Theoretical Assumptions of Knowledge Creation

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ABSTRACT

A prominent theme in the debate about knowledge and organisations is the role of knowledge in the theory of the firm. The knowledge-intensive firm is both important economically and a source of great interest academically; it operates in highly dynamic environments, which require the firm to construct new knowledge in order to respond to changes within the operating environment. The central feature of these post-industrial firms is that knowledge is fundamental to the functioning of the modern economies in which they operate. Thus the creation and utilisation of knowledge is of major importance to the success of these firms. Knowledge has always been implicated in the process of economic development; since anything we do, how we transform resources into products and services, crucially depends on the knowledge we have at our disposal for affecting such transformation.

***Key Words*:** Knowledge; Knowledge and Organisations; Social Interaction; Dynamic; Generative and Emergent; Complexity Science.

INTRODUCTION

A prominent theme in the debate about knowledge and organisations is the role of knowledge in the theory of the firm. The knowledge-based view of the firm is an outgrowth of the resource-based view of the firm, which argues that knowledge is the key productive

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resource of the firm (Kogut and Zander, 1992; Grant and Baden-Fuller, 1995). The knowledge-intensive firm is both important economically and a source of great interest academically; it operates in highly dynamic environments, which require the firm to construct new knowledge in order to respond to changes within the operating environment. The creation and utilisation of knowledge is of major importance to the success of the firm. Bell (1973) proposed that knowledge is a central feature of these post-industrial firms and argued that knowledge is fundamental to the functioning of late modern economies (Stehr, 1994; Drucker, 1993). Knowledge has always been implicated in the process of economic development; since anything we do, how we transform resources into products and services, crucially depends on the knowledge we have at our disposal for affecting such transformation. What is distinctive about the post-industrial firm is the change in the character of knowledge itself. If one begins to observe the use of theoretical knowledge in the knowledge-intensive firm (KIF), one will see the extent to which theoretical knowledge, far from being objective and explicit as it is often taken to be, is actually grounded in personal judgements and commitments of the knowledge agents in the firm. Thus even the most theoretical form of knowledge, such as pure maths, cannot be a completely formalised system, since the basis for its application and development are on the skills of mathematicians and how their 'know-how' skills are used in practice. That is to say that all codified knowledge contains personal knowledge elements.

Knowledge in the KIF is multi-faceted and complex, being situated and abstract, implicit and explicit, distributed and individual, developing and static, verbal and encoded. Analysis of the relationships between these different perspectives of knowledge is as important as any delineation of their differences within the KIF. Thus in order to develop the analysis of the interrelations between agents and their knowledge forms within the KIF it is necessary to address the basic question: 'what is knowledge within the KIF?' Hence the knowledge-based firm's ability for knowledge creation must exhibit components and structures which can link the conceptions of their knowledge forms to language, processes and norms that can enable and constrain knowing. The nature of the KIF, as an

organisation, and its management changes dramatically. Drucker (1993) maintains that productivity is becoming dependent on the application and development of new knowledge and on the contribution of knowledge agents. Drucker (1993) holds that knowledge agents are unlike previous generations of workers, not only in the high levels of education they have obtained, but principally because they own the firms' means of production. Because of this the KIF provides a vehicle in which the importance of social interaction between agents can lead to the activities of knowledge creation and help explore the difficulties that knowledge-intensive firms have in developing and understanding their own learning processes.

THEORETICAL ASSUMPTIONS OF KNOWLEDGE

The science of knowledge developed as an attempt to understand the challenges that face the social sciences today. The construction of the knowledge domain involved two kinds of interconnected intellectual reactions to modern conditions, which help to define the nature of social knowing. Firstly, it involved defining the form and content of the objects of analysis, such as society, as real elements, which can only be understood through the human senses. Secondly, it involved the development of an account of knowledge construction in order to comprehend these real objects through the conscious mind of the knowing subject (Kant, 1967). In this way the social sciences emerged with a tendency to reproduce the closed-system model of scientific inquiry developed from scientific experimentation and applied to the study of humans. The closed-system environment developed a boundary between what was required to be studied and what was to be excluded in the analysis. The system assumed the relations were simple and discrete, having complete bounded rationality. The reasoning assumes that the agents' knowledge of reality is an uncomplicated mirror reflection of the natural and social world. The problem of viewing the real world in such a simplistic way is that it fails to consider the exploration of the complexity, uncertainty and interconnectedness of the objects of analysis in the social sciences. It also acknowledges the complexities of the way in which the agent understands these objects. These conditions of existence play a crucial role in the activity of constructing knowledge in the first place. The emergence of science was part of

a process through which modern societies came into existence. The focus of knowledge construction can be noted on four key transformations, which highlighted the changes in the way agents viewed the world: the intellectual and religious transformations, and the emergence of new concerns such as the political and economic transformations. The new sensibility described as 'post-modernism' was an expression of the appreciation and realisation that the world was constantly changing (Berman, 1982; Harvey, 1989). The recognition that agents can have dramatic unintended consequences upon the ecological condition of the system they operate in, at any point and time, re-emphasises how human activities are interconnected in complex and unpredictable ways with the natural world.

