information collected with the support of a shadow guide, and
- promote the achievement of common ground to understand the social construction activities, not just the collection of individual perspectives.

The two remaining components of the Choo KM model are described as follows:

5.2 Knowledge Creation Theory

Knowledge creation is the process of the transformation of personal knowledge between individuals through dialogue, discourse, sharing, and storytelling. The organizations obtain and create improved or organized information through learning in order to create new knowledge. The new knowledge helps the organizations to extend new abilities and capabilities [24]. The creation of new knowledge involves the conversion, sharing, and combination of tacit, explicit and cultural knowledge. Choo has drawn upon the knowledge creation theory of Nonaka and Takeuchi [71], where successful knowledge creation described the integration and relationship in the organization between tacit and explicit knowledge. This theory provides a higher probability of success for the organization. Nonaka and Takeuchi [71] have developed the knowledge spiral model in 1995 to show the interaction between tacit and explicit knowledge in an organization for socialization, externalization, combination and internalization (SECI). They have given four knowledge conversion techniques as: i) socialization (tacit to tacit), ii) externalization (tacit to explicit), iii) combination (explicit to explicit), and iv) internalization (explicit to tacit) (Figure 3).

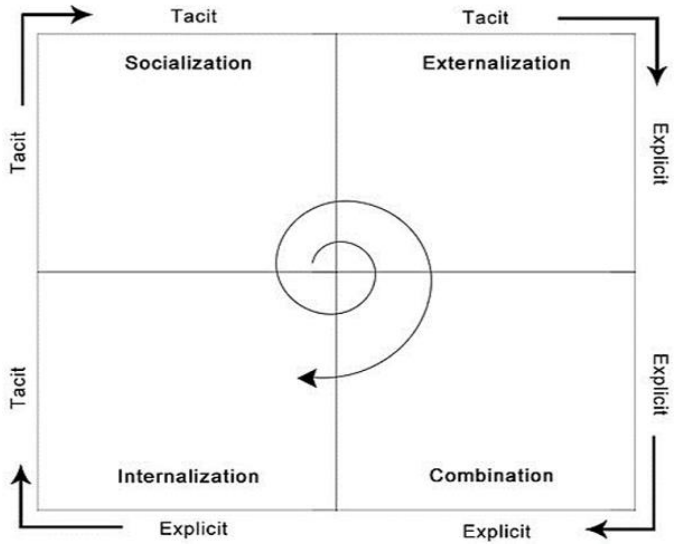

Figure 3: Knowledge creation process. Source: [71].

i) Socialization (tacit to tacit): It includes the shared formation and communication of tacit knowledge among people who have a common culture and can work together effectively. Using this form the individuals gain tacit knowledge from another person through observation, intercommunication, discussion, analyzing, imitation and practice, and can gain new knowledge through shared experiences. They do not use language as the main channel of allocation. It is a direct practice rather than form reading manuals. Sharing of it can take place in a team meeting during which experiences are described and discussed [71]. Humans learn to speak and survive in their culture almost entirely by socialization. People in an organization consult about what is important to them. They feed off the ideas of others, and the collective experience of sharing knowledge is a powerful means of creating new ideas. Individuals can also acquire tacit knowledge, create and share mutual trust during face-to-face interactions, sharing the same environment or during informal meetings. Knowledge and skills obtained is stored in tacit form (know-how). For example, communities of practice (CoP), collective or organizational memory are all phenomena that have been studied as best practice of the circulation of tacit knowledge [70, 48]. For socialization fewer lectures and more labs, studios, and apprenticeships are needed. On-the-job training is a common example of socialization.

ii) Externalization (tacit to explicit): By its nature, tacit knowledge is difficult to convert into explicit knowledge [95]. Externalization is realized daily in an organization, due to institutionalization of tacit rules as internal regulations. A standardized storage is required to store the experience gained from the situations and a mechanism providing a search engine which enables for an on demand service to the searcher. A group of expert persons need to form a circle who store their learning and experience to solve the problems efficiently [48]. It prompts sharing of ideas, beliefs, experiences and instant feedback [71]. The explicit form is also derived from drawings, models, words, concepts or metaphors that can be used by experts to articulate tacit knowledge [65]. Here ideas are turned into practical reality. Metaphors, analogies, concepts, hypotheses or models have an important part to play in this process. For example, the emergence of organizational strategies is a phenomenon of the enunciation of collective tacit knowledge into an explicit formulation embracing a plan, actions and tactics [4].

iii). Combination (explicit to explicit): This is our most familiar process. We take explicit, explainable knowledge, combine it with other explicit knowledge and develop new explicit knowledge. Individuals exchange and combine their knowledge through mechanisms, such as telephone conversations, documents, meetings, including plans, charts, research and development, and technical papers or computerized communication networks. The combination of existent information can be facilitated by the selection, adding, grading, and categorization of explicit knowledge [70]. There are three basic phases to this pattern: i) capturing knowledge from inside and outside the organization and internalizing it, ii) disseminating the explicit knowledge through networks and systems, and iii) processing the explicit knowledge into a more usable format like documents, plans, and reports. Combination can be achieved globally through the communications media or by learning in formal settings using lectures, workshops, published papers, conferences, and seminars. For example, creative use of database to get student reports, sorting the courses, enrolling users, categorizing are combination process [48].

iv). Internalization (explicit to tacit): This is the process whereby something we learn becomes automatic. Conversion of this process is more difficult. In this process learning by doing, training and exercises allow the individuals to access the knowledge domain of interest from the group and the organization. It is very important in building, understanding and developing a learning culture [48]. Individuals read, blend, and conceptualize their findings to create new insights, concepts and methods. Documentation assists people to internalize experiences, develop and broaden their tacit knowledge base [81]. To understand this form the best method used is the practical example. Prisoners have the explicit knowledge of the surveillance tower. They recognize the possibility that they are being watched at any given moment, but they do not know exactly the moment when the guardian is looking or not. The prisoners *internalize* the knowledge and turn it into tacit knowledge; they know tacitly that they may be watched at any given time and they accept the possibility [4].

The SECI model focuses on the knowledge transformations between tacit and explicit knowledge, but the model does not provide larger issues on decision making theory [24]. But the results from the knowledge creation theory stimulate for the creation of satisfactory decision making process.

5.3 Decision Making Theory

The third component of Choo's [17] model is decision making. It is used to identify and evaluate alternatives by processing the information and knowledge collected to date. Every organization must choose the best option it has which is reasonable and beneficial for the organization. The organization can pursue it according to its strategy. Decision making process in organizations is constrained by the bounded rationality principle [69, 87]. Many suggestions can be made upon the decision making theory. Choo [17] provides a few of them as: i) the decision making process is driven by the search for alternatives that are satisfactory, rather than seeking for the optimal solution, ii) the choice of one single alternative means the leave of the others, and iii) a completely rational decision would require information beyond the capability of the organization to collect, and information processing beyond the human capacity to perform [69].

Mintzberg et al. [66] conceptualize the decision model into three phases with seven central routines by studying twenty-five strategic decision processes. The three phases are; i) identification, ii) development, and iii) selection.

Identification: It comprises of two routines: decision 'recognition' in which opportunities, problems, and crisis are recognized and 'diagnosis' in which management seeks to comprehend the evoking stimuli and determine cause-effect relationships for the decision situation.

Development: It leads to the development of one or more solutions to a problem or crisis or to the elaboration of an opportunity. It may be described in terms of two basic routines, *search* and *design.* Search is to find ready-made solutions, and design is to develop custom-made solutions or to modify ready-made ones [104]. The information required to develop a new solution or modify an existing one is uncertain and less structured and defined than information required to evaluate a ready-made solution [17].

Selection: It is logically considered to be the last step in the decision processes. It comprises of three routines: screen, evaluation-choice, and authorization. Screen is used first to reduce a large number of alternatives to a few feasible ones and to a number that can be stored and handled by time-constrained decision making. Evaluation may use three modes: judgment, bargaining, and analysis. In judgment, one individual makes a choice in his own mind with procedures that he cannot explain; in bargaining, selection is made by a group of decision makers with conflicting goals; and in analysis, factual evaluation is carried out. Decisions need to be authorized when the individual making the choice does not have the authority to commit the organization to a course of action [30].

There are a wide range of decision making theories such as [24]:

- the theory of games and economic behavior [6],
- the chaos theory, emergent theory, and complexity theory [88], and
- there is even a garbage can model (GCM) of decision making [23].

The GCM of organizational decision making was developed in reference to explanations or interpretations of

behaviors that at least appear to contradict classical theory. It was greatly influenced by the realization that extreme cases of aggregate uncertainty in decision environments would trigger behavioral responses, which, at least from a distance, appear to be *irrational* [24].

Organizational decision making theory was produced in the 1940s and 1950s by a number of theorists interested in how organizations came to make particular decisions in the Carnegie school [87]. Decision making analysis leads to more collaboration, information expertise and insight sharing among knowledge workers. H. A. Simon [87] outlined the ways in which an individual can be bound in a decision making process so that he/she is limited by:

- own unconscious skills, habits and responses,
- individual values and conception of purpose, which may diverge from the organizational goals, and
- the extent of personal knowledge and information.

According to Choo [17], there are four methods of decision making; i) the rational model is the one with clear goals and clear rules and routines to achieve the goals [89], ii) the process model is for situations with clear goals but there are multiple options and alternative solutions [66], iii) the political model discusses the situation where there are conflicting goals from different parties and each party is pretty clear how to achieve its own interests [2], and iv) the anarchy model where both goals and procedures are unclear [18].

In real world, decisions could not be made based on complete rationales due to the limitation on decision makers' mental skills, the extend of knowledge and information possessed, and values or conceptions of purpose which may diverge from organizational goals [89].

The Choo KM model is the holistic treatment of key KM cycle processes extending to organizational decision making. It is well suited to simulations and hypothesis testing applications [24].

6 Hedlund and Nonaka's KMM

Knowledge transfer in organizations is not as simple as Nonaka's simple SECI model. The process is very complicated and complex. A more elaborate version of Nonaka's model was developed to describe the four levels of carriers or agents of knowledge in organizations [41]. The model builds on two primary distinctions: i) distinguish between tacit and articulated knowledge, and ii) distinguish between four different levels of carriers, or agents, of knowledge the individual, the group, the organization and the inter-organizational domains (important customers, suppliers, competitors, etc.) [85].

Gunnar Hedlund and Ikujiro Nonaka [42] argued that KM 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. They proposed a model in which knowledge flow is the interplay between articulated and tacit knowledge within three forms of knowledge *cognitive knowledge* in the form of mental constructs and precepts, *skills*, and knowledge *embodied* in products, well-defined services or artifacts (Table 1).

Table 1: Hedlund and Nonaka's KMM. Source: [42].