The most serious theoretical deficiency of existing theories of modern society which assign a central role to knowledge is the rather undifferentiated treatment of the key ingredient, namely knowledge itself. The fact that science becomes increasingly the only source of additional knowledge and that the change in the available knowledge dramatically enlarges the available options of social knowing, suggests that the investment in and the distribution and reproduction of knowledge also changes and acquires greater social significance, as does the production of knowledge. The most widely employed conception of different forms of knowledge is dichotomies. The classical distinction lies between scientific and non-scientific knowledge. The distinction has not been elaborated on, except in the sense that non-scientific knowledge became a residual form of knowledge. In order to draw understanding for the concept of knowledge, one must distinguish between what is known, the content of knowledge and knowing. Knowing can be described in relation to things and facts, but also to rules, laws and programmes. This offers the suggestion that some form of human participation is required in order to relate the knowing of things, rules and programmes or processes by including them in the human's field of orientation and competence.

A person is able, in other words, to acquire knowledge from books. The social significance of language, writing, printing and data storage is that they all constitute knowledge symbolically or provide the possibility of objectified knowledge. Thus, what we refer to as knowledge and learning is not direct knowledge of facts, rules

and things but objectified knowledge. However such participation is of course subject to stratification, life changes, lifestyle and the social influence of other individuals, which depend on their access to the stock of knowledge at hand. Knowledge, ideas and information are strange entities with properties unlike those of commodities. Knowledge is a public good, when revealed it does not lose its influence, but in fact may gain in influence. While it is reasonable and in some sense urgent to speak of the limits of growth in many resources of life the same does not appear to hold for knowledge: knowledge has no limits to its growth (Simmel, 1993). Knowledge, when taken into the context of a social sphere, is a universal phenomenon, but the role of knowledge in social knowing is restricted to this elementary observation. Giddens (1984) characterises knowledge as an ordinary, widely shared and tacit component of social action, to which knowledge is common to social knowing.

The definition of knowledge as a capacity for knowing indicates strongly that the material realisation and implementation of knowledge is dependent on being embedded within the context of specific social and intellectual conditions. Knowledge has many enabling features that allow individuals and groups to organise. The crucial importance within knowledge theory and the KIF has not been matched by extended and enlightened discussions of the concepts of knowledge. More generally speaking, the KIF's conception of knowledge about knowledge is, despite, and for a time because of, the sociology of knowledge, not very sophisticated and comprehensive. The range of knowledge forms (embrained, embodied, encoded and embedded knowledge)[1] that is made available dramatically enlarges the available scope of social action. The development of knowledge also changes and is bound to acquire greater social significance. The KIF relies not only on the formal knowledge of its agents, but draws heavily on the interaction between agents to create a knowledge capability from the diverse know-how and practical problem-solving skills embodied in the individual experts in the firm.

DOMAINS OF KNOWING AND LEARNING

To understand knowledge as a stratified phenomenon of social knowing where knowledge is uniquely created as a productive force within a particular social setting is to draw on one's ability to understand

how meaning is intrinsically related to the use of mediating language and interaction (Gherardi, 2000). The definition of knowledge as a capacity for knowing indicates strongly that the material realisation and implementation of knowledge is dependent on, or embedded within, the context of specific social and intellectual roots. Consequently, individual knowledge can be considered as the 'ability to draw on distinctions within collective domains of knowing' (Tsoukas and Vladimirou, 2001: 974). Routines are the source of stability within organisations since agents in the firm cope with new situations by reapplying routines they already know (Starbuck, 1983). Routines provide knowledge of what actions are helpful in certain circumstances and why that action is correct. Therefore paying attention to the mediating use of language means paying attention to the structures by which managers make sense of their world, along with the way in which they inhabit those structures. Knowing in organisations is conceptualised as a periodic and often volatile interaction between the various agents within the knowledge system (Blackler, 1995). These include the agents, the object of learning in knowledge, the immediate community of peers and mediating artefacts, such as technology, rules and norms. By investigating these and their interrelationships it is possible to analyse the implications of knowledge creation and hence trace the development of new knowledge (Engeström, 1987).