	Individual	**Group**	**Organization**	**Inter-organizational domain**
Articulated knowledge Cognitive, skills, embodied.	Knowing calculus	Quality circle's documented analysis of its performance	Organization chart	Suppliers' patents and documented practices
Tacit knowledge Cognitive, skills, embodied.	Cross-cultural negotiation skills	Team coordination in complex works	Corporate culture	Customers' attitudes to products and expectations.

7 The von Krogh and Roos KMM

The first model that clearly distinguishes between individual knowledge and social knowledge is given by the Georg von Krogh and Johan Roos KM in 1995. They have taken an epistemological approach to manage organizational knowledge and have provided conceptual arguments for tacit knowledge being wholly a characteristic of individuals. They have also examined the nature of KM from the five factors which can prevent KM strategies as; employees, communication and connection, organizational structure and layout, links between members, and management of human resources [100]. This model analyzes the aspects of the following questions [20]:

- Why and how the knowledge gets to the workers of a company?
- Why and how the knowledge arrives at the organization?
- What does knowledge mean for the workers as well as the organization?
- What are the barriers of organizational KM?

This model indicates that there can be no knowledge without a knower and it needs to maintain links between the knowledge objects and those who are knowledgeable about them. It concludes that knowledge is to be found both in the mind of the people and in the connections between them. It enables overall set of organizational activities that positively affects knowledge creation and facilitates the relationships and conversations, sharing of local knowledge throughout the organization [100].

F. Varela, a cognitivist perspective proposes that a cognitive system, whether it is a human brain or a computer, creates models of reality and that learning occurs when these representations are manipulated [99].

A cognitive organizational epistemology views organizational knowledge as a self-organizing system in which humans are transparent to the information from the

outside. Humans take in information through our senses, and we use this information to build our mental models. The brain is a machine based on logic and deduction that does not allow any contradictory propositions [20].

8 The Wiig KMM

Karl M. Wiig is one of the pioneers in the field of KM and was among the first to publish a series of texts that assembled management relevant concepts. His KM cycle addresses how knowledge is built and used as individuals or as organizations. The model is highly favored in KM, because it addresses the organization as a whole and includes business areas that are commonly found in most organizations. He proposes that the foundation of KM is comprised of the way knowledge is created, used in problem solving and decision making, and manifested cognitively as well as in culture, technology and procedures [114].

Wiig focuses on the three conditions that need to be presented for an organization to run its business successfully as: i) it must have a business (products/services) and customers, ii) it must have resources (people, capital, and facilities), and iii) it must have the ability to act. The third point is emphasized in the Wiig KM cycle [111].

Wiig identifies the major purpose of KM as an effort "*To make the enterprise intelligent-acting by facilitating the creation, commutation, deployment and use of quality knowledge*." He proposed an organizational KM cycle of four consecutive stages as [111]: i) building, ii) holding, iii) pooling, and iv) using knowledge. This cycle can be presented in linearly, but some activities within these stages can be performed simultaneously or in reverse [75].

Building knowledge: It consists of obtaining, analyzing, reconstructing, synthesizing, organizing, codifying and modeling knowledge. Obtaining knowledge indicates the activities of i) R&D projects, individual innovations, experimentation, reason with existing knowledge, hiring new people, ii) import knowledge from outside sources, and iii) observation of the real world (site/field visits, etc.). Analyze knowledge indicates; i) extract potential knowledge from obtained material, ii) abstract extracted materials, iii) identify patterns extracted, iv) explain relations between knowledge fragments, and v) verify that extracted materials kept their original meetings. Knowledge is organized for specific uses and according to an established organizational framework such as, standards and categories. Reconstruct and synthesize knowledge is to i) generalize analyzed material to obtain broader principles, ii) generate hypotheses to explain observations, iii) establish conformance between new and existing knowledge, and iv) update the total knowledge pool by incorporating the new knowledge. Codify and manage knowledge indicates; i) how we represent knowledge in our minds, ii) how we assemble the knowledge into a coherent model, iii) how we document the knowledge in books and manuals, and iv) how we encode it in order to post it to a knowledge repository [111]. At this point knowledge is acquired and built from various sources. Experts and advisers, training courses, procedures and instructions, research, books, media, inspections and observations are needed for the building of organizational knowledge [75].

Holding knowledge: This type is the remembering, accumulating and embedding knowledge in storehouse as documents which are gained as research reports, practical tips, case studies, etc. Remembering is the individual has retained the item of knowledge. Accumulating is the creating a computer-resident knowledge base and encoding knowledge so it can be stored in organizational memory. Embedding is the ensuring knowledge and is a part of business procedures. Archiving is the systematically retiring outdated, false, irrelevant knowledge from the active repository. Archiving typically involves storing the content in another, less costly or less bulky medium for less frequent future retrieval [112]. This type includes holding tacit knowledge that can be found in company members' minds and which can be extracted in the form of practical tips and case studies, etc. [75].

Pooling knowledge: It consists of coordinating, assembling, and accessing and retrieving knowledge. It indicates knowledge coordination that primarily relies on setting a knowledge resource network structure which is responsible for making certain resources available. Coordinating is formed collaborative teams to work with particular content to create a 'who knows what' network. Assembling is the gather knowledge sources into a background library or repository to make later access/retrieval easier. It typically requires the formation of collaborative teams to work with particular content in order to create a 'who knows what' network. Access and retrieval can get knowledge from the repository or through consultation with knowledgeable people about difficult problems, obtaining a second opinion from an expert, or discussing a difficult case with a peer. Collection of information about locating knowledge in documents, databases, expert networks is needed from all employees. So that, knowledge is acquired and built from various sources such as, experts and advisers, training courses, procedures and instructions, research, books, media, inspections, and observations [111, 114].

Using knowledge: It is ways of using practical knowledge such as, routine tasks, productions and services mostly in any kind of decision-making within an organization at various management levels [112]. This can consist in using knowledge in routine tasks, production and services in any kind of decision-making processes conducted at various management levels. Routine tasks typically use compiled knowledge that we use almost unconsciously or automatically. The services include using knowledge to identifying problems and their potential consequences, choosing knowledge suitable for solving these problems, searching for alternative solutions, assessing the advantages and disadvantages of those solutions, and planning and implementing selected solutions [75].

Wiig focused on six strategies to organizational knowledge management process as follows [62, 113]:

- Knowledge management as a business strategy which places KM as a strategy that spans the entire organization.
- Managing intellectual assets strategy which is a focus on the existing knowledge that is present within the organization and utilizing them or enhancing them fully.
- Personal knowledge asset responsibility strategy which is a strategy that supports employees to develop their skills and knowledge, sharing it with others.

- Knowledge creation strategy which focuses on creating new knowledge through research and development for shaping the future of the organization.
- Knowledge transfer strategy which is sharing and transferring best practices in support of improving quality and efficiency throughout the organization.
- Customer-focused knowledge strategy which focuses on understanding customer needs and provide products and services that address those needs.

Wiig considers KM in organizations from three perspectives, each with different horizons and purposes [111]:

Business perspective: It focuses on why, where, and to what extent the organization must invest in or exploit knowledge. Strategies, products and services, alliances, acquisitions, or divestments should be considered from knowledge-related points of view.

Management perspective: It focuses on determining, organizing, directing, facilitating, and monitoring knowledge related practices and activities required to achieve the desired business strategies and objectives.

Hands-on perspective: It focuses on applying the expertise to conduct explicit knowledge related works.

Wiig also proposed classifying manageable knowledge into three principal forms: public knowledge, shared knowledge, and personal knowledge [20]. Each of these forms is further divided into passive and active knowledge. Public passive knowledge consists of books, standards and websites, and public active knowledge is formed by recognized experts, expert systems, etc. Written information on products, technologies, documented procedures, etc., is passive shared knowledge and informative systems uses in an enterprise, including the intranet are active shared knowledge. Personal passive knowledge includes information, facts and events stored in an individual's memory, and personal active knowledge includes skills, habits and an individual's interpretation of procedures [75, 116].

Wiig [111, 115] stresses that knowledge assets that must be applied, nurtured, preserved, and used to the largest extent possible by both individuals and organizations; and knowledge related processes to create, build, compile, organize, transform, transfer, pool, apply, and safeguard knowledge. These knowledge related aspects must be carefully and explicitly managed in all affected areas.

A major advantage of the Wiig approach to the KM cycle is the clear and detailed description of how organizational memory is put into use in order to generate value for individuals, groups, and the organization itself. The ways in which knowledge can be applied and used are linked to decision making sequences and individual characteristics. Wiig also emphasizes the role of knowledge and skill, the business use of that knowledge, constraints that may prevent that knowledge from being fully used, opportunities and alternatives to managing that knowledge, and the expected value added to the organization [24].

9 The Boisot I-Space KMM

In 1987, Max H. Boisot describes a KMM for knowledge asset development that is three-dimensional. This model is based on the concept of informational asset which is different from a physical asset. It considers knowledge as either codified or uncodified and as difussed or undiffused, within an organization. It has an extra dimension 'abstraction' to Nonaka's SECI model. Boisot distinguishes information from data by emphasizing that information is what an observer will extract from data as a function of one's expectations or prior knowledge. It is consisted for providing relevance and purpose of the available information. Hence, the I-space is a knowledge interpreter, compiler and generator [9]. It provides a mechanism to explain the knowledge flowing through the societies, as well as the understanding process for knowledge handling [15].

Boisot [9] proposes two key points as: i) the more easily data is converted to information the more easily it is diffused, and ii) the less the data is structured requires a shared context for its diffusion, the more diffusable it becomes.

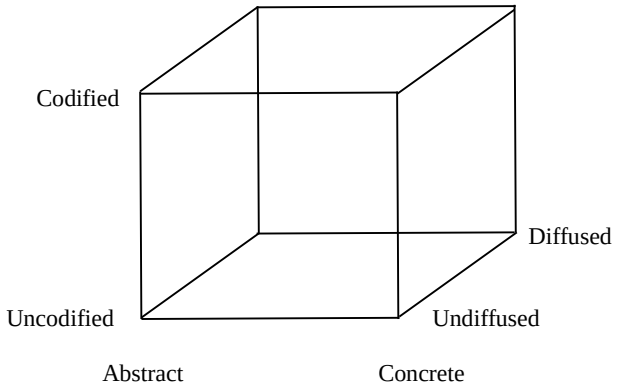

Figure 4: Boisot I-Space model. Source: [9].

The model considers knowledge as either codified or uncodified and as diffused or undiffused, within an organization. Boisot's Information Space (I-Space) philosophy describes three axes which can be visualized as a cube as Figure 4 with the three-dimensions [32]: i)

uncodified to codified, ii) concrete to abstract, and iii) undiffused to diffused.

The Boisot KMM addresses the tacit form of knowledge by noting that in many situations, the loss of context due to codification may result in the loss of valuable content. The model incorporates a theoretical foundation of social learning and serves to link together content, information, and KM in a very effective way [24].

Data is structured and understood through different codification and abstract processes. The term *codified* in this case refers to knowledge that can be readily organized and prepared for transmission purposes such as, financial data. Lesser the number of categories, more abstract the codification scheme will be. Boisot model implies that in many situations the context loss because of the codification can lead also to the loss of important knowledge [9].

Codified undiffused knowledge is referred to as propriety knowledge and is intentionally transmitted to a little group of people, on a 'need to know' basis. The *uncodified* referred on the way to as knowledge that cannot be easily prepared meant for transmission purposes such as, experiences. The model recommends that uncodified and undiffused knowledge is referred to as individual knowledge such as, experiences, views, perceptions, and ideas. The left quadrant of the model covers public knowledge and common sense knowledge (Table 2). Knowledge of public is codified and diffused such as, library, books, journals, newspapers, etc. Common sense knowledge which is comparatively diffused and uncodified can steadily develop through the process of socialization and internationalization [8, 41].

Table 2: Boisot's knowledge category model. Source: [9].

Codified	Propriety knowledge	Public knowledge
Uncodified	Personal knowledge	Common sense knowledge
	Undiffused	Diffused

This model suggests that there is a spread or diffusion of knowledge across organization as reflected in the horizontal dimension of the model. But the codified and uncodified categories in the model are discrete categories of knowledge. Again, 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 [41].

The I-Space develops a simple, intuitively plausible basis as; structured knowledge flows more readily and extensively than unstructured knowledge [11]. The I-Space takes information structuring as being achieved through two cognitive activities: codification and abstraction. Codification articulates the categories that we draw upon to make sense of our world. Abstraction reduces the number of categories that we need to draw upon to apprehend a phenomenon. When two categories are highly correlated, one can stand instead of the other. Codification facilitates the categorical distinctions and associations required to achieve abstraction and abstraction in turn reduces the data processing load associated with the act of categorization [16].

The more codified and abstract indicate the larger the population that it can be diffused to in a given time period. Codification, abstraction, and diffusion, make up only one part of a wider social learning process [9]. When knowledge may not fit in well with existing schema and may trigger a search for adjustments and adaptations. Piaget [74] described it as a process of assimilation and accommodation that we shall refer to as *scanning*. Boisot then describes a Social Learning Cycle (SLC) that works within the I-Space model. This process flows through six phases as follows [20]:

Scanning: It involves knowledge obtained from the environment, which is uncodified. It can be fast when data are well codified and abstract, or very slow and random when data are uncodified and dependent of context. It identifies threats and opportunities in generally available but often fuzzy data, i.e., weak signals. In the context of some models, it discovers new visions, which to become the possession of an individual or group [16].

Problem solving: It offers structure and coherence through problems being solved with that knowledge (knowledge becomes codified). During this phase they are given a definite shape and a large amount of uncertainty initially associated with them is eliminated. Problem solving initiated in the uncodified region of I-space model is often hazardous and conflict generating [9].

Abstraction: When new and codified knowledge is applied to a wide range of scenarios, making this knowledge more abstract in nature (knowledge becomes more abstract). It implies to reach the most important characteristics of a situation (conceptualization). Problem solving and the abstracting often work together. Generalization of applying new codified visions is observed in a large number of applications [20].

Diffusion: It shares newly created insights with a certain number of persons. The diffusion of well codified abstract content to a large number of persons will be technically less problematic than the uncodified case and content dependent (knowledge becomes diffused). Only a sharing of context between sender and receiver can increase the diffusion speed of uncodified knowledge. The probability of a shared context is inversely achieving proportional to population size [16].

Absorption: It is happened when the knowledge is applied to many scenarios, which produces new individual learning, which becomes uncodified because it returns to tacit knowledge (knowledge is absorbed and produces learnt behavior and so becomes uncodified or tacit). Over time, such codified insights come to acquire an obscurity of uncodified knowledge which helps to guide their application in particular circumstances. The new codified visions will interact with those are uncodified [16].

Impacting: It is performed when the abstract knowledge is integrated into organizational practices as rules, policies, and procedures (knowledge becomes concrete). It includes knowledge in real practices, technical rules, organizational rules or in behavioral practices. Absorption and impact often work in tandem [9].

The proposed SLC serves to link content, information, and knowledge management in a very effective way; the codification dimension is linked to categorization and classification, the abstraction dimension is linked to knowledge creation through analysis and understanding, and the diffusion dimension is linked to information access and transfer [10].

There is a strong potential to make use of the Boisot I-Space KM model as to map and manage an organization's knowledge assets as the social learning cycle. In the I-Space, utility is achieved by moving up the space towards higher levels of codification and abstraction. Maximum value is achieved in the I-Space at the point where codification and abstraction are at a maximum and where diffusion is at a minimum. The Boisot model appears to be somewhat less well known and less accessible, and as a result has not had widespread implementation. More extensive field-testing of this model would provide feedback regarding its applicability as well as more guidelines on the best way to implement the I-Space approach [12]. Boisot's concept complements thinking about codification in terms of shaping knowledge expressions, so that they communicate to others [28].

In moving around an SLC, an agent incurs both costs and risks. There is no guarantee that the cycle can be completed. What seems clear from both Boisot's model and that of Nonaka and Takeuchi is that the process of growing and developing knowledge assets within organizations is always changing, which means that the KM strategy identified as appropriate at one moment in time will need to change as knowledge moves through the organizational learning cycle to a new phase [86].

In Boisot's model, the process of growing and developing knowledge assets within organizations is always changing. This means that organizations need to adopt a dynamic KM strategy which accommodates the dynamicity of the organizational learning cycle [12].

10 Wenger's Communities of Practice (CoP) Model

One of the most important concepts in social learning theory is the notion of Communities of Practice. Wenger's Communities of Practice (CoP) is used to encourage interaction among the employees regardless of hierarchy, and availability of meeting rooms that are relevant to tacit KM. The term Communities of Practice was coined by Jean Lave and Etienne Wenger in their landmark book on *Situated Learning*, who described it as "*Groups of people informally bound together by shared expertise and passion for a joint enterprise*." CoPs are learning groups which aim to collaborate and build knowledge together within specific areas of practice [56, 110].

The authors E. Wenger, R. McDermont and W. M. Snyder defined CoP as "*Groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis… these people do not necessarily work together every day, but they meet because they find value in their interactions… they discuss their situations, their aspirations, and their needs… they may create tools, standards, generic designs, manuals and other documents or they may simply develop a tacit understanding that they share*." In brief, groups of people who have a shared concern or passion for something they do and learn how to do it better as they interact regularly in their domain of interest. To share knowledge members become actively engaged in a social learning environment in which they develop and spread new ideas in an attempt to improve professional practice [109].

CoP is considered as one of the common approaches and has been used to manage the creation and sharing of both tacit and explicit knowledge. It is not goal driven, like tasks and projects [26]. Successful practitioners are active participants in CoP [108]. If a firm can manage itself effectively, the CoP can be a rich environment that can produce tangible knowledge [46]. This model takes knowledge and communicates it in a more relaxed and communal environment utilizing storytelling or metaphors as the channel. It is meant to breakdown complex knowledge into a simple format.

A CoP has three main areas [21]:

- Domain, the sphere of knowledge and expertise held by members.
- Community, relationship, affinity, and the sense of belonging among members.
- Practice, the common set of frameworks, ideas, and tools members shares in their work context.

The areas of activity of CoP are in the following functions [109]:

- Peer-to-peer help in problem solving.
- Developing and verifying best practices.
- Upgrading and distributing knowledge in daily use.
- Fostering unexpected ideas and innovation.

A CoP offers a flexible and effective approach for managing complexities of tacit knowledge. A CoP consists of individuals who are rich in the areas of knowledge and can enhance knowledge within the group through socialization. It has deeper and wider flat form of sharing knowledge which unlocks the confined individual knowledge. Sometimes specialists are invited to share with the CoP and it is while sharing that the people start to think creatively about new ways of development of organizations [60, 67]. Each CoP should have a Leader or Moderator who spearheads defining the objectives of the CoP and maintaining the focus of the community [118]. An important strategy for communities is, they may extend past institutional boundaries through online CoP [73]. Swan and Newell [96] contend that trust based rules of engagement are a critical factor to the success of this model.

At present the CoP is a mainstream KM strategy in the business sector, but is also increasingly adopted in the public and healthcare sector [78]. It provides a good background for KM initiatives in software engineering especially open source development.

Informal knowledge sharing opportunities within CoP are unwritten work routines, tools, stories, specialized language, and common wisdom that arise from experience.

Stories are shared at conferences and chance hallway meetings and all learning from each other's thinking when problem solving together [64].

Five characteristic elements of CoP are [94]: i) a knowledge domain of interest, ii) a set of interested and interconnected participants, iii) opportunities for on-going processes of sense making, knowledge sharing, and discovery within the domain of interest, iv) a set of resources related to the domain of interest including methods, tools, theories, practices, etc., that are acquired, retained and accessible by the community, and v) processes by which the community maintains and refreshes its membership.

The establishment of CoP may help partners and collaborators to overcome four barriers to knowledge sharing as follows [58]:

Awareness: CoP increases community members' awareness of one another's knowledge to share efficiently among the members to develop the community.

Access: CoP provides time and space for community members to connect with one another for better cooperation.

Application: CoP ensures that community members share the common language and understanding necessary to share their insights.

Perception: CoP creates an atmosphere where knowledge sharing among community members is respected and valued.

11 Kakabadse KKM

Andrew Kakabadse, Nada K. Kakabadse and Alexander Kouzmin [47] provided five useful models for KM, where each model treats KM initiatives differently as follows (Figure 5):

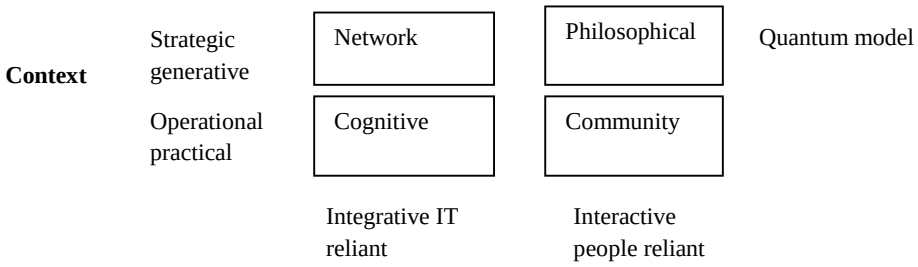

Figure 5: Kakabadse KKM. Source: [47]

Philosophy based model: This model focuses on the organization's view or philosophy of knowledge. It provides a high level perspective that requires reflections in areas of practice. Proponents of this model argue that KM needs not be technology centered, but the leading factor is top performers. It is concerned with the epistemology of knowledge or what constitutes knowledge, the relationship of the constituents and other notions such as, truth, justification, causation, doubt and revocability. It is mainly grounded on Socratic view of knowledge as justified true belief and wisdom as highest constituent in the knowledge continuum [68]. The key cultural drivers are maintaining open communication, encouraging deep reflection and learning, creative abrasion and belief justification. Interesting questions created in relation to this model is "What do we not know that we know?"