Learning within knowledge is based on the concept that the testing, revision and acceptance of knowledge is not cyclical but interactive, shaped by tensions between the past and present (Tsoukas, 1996). It is through such processes that knowledge is socially constructed and objectified in concrete routines, rules and procedures that are shared collectively but experienced individually. Thus knowledge has become a creative force that can be contested and has history; knowledge work is conducted at all firm levels as agents interact, improvise and develop in specific contexts (Tsoukas and Vladimirou, 2001). The creation of knowledge requires rule-breaking, improvisation and multiple voices (Nemeth and Nemeth, 2001). If knowledge work is intrinsically learning-based and experiential then one must be aware of ways in which managers identify and negotiate uncertainty to establish new areas of knowledge (Blackler, 1995). The creation of knowledge

within the firm must take into account the dynamic relationships between individuals, their communities and the objects of their activities, and provide a clear alternative to approaches that attempt to study such things and the factors which mediate the relationship between them. From this perspective the appropriate unit of analysis is the social relationships between the agents within the firm; within this process knowledge does not appear as a separate category, but rather permeates all the different knowledge-creating activities within the firm. The agents employ their knowledge in a situation which is itself constantly developing. In response to this developing situation the agents' knowledge and behaviour will also inevitably develop (Blackler, 1995). The process of knowing is at the heart of a new theory which encompasses knowledge but which overcomes its connotations of abstraction and permanency.

Knowledge can be considered as a dynamic, generative emergent process, as opposed to an attribute of an organisation, which has an intrinsically social nature. The ability to create knowledge lies in the social interactions of the firm's knowledge agents through constant exchanges, such as conversation, and practices of various knowledge types which exist in the knowledge-based firm. It is through these processes that knowledge is developed in the firm. Knowledge can be viewed as a resource of the firm or of the knowledge agents in the firm, a second perspective maybe to view knowledge as a dynamic and generative process. By viewing knowledge as a resource of the firm one can begin to view knowledge as a functional perspective on organisations, by conceptualising the firm as a machine (Morgan, 1986). Thus regarding knowledge as part of the structural system of the organisation and supportive of it, one takes for granted that the organisation 'has' knowledge and that in exploiting it, it will become the firm's main source of 'competitive advantage' (Holsapple and Joshi, 2002).

Knowledge in this context is regarded as objective, and as a result manageable – developing the understanding that the social phenomena underlying the generation and sharing of knowledge are considered as factual, measurable and delimited and therefore perceived as behaving in a functional way in terms of achieving the firm's survival.

In the post-modern era knowledge is viewed as dynamic and highly interpretive phenomena, related to meaning, understanding and process, which by their very social nature are difficult to manage. Therefore the facilitating and production of knowledge is a more conducive method of not managing knowledge. But understanding organisational knowledge as an object tends to favour explicit over tacit knowledge, and consequently individual over collective. However what an individual knows and the method in which this is practiced emerges from the interplay between the different forms of tacit and explicit knowledge. The knowledge embodied in an agent emerges from the interaction between the agent's tacit knowledge and explicit knowledge – it is inter-subjective and is inherently unpredictable and continually evolving (Tsoukas, 1996). In order for knowledge to be transferred to the collective organisational knowledge of the firm a language is required, so it can be transmitted and shared and as such becomes historically and culturally embedded in the collective knowledge of the firm. Thus individual experiences, new knowledge and skills are not considered in isolation but become entwined in the interactive and communicative action of the collective element of the firm; these have to be experienced by the social collective of the group. As the new knowledge becomes embedded in the group's experiences they become re-valued and constantly deployed in the day-to-day activity of the firm. The process of this interactive-based learning takes a contextual shift away from the individual to the collective, from possessions to processes, and the focus is on the interactions that take place as a result. By developing the social actions of learning neither the individual nor the system is allowed to predominate but rather the reflection is directed towards the actions which manifest organisational practices produced by the interaction of both, thereby relating the emerging knowledge created towards effects of self-organisation and emerging behaviour rather than that of managing. The knowledge creation process thus occurs among many variant groups in the firm.