Cognitive model: It is deeply embedded in positivistic science as the tool for understanding a mechanical universe driven by single cause-effective relationships. This model is rooted on identification of knowledge as an economic asset and it should be managed and accounted as a part of normal business and a number of efforts are being made to develop procedures for measuring it. It requires careful capture, representation, storage, measurement, preservation and dissemination. It focuses on organizational perspective of knowledge and considers ICT as an enabler of the KM process. The key focus is on reuse, replication, standardization and 'weeding' of outdated routines. Swan and Newell [48] question the application of this model in rapidly changing environment characterized by technology discontinuity such as software development.

Network model: This model is based on socialization of knowledge and relationships of actors. It focuses on awareness of ideas that exist outside focal organizations that can be adapted for a vantage position. Knowledge work is seen as building social relationships, social capital and attending to reciprocity. It highlights the role of social patterns between individuals and interest groups in knowledge creation, acquisition, sharing and transfer. It inoculates the collaborative aspect of creating knowledge and sharing which is a key factor in software development especially in geographically dispersed teams [43]. It indicates that knowledge is seen as requiring collaboration through networks, allowing teams to use the knowledge for the betterment of the organization. It put less emphasis on individual achievement and more on teamwork. It has the advantage of focusing on external sources of knowledge through interest and practice networks.

The Community of Practice (CoP) model of KM: We have discussed this model in section 10.

Quantum model: This model builds on the work of quantum physics. It is based on recent advances in quantum computing, the assumes that application of quantum computing to the constituents of knowledge will lead to high level complexity and improved rationality in decision making as actors in given scenarios in the context of application. It positions knowledge as scenario-driven instead of fact-driven. It makes knowledge dynamic and adjustable to the scenario instead of referring to the knowledge as a static fact, leaving little room for innovation. It is not appropriate for use in low resourced communities.

12 Skandia Intellectual Capital KMM

The KM was not only seen as the transfer of tacit and explicit knowledge but it has also been argued as intellectual capital (IC) [82]. The Intellectual Capital KMM was developed in 1994 by a giant Swedish insurance and financial services company called Skandia as an approach for measuring its IC. Leif Edvinsson [34], Skandia's first Director of Intellectual Capital, proposed the Skandia Intellectual Model (figure 6) which is extensively referred to in IC measurement and research. 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. This model assumes a scientific approach to knowledge and assumes that IC can be transformed into commodity or assets of organizations but unfortunately, this intellectual view of KM ignores the political and social aspects of KM. This model gives a strong emphasis to the measurement associated with each of the decomposed elements (human, customer and structure) of KM assuming that it can be tightly controlled (Figure 6). This mechanistic approach to measurement is more consistent with Nonaka's process of externalization and combination [55]. The model identified two sources of the creation of knowledge value; i) the innovations which are generated by the firm's human resources, and ii) the products and services which result from the commercialization of innovations [85].

In this model, IC is comprised of human capital and structural capital (Figure 6). Human capital includes knowledge, know-how, skills and personnel expertise of an enterprise. It does not belong to a company but it is hired by the company for a period of time. It will be removed when staffs resign or retired from the company [34].

The human capital management is related to KM of employees including maintenance of knowledge base, encouragement, innovation and motivation of employees to transform their tacit knowledge to explicit knowledge [119]. Structural capital is a composite element that includes organizational capital and customer capital. It consists of information and communication systems, management systems, patents and everything that systemizes knowledge of the company and makes it internal and explicit. It has seven main indicators as: business philosophy, organization structure, intellectual property (e.g., research and development), research and development (R&D), process technology, product technology, and IT investment.

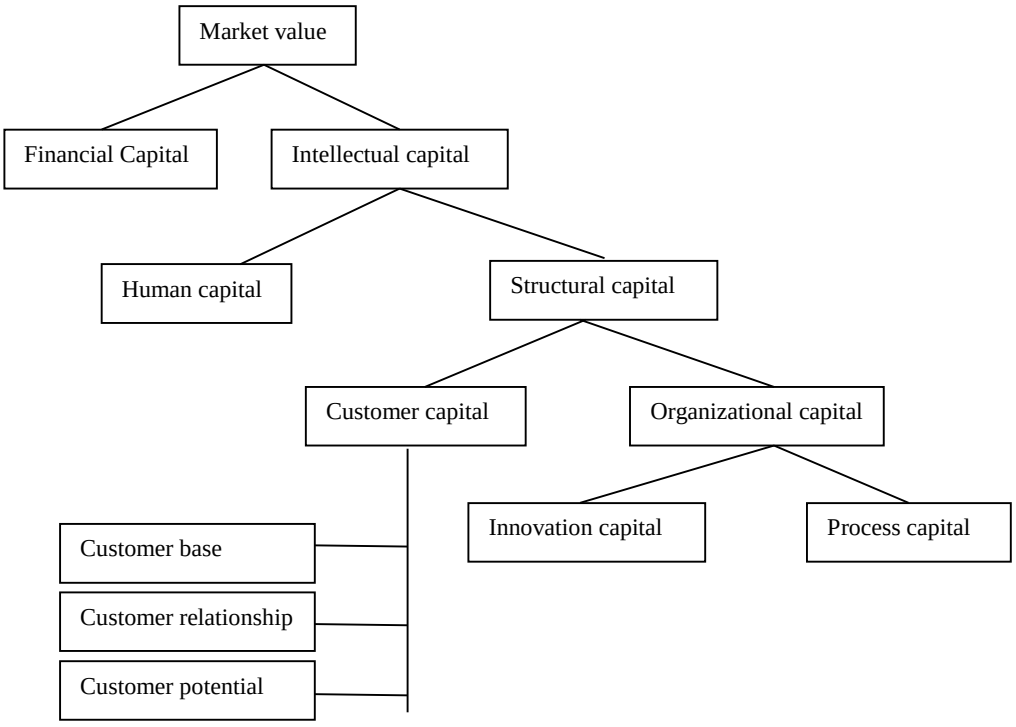

Figure 6: Skandia Intellectual Capital KMM. Source: [33]

Organizational capital is the knowledge that does not go home and stay at the organization. It consists of innovation capital (intellectual property and intangible assets) and process capital (databases and information systems). Customer capital is the external capital which includes the organizational relationships with external factors including customers, suppliers, partners and/or other stakeholders [33].

13 Stankosky and Baldanza's KMM

M. Stankosky and C. Baldanza [91] developed a KMM which presents the four major foundations of an organization

which are important for the KM and its flows are; leadership, organization structure and culture, technology infrastructure, and learning (Figure 7). This framework presents that KM 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. This model states that technology infrastructure should promote the efficient and effective capture of both tacit and explicit knowledge [92].

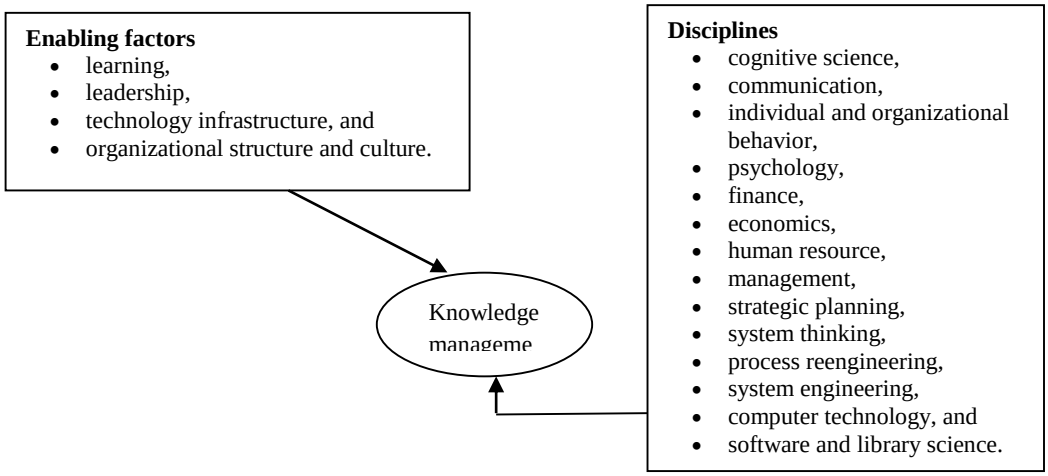

Figure 7: Stankosky and Baldanza's KMM. Source: [91]

Leadership: It requires the leader, who can stay at the top of the organization, and provides leadership needed for cultural changes in the company. 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 [90]. It deals with level decision-making processes involving the values, objectives, knowledge requirements, knowledge sources, prioritization and resource allocation of the organization's knowledge assets. It stresses the need for integrative management principles and techniques. Key elements for leadership are strategic planning, communication, system thinking and business culture [91].

Organization structure: It should facilitate personal interactions and support communities of practice (CoP) 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 functions, processes, procedures, control, measures, formal and informal organizational structures, process improvement, business process reengineering, performance management system, and communication [91].

Technology infrastructure: It deals with the various information technologies peculiar to supporting and/or enabling KM strategies and operations. It supports the collaboration and codification of KM in the entire organization. It promotes the efficient and effective capture of both tacit and explicit knowledge. By this strategy it is possible to exchange information without formal structures. The key elements of it are communication, virtual teams, electronic mail, intranet, internet, data warehousing, and decision support systems [91].

Learning: It deals with organizational behavioral aspects and social engineering. It leverages knowledge and focuses on the principles and practices to ensure that individuals collaborate and share knowledge to the maximum. 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. The key elements are learning communities, virtual teams, communication and a culture of trust [91].

These four pillars must be balanced in order to avoid failing the whole system. The implementation of the four pillars brings balance in the company during introducing KMS.

14 Kogut and Zander's KMM

Bruce Kogut and Udo Zander argue that there is a connection between the nature of knowledge and the way of growth a company efficiently. The knowledge-based view of the firm focuses the resource knowledge in the strategic management and proposes that knowledge is the most important resource in creating a sustainable competitive advantage (Figure 10). Their work is focused on the idea that "What firms do better than markets is the creation and transfer of knowledge within the organization" [51]. Kogut and Zander indicate that in the market view the following three reasons are essential for a company being successful [53]:

- The way the company coordinates its activities.
- The way the company facilitates communication.
- The way the company supports learning, which indicates knowledge creation or the combination into new knowledge.

Knowledge is consists of information and know-how. Sharing and transferring of knowledge of individuals and groups within an organization is essential for the existence

of organizations and to create network in the society (Table 3). Kogut and Zander have declared that knowledge is not only held by individuals but is also expressed in regularities by which members cooperate in a social community [51].

Table 3: Various types of knowledge. Source: [51].

	Individual	Group	Organization	Network
Information	Facts	Who knows what	Profits, accounting data, formal and informal structure	Prices, whom to contact, who has what
Know-how	Skill of how to communicate, problem solving	Recipes of organizing such as Taylorist methods or craft production	Higher-order organizing principles of how to coordinate groups and transfer knowledge	How to cooperate, how to sell and buy

As social communities firms act as "a repository of capabilities" that are determined by the social knowledge embedded in enduring individual relationships structured by organizing principles [52]. 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*" [53].

Kogut and Zander [51] assert that to create efficient organizations the following are necessary for the development of organizations:

- firms are efficient by which knowledge is created and transferred,
- a common understanding is developed by individuals and groups in a firm through repeated interaction to transfer knowledge from ideas into production and markets,
- 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
- the firm's boundary is determined by the difference in knowledge and the embedded capabilities between the creator and the users, and not market failure.

Kogut and Zander further extend their discussion on the concept of identity 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 preserve their own individuality (Figure 8). 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 [53].

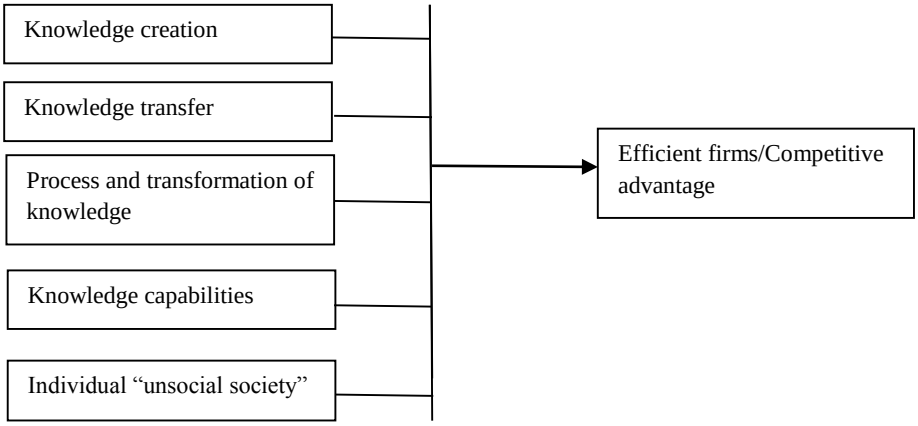

Figure 8: Kogut and Zander's KMM. Source: [53]

15 Demerest KMM

Demerest's KM model emphasizes on the construction of knowledge within an organization, with both scientific and social contributions. According to this model, the implementation of knowledge in an organization is not complete with explicit knowledge but also including the process of social interchange [29]. The model does not give a clear definition of knowledge but presents a more holistic approach. Once knowledge is covered within the organization, there is a follow-up process of dissemination of adopted knowledge all through the entire organization and its environments [83]. The model shows that there is a process of dissemination of the knowledge throughout the organization and its surrounding. The knowledge is seen as being of economic use in regard to organizational outputs. In this model the flows of knowledge transfer is extremely rapid and circulatory, as in the case for some forms of action learning [85].

The model identifies four phases of KM within an organization as: knowledge construction, knowledge dissemination, knowledge use, and knowledge embodiment (Figure 9).

Knowledge construction: It is defined as the process of finding out or structuring a kind of knowledge. This can include how to diagnose a specific client's problem [29].
Knowledge dissemination: It involves human processes and technical infrastructure that encompasses knowledge such as, available documents for people to use in the organization, which can explain how to carry out certain tasks [29].
Knowledge use: It indicates the ultimate objective of the knowledge management system, which is the development of commercial value to clients [29].
Knowledge embodiment: It comprises the process of selecting storage place for the created knowledge which can be a document [29].

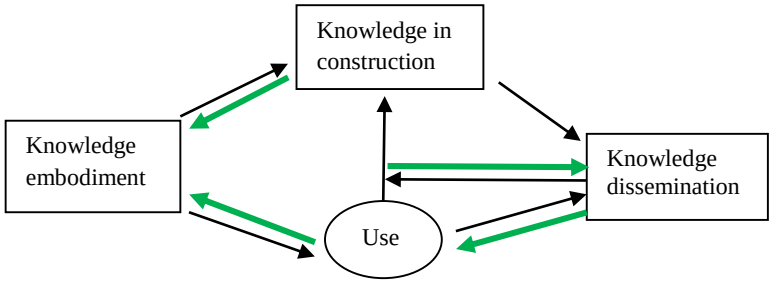

Figure 9: Demerest's KM model. Source: [29]

A modified Demerest's KM model can be formed by explicitly showing the influence of both social and scientific paradigms of knowledge in construction (Figure 10). In the figure a bold green arrow shows the primary flow of direction while the attractive point in this model mainly resides in the plain arrow which shows more recursive flows. The model also extends the 'use' element of knowledge becomes the central part in the model to cover both business and employee benefits. For the KM to have stakeholder support and commitment, employee emancipation must be addressed along with the benefits in the organization. Knowledge flows are seen as highly recursive rather than as sequential and mechanistic [63].

In this model, knowledge is analyzed as being of economic use in terms of the outlook of organizational output and also the processes within which the model moves back and onward between the phases [83].

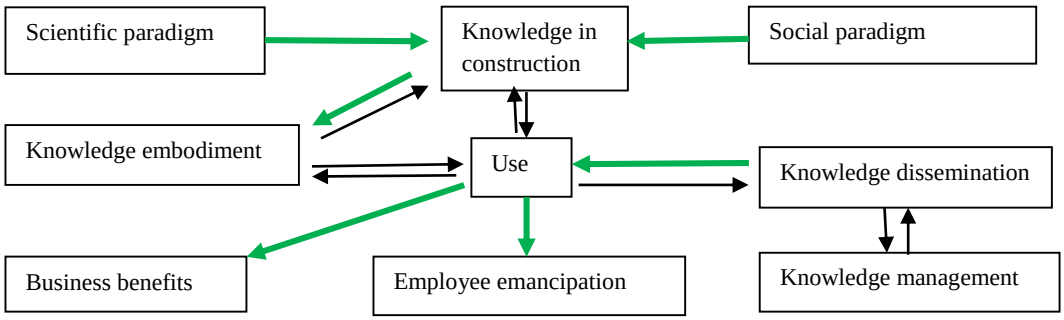

Figure 10: Demerest's modified KM model. Source: [64]

We have observed that the model reveals how knowledge is created, disseminated, used and embodied within the organization and its environments. The model helps all the members of the organization from the available knowledge found within the organization.

16 Frid's KM Model

R. Frid [36] divided the KM structure, the KM maturity assessment and KM implementation into five levels as; knowledge chaotic, knowledge aware, knowledge focused, knowledge managed, and knowledge centric (Figure 11).
Level 1–Knowledge chaotic: It suggests that organizations at this level are in the process of understanding along with implementation of Frid framework for KM which includes KM vision, goals, and indices. Hence, organization must focus on advocating in addition to adapting departmental KM vision in addition to goals as well as performing Frid's framework KM maturity evaluation.
Level 2–Knowledge aware: It recommends that organizations at this level are a step higher than those at level 1. Also, to understand and implement Frid's framework for KM; advocating and adopting departmental KM vision and goals; and performing Frid framework maturity assessment, organizations at this point should focus on developing a KM road map and working collaboratively with KM office.
Level 3–Knowledge focused: It indicates that organizations should have covered the implementation aspects of the levels 1 and 2. organizations start focusing on five new activities as; i) process engineering, ii) providing preliminary KM infrastructure, services and training, iii) support community

knowledge, iv) supervise and report on management indices, and v) KM within budgets.

Level 4–Knowledge managed: It adopts the fundamental activities in levels 1 to 3 are changed. Organizations should attempt to implant KM in performance reviews and also in business plans separately.

Level 5–Knowledge centric: It is the highest of all KM implementation maturity level as per Frid's model. The distinctive and differentiating activities that organizations need to focus on are institutionalizing successful initiatives and valuing intellectual assets. These activities distinguish knowledge from other levels. Moreover, all KM activities should be given equal emphasis at this level.

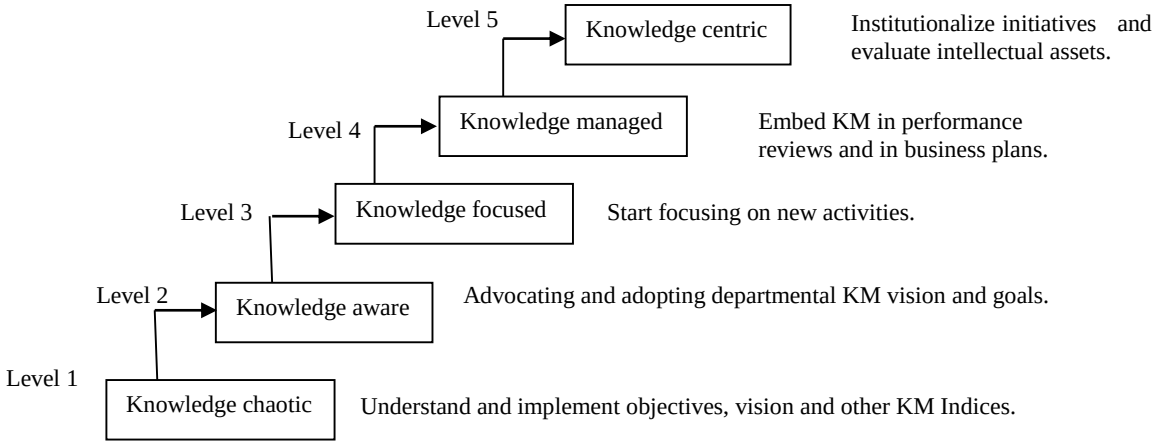

Figure 11: Frid's KM model. Source: [36].

17 The 360-Degree KMM

Arun Hariharan [39] has described the 360-degree approach to knowledge flow. This approach defines the combined power of knowledge and expertise from within and outside the organization. The 360-degree KM provides each knowledge champion and each expert access to all knowledge and expertise from within and outside the organization. It enables them to manage and improve performance on these measures better, faster and with zero re-invention.

This model has six dimensions (Figure 12). This approach represents business measure as a top priority in the center core with six circles around it. For each top priority measure, 360-degree KM creates a knowledge repository that helps the knowledge champion and experts for improve performance on that measure.

Dimension 1: It is headed by the knowledge champion. It is considered as the most critical dimension. It ensures that each member of each community has easy access to the rest of their community. It facilitates the collaboration, and knits a common pool of talent that is available within and outside the organization [39]. For example, scouts of schools of a country can create community of experts through knowledge sharing.

Dimension 2: For each community, the internal measurement system or dashboard is used for their top priority measure, which provides the knowledge champion and experts a view to how they are doing on their measure, helps them assess performance on their measure across different business units, across time periods and against benchmarks or targets. It helps them to understand where they are and where they need to go [39]. For example, the troops in a battlefield must know the best war strategy for their victory.