This perspective emphasises how connections among parts of the system can enable learning and adaptation (Griffin et al., 1998; Kallinikos, 1998; Anderson, 1999; Kauffman, 2000). As a system the firm is able to gain knowledge about its surroundings, itself and its behaviour and use this diverse knowledge for guiding future

actions (Kauffman, 2000). However, the connections established among different parts of the system allow not only for knowledge exchange among collectives but also open up possibilities of generating and sharing new meanings, thus providing increased capability to share and generate knowledge. Organisational collectives play a control role in the knowledge-creating firm, as they provide a shared context where individuals can interact with each other and engage in the constant conversations on which effective reflection depends. By taking this viewpoint one is able to propose the importance of the interactive and co-evolving nature of organisations with their environments as well as the process of emergence of both knowledge and organised structures through the connection, interaction and relationships between these diverse knowledge agents (Allen, 1997). The benefit of this perspective is the conceptualisation of the KIF as a structure that is fluid, yet sensitive to the needs of the connected elements as well as in connection with its environment (Griffin et al., 1998).

Drawing from studies in philosophy, sociology and organisational theory a differing approach can be considered to understanding knowledge. That is, rather than viewing knowledge as something which an individual has, it may be better understood if conceptualised that knowing is something which the individual does. Such a standpoint turns attention to the fact that knowledge and action within the firm are changing and developing. The firm's learning environment provides a driving force for knowledge creation, one in which account is taken of the fact that the knowledge-intensive firm environment is a lot less stable and rational than is usually recognised. By encouraging new ways of knowing and doing, new methods can emerge if firm knowledge agents begin to rethink established ideals in a different context. The firm's requirements for knowledge are constantly evolving: by visualising knowing as something that knowledge agents do and understanding the dynamics through which knowing is accomplished, one may realise the process as being located in a time and space specific to a particular moment, but one that is also constantly developing. Thus rather than asking the question, 'What sort of knowledge is needed and how may a firm harness this knowledge?' the question becomes, 'How are processes of knowing and doing changing?'

IMAGES OF KNOWLEDGE IN THE KNOWLEDGE-BASED FIRM

The theory of knowledge and organisational learning seeks to understand the nature of knowledge and organisational learning from a pluralistic epistemological perspective. It makes a distinction between explicit and tacit types of knowledge and argues that the interaction between these two modes of knowing is vital for the creation of new knowledge. The emphasis on the importance of tacit knowing as the origin of human knowledge directs our attention to the social and interactive nature of knowledge and learning.

Knowledge in the KIF can be situated at the level of the individual, or be shared amongst the agents of the firm as a collective element. Individual tacit knowledge is discrete and self-contained; it is knowledge that is owned by the individual knowledge agent in the firm, which can be applied independently to specific types of tasks or problems. Collective knowledge refers to the way in which knowledge is distributed and shared among members of the firm. It is the collective knowledge of the firm that is stored and reflected in the routines, procedures, rules and shared norms which guide the behaviour, problem-solving activities and pattern of interaction among its members. Collective knowledge in the context of the KIF can be either a stock of knowledge stored as hard data that is readily available for use by its members, or be a flow of knowledge that emerges from the interaction of the firm's agents. Collective knowledge exists between rather than within individuals, it may be centralised or disseminated throughout the firm. Taking into consideration the explicit and tacit elements of knowledge and the individual–collective dimensions of knowledge, the typology of knowledge forms suggested by Collins (1993) focuses on the socio-cognitive structures of knowledge, integrating the individual and organisational dimensions. It provides a means for relating the characteristics of knowledge to its specific embodiment, linking the process of generation and utilisation of knowledge with its cognitive dimension. The KIF is a social system based on coordination. It provides a social context in which different forms of knowledge interact and combine to achieve collective productive purposes. The firm's capacity for learning and innovation is closely related to how its knowledge is constituted, utilised and generated. What the variety

of images of knowledge attempt to identify serves to demonstrate the complexity of knowledge in the KIF. This illustration is emphasised by Orr (1990), in which the significance for the firm is the process of interaction.

Learning is a socially constructed understanding, which emerges from practical and local collaboration amongst agents in the firm. The collective wisdom depends upon communal narratives. The benefits from internal communications and collective dialogue are an essential element of organisational life in developing skills and abilities which are distributed amongst the agents in the firm. Orr's (1990) analysis of the knowledge-based consultancy firm points to the critical role which communication, interaction and integration play, with regard to creating a unified knowledge-based firm environment, which facilitates the growth and development of firm knowledge. The close relationship that exists between the various knowledge forms illustrates that it is a mistake to assume that each knowledge form can be sensibly conceived as separate to each other. Cook and Brown's (1999) study describes how maintenance personnel shared stories about technical problems, which are a core element of their daily work, illustrating the development of explicit knowledge within the collective group. What this demonstrates is that learning can be seen from a socially constructed process that emerges from the collaboration of various knowledge agents with varying knowledge forms.