Dimension 3: It is the voice of customers relevant to each top priority measure. Organizations could identify one or a set of customer satisfaction measures from customer-satisfaction measurement system which are related to each of the top priority internal measures [39]. For example, the electric bills of power Development Company often are not properly given and customers are not satisfied with the billing system if more errors occur.

Dimension 4: It is the knowledge base of all internal knowledge that could be useful in helping the knowledge champion and experts to improve performance on their top priority business measure. Types of internal knowledge could be best practices or lessons learned shared by employees, standard documented processes, and quality improvement projects, innovative ideas, FAQs, internal benchmarking, e-learning modules or training material [39]. For example, the members of an organization can enhance knowledge through sharing knowledge in face-to-face or using internet.

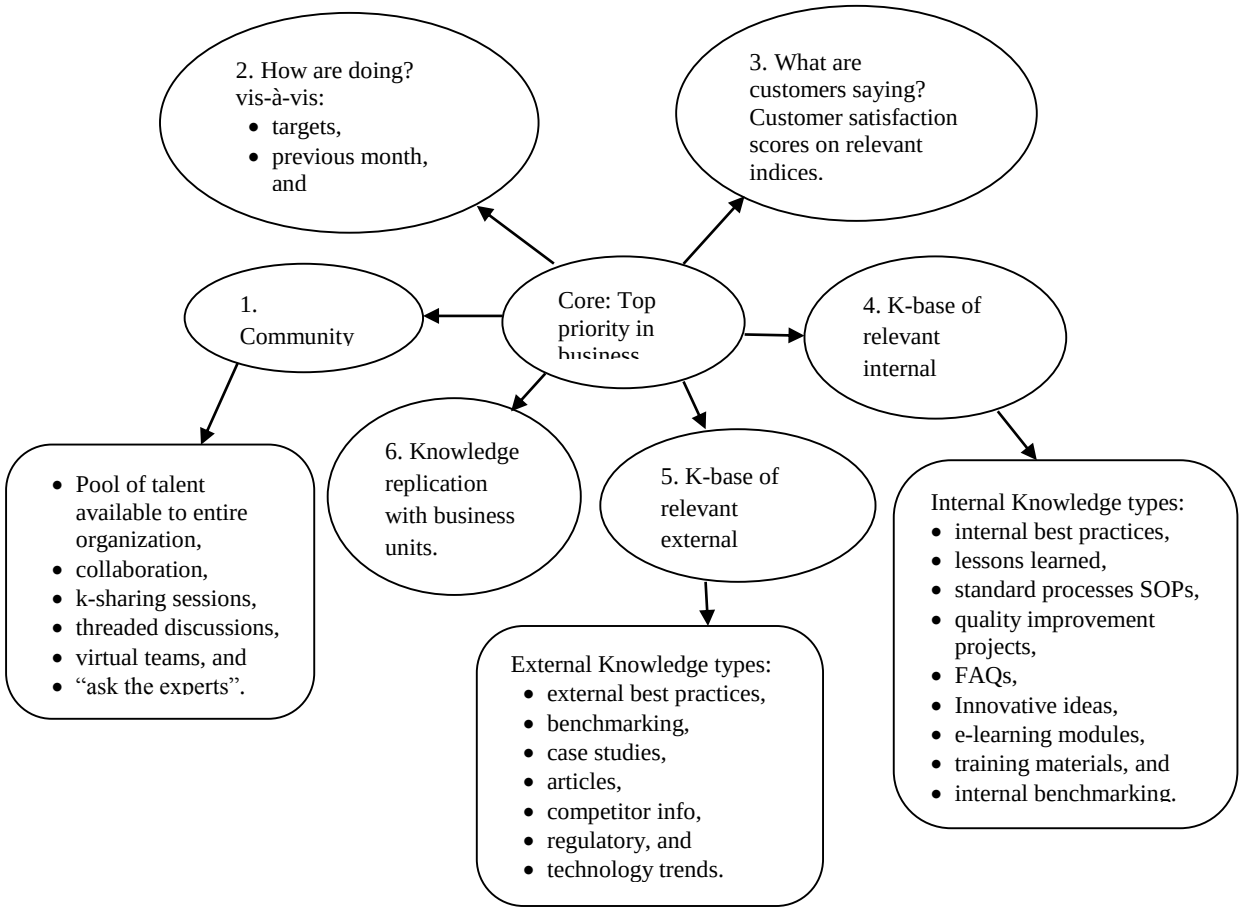

Figure 12: The 360-degree KMM. Source: [39]

Dimension 5: It is the knowledge base of all external that could be useful in helping the knowledge champion and experts improve performance on their top priority business measure. Types of external knowledge could include external best practices or lessons learned case studies, articles, information on markets, customers, and competitors, the regulatory environment or technology trends [39]. For example, Google scholars of various organizations can share knowledge through online community of practices.

Dimension 6: It consists of all replications or applications of knowledge from the knowledge base that result in performance improvement in the relevant top priority measure. It is important to document and publish each completed knowledge replication with demonstrated business results in the relevant knowledge repository. In knowledge replication, new knowledge is added to the knowledge base. Thus, almost every replication not only brings business results, but also adds new knowledge to knowledge base. KM is a never-ending cycle and knowledge repositories keep growing each time knowledge is replicated [39]. For example, knowledge acquisition process is a replication policy.

18 Complex Adaptive System KMMs

A complex adaptive system (CAS) is a term coined by John H. Holland in 1975 to describe *nonlinear systems* whose behavior is determined by the interaction of its adaptive parts. A CAS consists of a large number of interacting agents (people) that are diverse in form and ability [44]. It is a relatively new field that began in 1984 at the Santa Fe Institute (a private, non-profit, multidisciplinary research and education center) in a think tank of New Mexico [97]. CAS is defined as an open system with large variability and diversity of elements or agents, with dynamic interactions among them that creates nonlinear feedback systems [45].

It is comprised of agents, individuals as well as groups of individuals, and offers a new way of thinking about systems of interacting agents, who echo through sharing common interests, knowledge and/or goals due to their history of interaction and sharing of worldviews. Agents respond to both external and internal pressures that are generated as the agents struggle with interdependency and resulting conflicting constraints [59]. It is very useful in dynamic environments where organizations and information systems have to be responsive and adaptive [45]. It is used to describe a system that adapts through a process of self organization and selection into coherent new behaviors, structures, and patterns [25].

A CAS is a way of thinking about and analyzing things by recognizing complexity, patterns and interrelationships rather than focusing on causes and effects. It is the collections of simple interacting units that have the ability to

evolve to fit a changing environment. It provides a new perspective to the dynamics of complex systems. It is applied in biology, physics, human economics, economic instabilities, psychology, political science, political transitions, cybernetics, anthropology, healthcare, education, social sciences, social networks, social movements, international relations, family systems, organizational development, urban development, criminal behavior, coalition formation and the natural sciences [97].

The characteristics of CAS are as follows [5, 97]:

- It has a large number of elements which interact dynamically.
- Any element in the system is affected by and affects several other systems.
- It provides nonlinear interactions, so small changes can have large effects. The interactions of agents are guided by continuously evolving rules.
- It offers the concept of *openness* which is very important to understand how complex systems work, so it may be difficult to define system boundaries. Openness means that behavior of people within a system can only be understood within the context of their environment.
- It is a constant flow of energy to maintain the organization of the system.
- It has a history whereby the past helps to shape present behavior.
- The elements in the system are not aware of the behavior of the system as a whole and respond only to what is available or known locally.
- It exhibits emergence and self-organization. Emergence can be defined as interaction that surfaces out of interaction of a group of people organized in a network, whose behavior cannot be predicted or envisioned on the basis of individual, isolated actions. Self-organization occurs when people are free to network with others and pursue their objectives, even if it involves crossing organizational formal structures [19].

19 The 7-Circle KMM

The 7-circle KMM is based on 7 components as [72]; KM initiative, KM culture, KM people, KM mechanisms, KM technology, KM interaction, and KM motivation. They are used to explain the key ways in which things must go right in managing organizational knowledge (Figure 13).

Circle 1, KM initiative: It is a strategic focus of the KM process. It is dynamic and could be developed from any level of the organization, such as, top management, line managers or employees at the operational level. It is important for the top management to provide investment in cash, strategy, and flexible policy to monitor the organizational development process. Also it is responsible for employees at all level to contribute their time, participation and support to the process [72].

Circle 2, KM culture: After the KM initiative development, it is important for the organization to create KM culture which resides in the people of the organization. The organizational culture influences on a wide variety of individual, group and organizational KM choices and outcomes [49].

Circle 3, KM people: Knowledge is created and laid in the human brain. Without the willingness and cooperation among people knowledge cannot be flourished. The development of an organization depends on the choosing the right people in right place [27]. People are referred to as knowledge brokers and should appear in every department, unit and in teams at the organizational level. They are responsible for convincing all employees to create, share and apply knowledge [103].

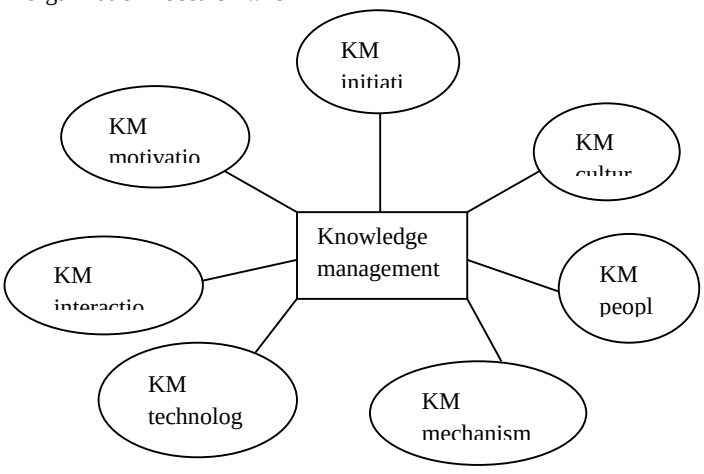

Figure 13: The framework of the 7-circle model. Source: [72]

Circle 4, KM mechanisms: As KM mechanisms are very complex, each organization should identify and choose the right mechanism to support its people and technologies. Some successful organizations, for example, Mckinsey, Siemens, Danone, Kraft Food, etc. had adopted KM mechanisms such as, communities of practice (CoP), central business unit (CBU), practice Olympic, focus groups, marketplace and best practices [57, 103].

Circle 5, KM technology: KM technology is essential to enhance the KM processes and performances for the success of an organization. For example, IT is an important factor in knowledge repositories, data mining, decision support

systems, storage and easily retrieval of knowledge resources for connecting people to information among employees of organizations [38].

Circle 6, KM interaction: Coordinating the KM interaction enables firms to maintain equilibrium of human and technology centered approach. Organizational people, organizational culture, structures, work processes, and technologies are closely interconnected and interact strongly to be of value to organizational performance [38].

Circle 7, motivation: Motivation is very important and if the employees are not motivated, no amount of infrastructure, technological intervention, and investment can make KM practice to be effective. Reward is a very good form of KM motivation [79].

20 Conclusions

A KMM provides a new momentum and direction of knowledge disseminating centre and corporate leadership and practices. For the sustainable development in the 21st century every organization needs KM policy and KMMs will help the organizations to develop and survive in future. In this study we have prepared the theoretical framework for multi-agent based KM framework and the organizations can use related models according to their organizational structure for the development of their institutions. Many KM representations exist in organizations and they differ in their focus and purpose. Some organizations do multitask, some do one task at a time, and some are messy, but most are neat and tidy, etc. As a result various models have been created and many models will be developed or will create new in future.

References

1- Abolafia, M. (2010), Narrative Construction as Sensemaking, *Organization Studies*, 31(3): 349–367.
2- Allison, G.T. and Zelikow, P. (1999), *Essence of Decision: Explaining the Cuban Missile Crisis*, 2nd Ed., New York: Addison-Wesley.
3- Barclay, R.O. (2000), Leading the Knowledge Enterprise CIOs, CLOs and Beyond, Corporate Education, Biz, LCC, NY.
4- Baumard, P. (2001), *Tacit Knowledge in Organizations*, SAGE Publications, London.
5- Beinhocker, E.D. (1997), Strategy at the Edge of Chaos, *McKinsey Quarterly*, 1: 24–39.
6- Bierman, H. and Fernandez, L. (1993), *Game Theory with Economic Applications*, Reading, MA: Addison-Wesley.
7- Bogner, W.C. and Barr, P.S. (2000), Making Sense in Hypercompetitive Environments: A Cognitive Explanation for the Persistence of High Velocity Competition, *Organization Science*, 11(2): 212–226.
8- Boisot, M.H. (1987), *Information and Organizations: The Manager as Anthropologist*, Harper Collins, London.
9- Boisot, M.H. (1998), *Knowledge Assets: Securing Competitive Advantage in the Information Economy*, Oxford University Press.
10- Boisot, M.H. and Canals, A. (2004), Data, Information and Knowledge: Have We Got it Right?, *Journal of Evolutionary Economics*, 14(1): 43–67.
11- Boisot, M.H. and Child, J. (1999), Organizations as Adaptive Systems in Complex Environments: The Case of China, *Organization Science*, 10(3): 237–252.
12- Boisot, M.H.; MacMillan, I.; Han, K.S.; Tan, C. and Eun, S.H. (2003), *Verification and Partial Validation of the Sim-I-Space Simulation Model*, Working Paper. http://wep.wharton.upenn.edu/Research/SimISpace2_2003 11.pdf
13- Brown, K.W.; Ryan, R.M. and Creswell, J.D. (2007), Mindfulness: Theoretical Foundations and Evidence for its Salutary Effects, *Psychological Inquiry*, 18(4): 211–237.
14- Bukowitz, W.R. and Williams, R.L. (1999), *The Knowledge Management Fieldbook*, Upper Saddle River, N.J.: Financial Times, Prentice Hall.
15- Canals, A. (2002), e-Learning y Gestión del Conocimiento. *IV Jornadas sobre gestión de la información y del conocimiento, Sociedad Española de Documentación e Información científica (SEDIC)*. http://www.sedic.es/documentos_boletin_km/4jornadas_ac anals.pdf
16- Canals, A.; Boisot, M.H. and MacMillan, I. (2004), *Evolution of Knowledge Management Strategies in Organizational Populations: A Simulation Model*, Working Paper Series WP04-007, Internet Interdisciplinary Institute (IN3), UOC.
17- Choo, C.W. (1998), *The Knowing Organization: How Organizations Use Information to Construct Meaning, Create Knowledge, and Make Decisions*, New York: Oxford University Press.
18- Cohen, M.D.; March, J.G. and Olsen, J.P. (1972), A Garbage Can Model of Organizational Choice, *Administrative Science Quarterly*, 17(1): 1–25.
19- Coleman, R. (1999), What Enables Self-Organizing Behavior in Business, *Emergence*, 1(1): 33–48.
20- Cristea, D.S. and Căpaţînă, A. (2009), Perspectives on Knowledge Management Models, *Economics and Applied Informatics*, XV(2): 355–366.
21- Cummings, S. and van Zee, A. (2005), Communities of Practice and Networks: Reviewing Two Perspectives on Social Learning, *KM4D Journal*, 1(1): 8–22.
22- Currie, G. and Brown, A. (2003), A Narratological Approach to Understanding Processes of Organizing in a UK Hospital, *Human Relations*, 56(5): 563–586.
23- Daft, R.L. and Weick, K.E. (1984), Toward a Model of Organizations as Interpretation Systems, *Academy of Management Review*, 9(2): 284–295.
24- Dalkir, K. (2005), *Knowledge Management in Theory and Practice*, Oxford: Elsevier-Butterworth Heinemann.
25- Dann, Z. and Barclay, I. (2006), Complexity Theory and Knowledge Management Application, *The Electronic Journal of Knowledge Management*, 4(1): 11–20.
26- Davenport, E. and Hall, H. (2002), Organizational Knowledge and Communities of Practice, *Annual Review of Information Science and Technology*, 36(1): 171–227.
27- Davenport, T.H. and Volpel, S.C. (2001), The Rise of Knowledge towards Attention Management, *Journal of Knowledge Management*, 5(3): 212–222.
28- Davenport, T.H. and Prusak, L. (1997), *Working Knowledge: How Organizations Manage What They Know*, Harvard Business School Press, Boston, MA, USA.
29- Demerest, M. (1997), Understanding Knowledge Management, *Journal of Long Range Planning*, 30(3): 374–384.
30- Deng, X.X. (2006), *Intentional Modeling for Enterprise Architecture-Managing Knowledge about "Why" to Support*

Change, MS Thesis, Faculty of Information Studies, University of Toronto.
31- Dunford, R. and Jones, D. (2000), Narrative in Strategic Change, *Human Relations*, 53(9): 1207–1226.
32- Dutta, A.B. and Banerjee, E.S. (2016), Study of Knowledge Management and Few Models, *Imperial Journal of Interdisciplinary Research*, 2(4): 914–918.
33- Edvinsson, L. (1997), Developing Intellectual Capital at Skandia, *Long Range Planning*, 30(3): 366–373.
34- Edvinsson, L.; Dvir, R.; Roth, N. and Pasher, E. (2004), Innovations: The New Unit of Analysis in the Knowledge Era the Quest and Context for Innovation Efficiency and Management of IC, *Journal of Intellectual Capital*, 5(1): 40–48.
35- Einhorn, H.J. and Hogarth, R.M. (1986), Judging Probable Cause, *Psychological Bulletin*, 99(1): 3–19.
36- Frid, R.J. (2003), *A Common KM Framework for the Government of Canada: Frid Framework for Enterprise Knowledge Management*, Canada Institute of Knowledge Management, Ontario.
37- Grøtan, T.O.; Størseth, F.; Rø, M.H. and Skjerve, A.B. (2008), Resilience, Adaptation and Improvisation: Increasing Resilience by Organising for Successful Improvisation, Paper Presented at the 3rd Symposium on Resilience Engineering Antibes, Juan-Les-Pins, France, October 28–30, 2008.
38- Handzic, M. (2011), Integrated Socio-Technical Knowledge Management Model: An Empirical Evaluation, *Journal of Knowledge Management*, 15(2): 198–211.
39- Hariharan, A. (2005), 360 Degree Knowledge Management, *Journal of Knowledge Management Practice*, Volume 6, Library, Online Journal, ISSN 1705-9232.
40- Haslinda, A. and Sarinah, A. (2009), A Review of Knowledge Management Models, *The Journal of International Social Research*, 2(9): 187–198.
41- Hedlund, G. (1994), A Model of Knowledge Management and the N-Form Corporation, *Strategic Management Journal*, 15(Special Issue): 73–90.
42- Hedlund, G. and Nonaka, I. (1993), Models of Knowledge Management in the West and Japan, In B. Lorange, B. Chakravarthy, J. Roos and H. Van de Ven (Eds.), *Implementing Strategic Process, Change, Learning and Cooperation*, pp. 117–144, MacMillan, London.
43- Hemetsberger, A. and Reinhardt, C. (2003), *Sharing and Creating Knowledge in Open-Source Communities, The case of KDE*, Paper Presented at the Proceedings of The 5th European Conference on Organizational Knowledge, Learning, and Capabilities (OKLC) 2003, Innsbruck.
44- Holland, J.H. (1975), *Adaptation in Natural and Artificial Systems*, The MIT Press, Cambridge, MA.
45- Holland, J.H. (1995), *Hidden Order: How Adaptation Builds Complexity*, Reading, MA: Addison-Wesley.
46- Irick, M.L. (2007), Managing Tacit Knowledge in Organizations, *Journal of Knowledge Management Practice*, 8(3): 1–5.
47- Kakabadse, A.; Kakabadse, N. and Kouzmin, A. (2003), Reviewing the Knowledge Management Literature: Towards a Taxonomy, *Journal of Knowledge Management*, 7(4): 75 –91.
48- Khan, A.A.A.; Sharfudeen, T. and Khader, P.S.A. (2013), Tacit Knowledge Codification for Academic Institutions, *International Journal of Research in Advance Technology in Engineering*, 1: 26–29.
49- King, W.R. (2008), Questioning the Conventional Wisdom: Culture-Knowledge Management Relationships, *Journal of Knowledge Management*, 12(3): 35–47.
50- Klein, G.; Moon, B. and Hoffman, R.R. (2006), Making Sense of Sensemaking 1: Alternative Perspectives, *IEEE Intelligent Systems*, 21(4): 70–73.
51- Kogut, B. and Zander, U. (1992), Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology, *Organization Science*, 3(3): 383–397.
52- Kogut, B. and Zander, U. (1993), Knowledge of the Firm and the Evolutionary Theory of the Multinational Corporation, *Journal of International Business Studies*, 24(4): 625–645.
53- Kogut, B. and Zander, U. (1996), What Firms Do? Coordination, Identity, and Learning, *Organization Science*, 7(5): 502–518.
54- Kumar, P. and Singhal, M. (2012), Reducing Change Management Complexity: Aligning Change Recipient Sensemaking to Change Agent Sensegiving, *International Journal of Learning and Change*, 6(3/4): 138–155.
55- Lank, E. (1997), Leveraging Invisible Assets: The Human Factor, *Journal of Long Range Planning*, 30(3): 406–412.
56- Lave, J. and Wenger, E. (1991), *Situational Learning: Legitimate Peripheral Participation*, Cambridge: Cambridge University Press.
57- Leidner, D.; Alavi, M. and Kayworth, T. (2006), The Role of Culture in Knowledge Management: A Case of Two Global Firms, *International Journal of e-Collaboration*, 2(1): 17–40.
58- Lesser, E.L. and Fontaine, M.A. (2004), Overcoming Knowledge Barriers with Communities of Practice: Lessons Learned through Practical Experience, In P. M. Hildreth and Chris Kimble (Eds.), *Knowledge Networks: Innovation through Communities of Practice*, pp. 14–23, Hershey, PA: Ideas Group.
59- Lichtenstein, B.B.; Uhl-Bien, M.; Marion, R.; Seers, A.; Orton, J.D. and Schreiber, C. (2006), Complexity Leadership Theory: An Interactive Perspective on Leading in Complex Adaptive Systems, *Emergence: Complexity and Organization*, 8(4): 2–12.
60- Loyarte, E. and Rivera, O. (2007), Communities of Practice: A Model for Their Cultivation, *Journal of Knowledge Management*, 11(3): 67–77.
61- Maitlis, S. (2005), The Social Processes of Organizational Sense Making, *Academy of Management Journal*, 48(1): 21–49.
62- Manasco, B. (1996), Leading Firms Develop Knowledge Strategies, *Knowledge Inc.*, 1(6): 9–26.
63- McAdam, R. and McCreedy, S. (1999), A Critical Review of Knowledge Management Models, *The Learning Organization*, 6(3): 91–101.
64- McDermott, R. (1999), Learning across Teams: How to Build Communities of Practice in Team-Based Organizations, *Knowledge Management Review*, 8(10): 32–37.
65- McKenzie, J.S. (2001), The Unwired Classroom: Wireless Computers Come of Age, *Educational Technology*, 10(4): 19–28.