Learning is an element that occurs in all types of human activities. In the field of organisational theory learning ranges from the individual to the collective. Learning in the KIF firm may be described as an emerging activity in a social system, where knowledge agents, both collectively and individually, continually expand their ability to create, in which new expansive patterns of thinking are evolving in the firm's social system. By understanding this process learning may be aligned as an interactive process of varying activities, whereby new knowledge is produced through the transformation and interpretation of knowledge forms. The concept of the learning organisation is focused on the firm as a whole entity, and all individual and collective learning is directed towards developing a common understanding of what constitutes the whole. This should be viewed as a metaphor rather than an abstract structure,

because as knowledge is created the elements and the whole will constantly change in structure (Drew and Smith, 1995). According to Pedler et al. (1991) the learning organisation is a firm capable of adapting, changing, developing and transforming itself in response to the changing needs of the firm's environment and the wishes and aspirations of people in and outside the firm. Stacey (2003: 325) defines learning as an 'activity of interdependent people, which can only be understood in terms of self-organising communicative interaction and power relating, in which identities are potentially transformed or changed'. This demonstrates the emerging shifts in the patterns of human action, in which individuals and groups are aspects of a process of interaction between people.

In the new science of complexity and chaos the process of organisational learning may be defined as a network of social interaction that facilitates the exchange of differing knowledge forms. Shelton and Darling (2003: 357) refer to this as 'quantum skills to change established mental models'. One of the most important areas of the chaos and complexity-based approach is that at the heart of the learning organisation is a shift in mind set: from seeing ourselves as separate from the whole, to being connected to the whole, from seeing problems caused by someone 'out there to seeing how our own activities create problems we experience' (Senge, 1990: 12–13), thereby illustrating the fact that people act upon a system of which they themselves are an inseparable part, so the observer and the observed are belonging to the one and the same complex dynamical system.

LEARNING AS A SOCIAL INTERACTION

The social interaction approach develops the assumption that the real world is actively constructed by human knowing, even though social scientists tend to behave as if it is independent of human knowledge. Interactionism treats social action and its small face-to-face interactions as the basis of all social life, so that the meaning of any concept or idea can only be located in the experimental consequences that it produces. Polanyi (1962) distinguished 'knowledge about' from 'knowledge of'. The former, which is acquired through textbooks, is conveyed in abstract general principles which

can be learned and memorised; the latter, knowledge of practical knowledge, is acquired through experience in everyday life, is established through trial and error and can take an unconscious tacit form. Thus the concept of the knowing agent as a 'thinking process' can be viewed as a continuous developing entity, rather than as a fixed element. In this way individuals can define objects and their context, identify sensible courses of action, imagine the consequences of these choices and select an appropriate course. Other interactionist theorists such as Mead (1934) identify the actual behaviour of the actors and the development of the mind as an unfolding process. They begin to learn to develop an inner mutual understanding of the process and its related parts, which allow the agent to predict the behaviour of the other constituent parts. The prediction of the routine habitual practices of the related parts of the process responding in similar predictable ways enables the social interactions of human beings to take place while avoiding conflict.

Social interaction can be seen as an ongoing process rather like the changing patterns of the weather, instead of following a definite fixed plan. Schutz (1967) argued that it is through the condition of inter-subjectivity that the individual agents are able to understand each other's routines and construct their life-world. By sharing time and space, the (individual) action involved in communication could engage in a process of understanding which involves the discovery of what is going on in the other person's mind (Schutz, 1967). Schutz argued that there were no hard facts, only interpretations of inter-subjective facts. The conception of organisational knowing builds on this conception, further developed by Spender (1980), who argues that when managers are confronted with an undetermined situation, one in which knowledge or lack of it is an issue, they characterise it with a set of corresponding rules and purposes that comprise rationality. A critical point here is that the social world is constructed by agents who possess free will and who can and will behave in spontaneous ways not anticipated by the scientific methods. For Schutz (1967) in the natural sciences it is plausible to collect 'facts', but when faced with the problem of understanding social existence, consideration needs to be given to

the motives, the means and ends, the shared relationships, and the plans and expectations of human actors.

The knowledge-intensive firm is a network of non-linear interaction. Although the firm's subsystems are conceptually distinguishable, they are so intertwined that they must be understood as a whole; the whole is nonlinear because of the alternating patterns of behaviour between the firm's agents. The firm develops over time through feedback processes in which the individual agents in the firm discover new forms of knowledge in the firm as well as those parts of the firm environment the agents are in contact with. They have the autonomy to choose a response to those states from either universal or specific rules or both. These actions have consequences for each other and for agents in the firm: they may change the internal state of the organisation by provoking a response from agents constituting the firm environment. In other words individual agents or groups of agents, and thus the whole organisation, move through continuous loops of learning (choice and actions). Agents in the firm choose to make sense of what they learn and as a consequence of this decide what action to take in response to that meaning in order to make these choices.

The firm's agents and the system that they constitute evolve around the learning loop of discovery, choice and action; they are clearly engaged in a co-evolutionary feedback process in which what one agent does affects others. The feedback has an important process in that it may be negative or positive. Negative feedback is the process of intentional development and control in an organisation that clamps down on change and looks towards stability; the opposite to this is positive feedback, which promotes learning in a way that amplifies and destabilises the system by spreading revolutionary new ways of thinking. These two forms of feedback are linked to the method by which agents and the firm learn and it is this learning that drives the co-evolutionary process. Complex learning occurs (Argyris and Schon, 1978) when the patterns of interaction are altered and, at more or less the same time, the behaviour of the system alters. The firm, via the learning process, evolves through both positive and negative feedback, both single and complex double-looped learning, co-creating and co-constructing the firm's collective knowledge environment.

A STRATEGY FOR KNOWLEDGE CREATION USING COMPLEX EVOLVING KNOWLEDGE SYSTEMS

In the context of the KIF the firm may be described as a 'complex evolving knowledge system' (CEKS) in which the firm is comprised of knowledge that is situated in both the individual knowledge agents and their interactions. The development of new knowledge lies in the understanding of the interactions among the individual knowledge agents in the firm, which forms new emerging patterns of learning. In order to make sense of the knowledge creation phenomena one must look towards theories that can aid understanding and facilitate the interactions among individual knowledge agents that allow them to create knowledge. Whereas individuals can create embodied tacit knowledge the greater challenge is to establish a strategy that promotes the social interaction and resultant emergence of new patterns among knowledge agents, which facilitate not only the collective knowledge of the firm but also the creation of both explicit and tacit knowledge.

The creation of knowledge in the firm is better accomplished through the process of interaction among individual agents with differing knowledge forms rather than individuals with similar knowledge forms. The complexity of the firm environment and the task of how one creates knowledge requires the use and development of diverse knowledge forms (Leonard-Barton, 1995). For example, in the case of a problem exercise an individual agent may initiate an suggestion, but in order for this suggestion to become a solution to the problem in hand it has to be considered by other agents in the firm who hold differing forms of knowledge, such as technical, financial or marketing, in order to ensure that it suits the demands of the problem and its environment. Therefore the possibility of exchanging knowledge and recombining existing knowledge in order to develop knowledge is greater when the agents involved have diverse knowledge forms. In this way a firm environment of learning is developed and scope in knowledge diversity is achieved.

The creation of knowledge requires multi-directional interaction and self-organisation among agents with diverse knowledge forms, enabling them to become both sources and recipients of learning (knowledge). This multi-directional interaction can be facilitated by the development of a learning environment in which the firm's

agents participate, as it is not only the transfer of explicit knowledge that is involved but also that of tacit knowledge, which can only be acquired through the process of interaction (Nonaka and Takeuchi, 1995). Interaction among varying agents with differing knowledge forms which are shared and transferred in order to create knowledge has two critical focal points: firstly, the willingness of the agents located in different parts of the firm to share their knowledge and understanding, and secondly, knowledge agents with different knowledge forms need to be able to understand each other, in that they require a common language (Arrow, 1974) or a common tacit knowledge of the firm and its environment (Grant, 1996).

The individual knowledge agent, by been exposed to differing knowledge forms, must be able to understand the language used within the firm and between the various other agents; that is to say, there is a necessity to have a common language (Arrow, 1974). Without understanding among these individuals knowledge cannot be exchanged in a meaningful way; only when elements such as interaction, integration and interdependency of knowledge sets co-evolve is knowledge creation possible. In the KIF learning is considered to be essential in the firm (work processes are not based on routines but rather on personal commitment); it requires abstract thinking where teamwork will aid the success of the service that the firm offers. Working in these firms is interactive by nature. Emerging approaches to knowledge creation and its understanding include complex evolving knowledge systems. CEKS is different from classical approaches in terms of viewing the organisation from a holistic point of view. The concept is multi-disciplinary and a creative approach to enhancing strategic thinking and understanding.