66- Mintzberg, H.; Raisinghani, D. and Theoret, A. (1976), The Structure of 'Unstructured' Decision Processes, *Administrative Science Quarterly*, 21(2): 246–275.
67- Mungai, G.C.N. (2014), *Tacit Knowledge Management in Public Institutions in Kenya: A Case of the Kenya Institute for Public Policy Research and Analysis* (KIPPRA) Nairobi, Master Thesis, University of South Africa.
68- Mwangi, K.E.; Thuku, L.X. and Kangethe, J.P. (2012), *Africa Casebook-Synergies in African Business and Management Practices*, Volume-I, pp. 26–37, AJBUMA Publishing, University of Nairobi, School of Business.
69- Neto, R.C.D. de A.; Souza R.R.; Queiroz J.G. and Chipp, H. (2009), Knowledge Management Implementation: A Process Design Proposition at Brazil's ONS (National Operator of the Interconnected Power System), *Electronic Journal of Knowledge Management*, 7(5): 593–604.
70- Nonaka, I. (1994), A Dynamic Theory of Organizational Knowledge Creation, *Organization Science*, 5(1): 14–37.
71- Nonaka, I. and Takeuchi, H. (1995), *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York, NY.
72- Ologbo, A.C. and Nor, K.M. (2015), The 7-Circle Model: A Practical and Coherent KM Model for Managing Organizational Knowledge, *Mediterranean Journal of Social Sciences*, 6(4): 120–128.
73- Pavlin, S. (2006), Community of Practice in a Small Research Institute, *Journal of Knowledge Management*, 10(4): 136–144.
74- Piaget, J. (1967), *Biologie Et Connaissance: Essai Sur Les Relations Entre Les Regulations Organiques Et Les Processus Cognitifs*, Paris: Gallimard.
75- Podgórski, D. (2010), The Use of Tacit Knowledge in Occupational Safety and Health Management Systems, *International Journal of Occupational Safety and Ergonomics*, 16(3): 283–310.
76- Polanyi, M. (1973), *Personal Knowledge*, London, UK: Routledge & Kegan Paul.
77- Quintas, P.; Lefrere, P. and Jones, G. (1997), Knowledge Management: A Strategic Agenda, *Journal of Long Range Planning*, 30(3): 385–391.
78- Ranmuthugala, G.; Cunningham, F.C.; Plumb, J.J.; Long, J.; Georgiou, A.; Westbrook, J.I. and Braithwaite, J. (2011), A Realist Evaluation of the Role of Communities of Practice in Changing Healthcare Practice, *Implement Science*, 6: 49.
79- Rhodes, J.; Hung R.; Lok, P.; Lien, B.Y.H and Wu, C.M (2008), Factors Influencing Organizational Knowledge Transfer: Implication for Corporate Performance, *Journal of Knowledge Management*, 12(3): 84–100.
80- Roberts, J. (2000), From Know-How to Show-How: Questioning the Role of Information and Communication Technologies in Knowledge Transfer, *Technology Analysis* and *Strategic Management*, 12(4): 429–443.
81- Romito, C.; Probert, D. and Farrukh, C. (2007), Technology Evaluation under Information Inadequacy, In Management of Engineering and Technology, pp. 1672–1679, Portland International Center for, IEEE.
82- Roos, G. and Roos, J. (1997), Measuring Your Company's Intellectual Performance, *Journal of Long Range Planning*, 30(3): 413–426.
83- Rowely, J. (2000), From Learning Organization to Knowledge Entrepreneur, *Journal of Knowledge Management*, 4(1): 7–15.
84- Saetre, A.S.; Soernes, J.-O.; Browning, L.D. and Stephens, K.K. (2003), Organizational Members' Enactment of Organizational Environments and Media Use: A Study of ICT Practices in Norway and the United States, Paper Presented at the Informing Science +IT Education Conference, Pori, Finland.
85- Saini, R. (2011), Incorporating Knowledge Forms in Knowledge Management Flow, *International Journal for Management Research*, 1(2): 152–168.
86- Shannak, R.O. (2009), Measuring Knowledge Management Performance, *European Journal of Scientific Research*, 35(2): 242–253.
87- Simon, H.A. (1957), *Models of Man: Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting*, New York: John Wiley & Sons.
88- Simon, H.A. (1969), *The Sciences of the Artificial*, Cambridge, MA: MIT Press.
89- Simon, H.A. (1976), *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization*, 3rd Ed., New York, NY: Free Press.
90- Stankosky, M. (Ed.) (2005), *Creating the Discipline of Knowledge Management: The Latest in* University *Research*, Burlington: Elsevier Butterworth-Heinemann.
91- Stankosky, M. and Baldanza, C. (2001), *A Systems Approach to Engineering a KM System*, *Unpublished Manuscript*.
92- Stankosky, M.; Calabrese, F. and Baldanza, C. (1999), *Knowledge Management: The Architecture of Enterprise Engineering-4 Pillar Slide*, George Washington University, Washington DC.
93- Starbuck, W.H. and Milliken, F.J. (1988), Challenger: Fine Tuning the Odds Until Something Breaks, *Journal of Management Studies*, 25(4): 319–340.
94- Stein, E.W. (2005), A Qualitative Study of the Characteristics of a Community of Practice for Knowledge Management (KM) and its Success Factors, *International Journal of Knowledge Management*, 1(3): 1–24.
95- Sulaiman, R.V.; Thummuru, L.; Hall, A. and Dijkman, J. (2009), *Tacit Knowledge and Innovation Capacity: Evidence from the Indian Livestock Sector*, United Nations University (UNU)-MERIT Working Paper No. 2009–058.
96- Swan, J. and Newell, S. (2000), *Linking Knowledge Management and Innovation*, Paper presented at the 8th European Conference on Information Systems, Vienna University of Economics and Business Administration.
97- The Health Foundation (2010), *Complex Adaptive Systems*, Inspiring Improvement, Identify Innovate Demonstrate Encourage, London, UK.
98- Thurlow, A. and Mills, J. (2009), Change, Talk and Sensemaking, *Journal of Organizational Change Management*, 22(5): 459–579.
99- Varela, F. (1992), Whence Perceptual Meaning? A Cartography of Current Ideas, In F. Varela and J. P. Dupuy (Eds.), *Understanding Origin: Scientific Ideas on the Origin of Life, Mind, and Society* (A Stanford University International Symposium) Boston Studies Philosophical Science, Kluwer Assoc., Dordrecht, 1992.
100- von Krogh, G. and Roos, J. (1995), *Organizational Epistemology*, Macmillan Press, London.

101- Watson, T.J. (2009), Narrative Life Story and the Management of Identity: A Case Study in Autobiographical Identity Work, *Human Relations*, 62(3): 1–28.

102- Weber, P.S. and Manning, M.R. (2001), Cause Maps, Sensemaking, and Planned Organizational Change, *Journal of Applied Behavioral Science*, 37(2): 227–251.

103- Weeks, M. (2004), Knowledge Management in the Wild, *Business Horizons*, 47(6): 15–24.

104- Weick, K.E. (1979), *The Social Psychology of Organizing*, (2nd Ed.), Reading, MA: Addison-Wesley.

105- Weick, K.E. (1995), *Sensemaking in Organizations*, Thousand Oaks, CA: Sage.

106- Weick, K.E. (2001), *Making Sense of the Organizations*, Malden, MA: Blackwell Publishers.

107- Weick, K.E.; Sutcliffe, K.M. and Obstfeld, D. (2005), Organizing and the Process of Sensemaking, *Organization Science*, 16(4): 409–421.

108- Wenger, E. (1999), *Communities of Practice*, New York: Cambridge University Press.

109- Wenger, E.; McDermont, R. and Snyder, W.M. (2002), *A Guide to Managing Knowledge: Cultivating Communities of Practice*, Boston, Massachusetts: Harvard Business Press.

110- Wenger, E. and Snyder, W.M. (2000), Communities of Practice: The Organizational Frontier, *Harvard Business Review*, 78(1): 139–145.

111- Wiig, K.M. (1993), *Knowledge Management Foundations*, Arlington, TX, USA: Schema Press.

112- Wiig, K.M. (1997a), Integrating Intellectual Capital and Knowledge Management, *Long Range Planning*, 30(3): 399–405.

113- Wiig, K.M. (1997b), Knowledge Management: Where Did It Come From and Where Will It Go?, *Expert Systems with Applications*, 13(1): 1–14.

114- Wiig, K.M. (1997c), Roles of Knowledge-Based Systems in Support of Knowledge Management, In J. Liebowitz and L. C. Wilcox, *Knowledge Management and its Integrative Elements*, pp. 69–87, New York: CRC Press.

115- Wiig, K. (1999a), Knowledge Management: An Emerging Discipline Rooted in a Long History, *Knowledge Management*, Oxford, UK: Butterworth-Heinemann.

116- Wiig, K.M. (2004), *People-Focused Knowledge Management-How Effective Decision Making Leads to Corporate Success*, Boston, MA, USA: Butterworth-Heinemann.

117- Wiley, N. (1988), The Micro-Macro Problem in Social Theory, *Sociological Theory*, 6(2): 254–261.

118- Zhang, W. and Watts, S. (2008), Online Communities as Communities of Practice: A Case Study, *Journal of Knowledge Management*, 12(4): 55–57.

119- Zhou, A.Z. and Fink, D. (2003), The Intellectual Capital Web: A Systematic Linking of Intellectual Capital and Knowledge Management, *Journal of Intellectual Capital*, 4(1): 34–48.