CEKS is a system based on interaction, which can be social, ecological, economic, cultural or political (Dooley, 1997). The critical concepts of the system are self-organisation, non-linearity and emergence. Self-organisation in the system enables the learning process and is a key characteristic of complexity (Dooley, 1997); complexity thinking transfers the emphasis of control to that of learning environments and relationships. Maturana and Varela (1992) describe self-organisation as a process where reproduction is emphasised. In the context of the KIF, the process of self-organisation is that of the action in human organisations, where agents spontaneously come

together to undertake an activity (Milton-Kelly, 2004). The concept of non-linearity can be understood in that complex systems display complex patterns of behaviour that are not common to their multiple causes (Fitzgerald and van Eijnatten, 2002). In contrast a linear system is one in which the change of events can be easily recognised and repeated. The process of emergence is a novel, sudden appearance of a pattern in a non-linear-based system that is new: it is a system's behaviour which is the result of an interaction of many agents within the system (Lissack, 1999).

In the CEKS agents with differing knowledge forms are connected to and interact with one another. Because the agents are connected together in the system, the behaviour of an agent can have an impact on the system and the other agents. All agents observe and act on local information and co-evolve with one another. Co-evolution is where each agent adapts to their environment in order to suit the demands of the knowledge landscape in which they are functioning. These linkages between each agent in the system can evolve over time and change the pattern describing the strength of connections. While co-evolving these agents also compete with each other for resources (Dooley, 1997). According to Dooley (1997) a CEKS appears best suited in turbulent environments where change is imminent and frequent. Each element in the CEKS is a dynamic approach towards understanding how all agents in the firm emphasise new knowledge creation through self-organisation in a chaotic environment and the knowledge landscape. By understanding the dynamic complexity of knowledge it is possible to comprehend the whole organisation and its activities in knowledge development, through learning and interaction.

The chaos metaphor describes most systems as not only complex but dynamic and non-linear, in which both order and disorder coexist (Nicolis and Prigogine, 1989). A chaotic system is a complex and dynamic arrangement of connections between elements forming a unified whole, the behaviour of which is both unpredictable and yet patterned (Fitzgerald, 1996). By using these theories one may begin to understand and recognise the underlying philosophies and structures that shape individual and organisational knowledge. It is a focused approach to illustrate that complex evolving knowledge systems recognise the firm not as a static structure but one that

changes and develops with new knowledge at any particular point in time. It offers new concepts to better understand uncontrollability, uncertainty and complexity in the KIF as a learning organisation, where people continually expand their capacity to create the results they desire, and where new and expansive patterns of knowledge types are integrated and evolve. Where collective thinking is nurtured and where people are continually learning to see the whole.

Knowledge has always been an organisational asset; it is only relatively recently that it has been widely recognised. Bell (1970) foresaw that what is distinctive about the post-industrial society is the change in the character of knowledge itself. What has become decisive for the organisation of decisions and the direction of change is the centrality of theoretical knowledge – the primacy of theory over empiricism and the codification of knowledge into abstract systems of symbols that, as in any axiomatic system, can be used to illuminate many different and varied areas of experience. Individual and collective knowledge is bought to bear through the interplay of knowing and doing. Blackler (1995) emphasises the collective, situational and tentative nature of this process, particularly where agents enact new conceptions of their knowledge. This interaction creates tensions and contradictions amongst firm agents, which leads them to question what constitutes the source of innovation and knowledge creation as complex tensions are explored and new patterns of knowing start a learning cycle (Engeström, 2001).

The emergence of new knowledge is critical to understanding the social construction of the complex relations between agents within the KIF, by focusing on the processes of interaction within and between individual and collective groups where existing knowledge is contested in order to contend with uncertainty. Thus an emergent social system is developed. A system whose agents have learned and established conscious communal processes for continually generating, retaining and leveraging individual and collective learning to improve performance of the organisational system in ways important to all stakeholders, and monitoring and improving performance. It is not only specific elements of knowledge but the practice of new emerging patterns of knowledge that can be contested, as knowledge is held in dynamic rather static relations. Giddens (1984) characterises knowledge as an ordinary, widely

shared and tacit component of social action in which he expresses the extent to which knowledge is common to social knowing. Knowledge is a highly differentiated stock of intellectually shared nature and society, which can constitute the cultural resource of a society. But participation in this resource is determined by changes and the social influence of agents and the knowledge to which they have access.

The theories of chaos and complexity help to describe and understand a new holistic approach to viewing the process of knowledge creation and learning. This system of learning may be described as a complex and dynamic arrangement of connections between elements forming a unified whole, the behaviour of which is both unpredictable and patterned, ordered and disordered. To view the KIF as a learning organisation in which knowledge is continuously changing, one may understand the firm as an enterprise in which the two most fundamental properties of reality are maintained in dynamic balance by virtue of an institutional process. The knowledge system in the KIF is that of a 'complex evolving knowledge system', which consists of a large number of frequent interacting heterogeneous knowledge agents, each having a particular knowledge set which is governed by second-order learning and discovering new ways of looking at the world in terms of decision-making or problem-solving.

Thus knowledge is considered dynamic, generative and emergent, which is rooted in social practice and (re)produced and shared in social interactions. What a knowledge agent 'knows' and the way in which knowledge is used emerges from the interplay between tacit and explicit knowledge. It is inter-subjective and is therefore inherently indeterminate and continually emerging. Knowledge needs a language to be transmitted, represented and shared; as a result it is always historically and culturally specific. The knowledge and the sense of reality that is shared by particular social groups are sustained by social processes. The CEKS concept suggests that individual experiences are not considered in isolation, since knowledge is the product of interaction and communication in this regard. In order for experiences and explanations to be considered as relevant knowledge they have to be experienced as meaningful by the social collective of the KIF, and in turn become part of

the firm's lived experiences. This perspective takes a conceptual draw away from the individual towards the collective knowledge agents in the firm, from possessions towards processes, and the focus is on interactions and social practices. By placing actions and social practices at the centre of attention in the CEKS, it suggests that neither individuals nor the systems are allowed to predominate and draws attention towards the processes which manifest new knowledge (which are displayed in the interactions between both the individual and collective agents of the firm).

The emergent complexity is built up through differing patterns of knowledge exchange combined in infinite variety and at different scales – phenomena that have been observed in both living and non-living entities (Pascale, 1999). The patterns are not directed by a specific learning, and continue as agents come and go in the system (Beinhocker, 1997). The firm that emerges from this state is changed in that the firm has acquired new knowledge to do something that it could not have done prior to being disturbed and allowed to emerge. Thus a firm which learns less and remains relatively unprovoked has fewer stimuli to adapt to and is at a greater risk over time of being at a disadvantage in the natural selection process. For example a lack of diversity may promote stability, whereas a stimulated interaction of diverse knowledge elements in a learning-oriented environment would seem to prepare the firm better for the future.

The largest part of learning is through interaction. It is also the case that learning opportunities and self-management are good things, that both individual and collective agents have a significant influence on learning effects, that diversity adds valuable perspectives and that knowledge involves doing and experimenting. This self-organised-based environment, in which learning can occur, is dependent upon a culture of sharing and an emphasis on learning with full access to knowledge (individual or collective) by emphasising broad and diverse participation and interaction, as well as consistent interactive communication, using a common language. Pressure is required which can push the firm towards the edge of chaos (that of dissipative structures) and disturbances within the firm landscape which can provoke the emergence of new knowledge, thus allowing the avoidance of control and procedure. The

understanding of knowledge has moved away from the scientific and philosophical prejudice that all knowledge is dependent on philosophical and scientific knowledge, which are the types of knowledge relatively most detached from social frameworks. The KIF must concentrate on the effects on the types of knowledge that are most deeply involved in social reality and the roots of its structures, such as the perceptual knowledge of the external world, knowledge of the other, and political, technical and common sense knowledge. As humans we must consider that there exist a much larger number of knowledge types, which the social element of knowledge, as well as epistemology, must take into consideration, thus eliminating the issue of the universal validity of judgement.

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1 The explicit–tacit and individual–collective dimensions of knowledge give rise to four categories of knowledge: 'embrained', 'embodied', 'encoded' and 'embedded' knowledge. These conceptual distinctions were first suggested by Collins (1993) to explain the psychological and behavioural aspects of knowledge. **Embrained knowledge** (individual–explicit) is knowledge that is dependent on conceptual skills and cognitive abilities of the individual. It is formal, abstract or theoretical knowledge. **Embodied knowledge** (tacit–individual) is action oriented; it is the practical, individual type of knowledge (know-how or technique) on which Polanyi (1962; 1966) has focused. **Encoded knowledge** (collective–explicit) is knowledge (or sometimes referred to as 'information') conveyed by signs and symbols. It is knowledge that has been codified and stored in blueprints, recipes, written rules and procedures. **Embedded knowledge** is the collective form of tacit knowledge residing in organisational routines, practices and shared norms.

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