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## **Complexity Theory and the Role of Knowledge Management in the Knowledge-Based Small Business**

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### **Abstract**

The paper aims to contribute to our understanding of the knowledge creation process in the knowledge-based small business. The authors consider how a complexity science perspective of knowledge is useful in this regard. So for example, the complexity of knowledge creation might be seen as systemic as no one individual knowledge agent can operate in an isolated and self-sufficient manner. Additionally, the social structures of the small business involve relations and patterns of behaviour that have become established across time and space. This idea that knowledge is socially and culturally situated lends itself to a qualitative interpretation of the processes evident in the small business.

By drawing on pilot evidence propositions about facilitating knowledge creation as both an individual and collective knowledge appear to co-emerge. This is consistent with the idea that knowledge develops as a process of interaction, as opposed to a managed process and further as Tsoukas (1996) suggests, knowledge in the small business is a socially constructed understanding derived from the interplay between tacit and explicit practices and processes. We seek to examine whether individual knowledge agents exist in a network of relations that are complex and dynamic and if so, reflect on what the boundaries to those networks might be. This supports the view that the nature of knowledge is inherently indeterminate and continually evolving. Further thought on how knowledge and knowing is emergent and produced and reproduced in recurrent social practices allow the authors to reject any ideas that knowledge is static or created as a predetermined outcome. The authors conclude the paper by suggesting knowledge in the small business is embodied as evident in such notions as tacit knowing and learning, and embedded grounded in the situated social historic contexts of individual lives and work.

**Key Words – knowledge creation, Learning, Knowledge Management, Complexity Theory, knowledge-based small firm.**

### **Introduction**

The development of Knowledge Management (KM) has increased rapidly over the last decade, as a result KM has become a central topic of management philosophy and many firms are now starting to introduce KM practices in their organisations. A KPMG survey of SME firms in the UK found that 64% of firms had introduced KM strategies, whilst 24% were at the introduction stage. The diversity of the KM field stems from the fact that agents working within the field originate from various disciplines such as psychology, management science, organisational science, sociology, strategy and so on. However, one commonality exists, (which is apparent) in that all of these fields take on a very practical approach to knowledge, in the context of how knowledge can contribute to organisational understanding and effectiveness. Largely, the term KM makes reference to how broad collections of firm practices and processes are related to generating, capturing and disseminating knowledge that is relevant to the firm.

The aim of this paper is to provide a different understanding and focus on how the knowledge-based small firm views knowledge. By presenting a complexity based view, the paper contributes to our understanding of the knowledge creation process in the knowledge-based small business. The paper views knowledge creation as an emerging process, in which knowledge content and form crucially depend on the social relationships around which work is organised, and the purpose for which knowledge is used. The idea that knowledge is socially and culturally situated, lends itself to a qualitative interpretation of the processes evident in the small business.

Creating knowledge provides value to the knowledge-based small firm and is the potential source of competitive advantage. As noted by Tsoukas & Mylonopoulos (2004), a firm that can create knowledge on an ongoing basis, has developed a dynamic and unique process that potentially underpins continuous firm learning. In view of the potential advantages which can be derived for the knowledge-based small firm from developing a knowledge creating capability, and the number of failed attempts by firms to do so (Dachler, 1992), it is not surprising that knowledge management continues to be a research priority. Current existing research tends to investigate knowledge sharing and transfer, or alternatively the use of IT based technologies through which knowledge can be effectively managed. The processes that underpin effective knowledge creation, continues to permit theoretical and empirical investigation. The view of knowledge adopted in this paper is a performative one, as opposed to a representational view. From this perspective, knowledge in the knowledge-based small firm is viewed as a dynamic, ongoing social accomplishment. This is a view of knowledge in practice, which is receiving much attention from researchers in the field of knowledge management (Tsoukas, 2005).

The complexity of knowledge construction, in this regard, focuses on knowledge not as static or given, but as a firm capability produced and reproduced in a recursive process, occurring at different levels of analysis and different time scales. Just as the corpus of modern medicine is an outcome of a historically and a periodic shaped social practices so to the firms' knowledge of customer preferences or employees skills is an outcome of practices that have sought to answer particular questions in a particular way (Jacques, 1996). A practice view of knowledge, leads us to understand knowing as an emergent (arising from the everyday activities and interactions in the firm), embodied (as evident in such notions as tacit knowing and experiential learning), and embedded (grounded in the situated social historic contexts of the firms' knowledge agents working lives). While studying the links between organisational knowledge, learning and KM has been the focus of some studies, (Eisenhardt and Santos, 2002), accounting for how organisational knowledge is developed in the first instance, remains relatively unexplored. While it is important to study how knowledge assets develop over time, it is also important to do more foundational study by exploring how knowledge is constructed in the first place. Understanding knowledge becomes important the moment we cease to take knowledge for granted, assuming it has already a particular form and content.

Knowledge was first recognised as a key resource by Bell (1999); it is only recently that this has been widely recognised. Bell (1999) offered an insight into the knowledge-based economy, suggesting "what is distinctive about the post-industrial society is the change in the character of knowledge itself". What has become decisive for the organisation, for 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 symbols that, in any self-evident system can be used to illuminate many varied areas of experience. Bell (1999) drew attention to the increasing importance of theoretical knowledge for the functioning of economies. Demonstrating that even the most theoretical forms of knowledge essentially depend on the application of types of cognition and social skills that are inherently non-codifiable (Brown and Duguid, 1999). This suggests that theoretical knowledge, practical application and social context are inherently, inextricably linked. By viewing the knowledge-based small firm as a firm of knowledge assets, the emphasis on understanding and developing KM processes of knowledge creation, transmission and retrieval is critical. Thus organisational knowledge, learning and KM form a triangle, facilitating the ongoing development of organisational knowledge via a KM process that leads to continuous organisational learning and firm knowledge. A KM process that has the ability to integrate, communicate and transfer knowledge on a on-going bases, as part of a natural emergent process, virtue of being inextricably linked and embedded into its historical and a-historical developed context are idiosyncratically complex and dynamic (Eisenhardt and Santos, 2002; Spender, 1996).

### **Knowledge & Knowledge-Based Firm**

The majority of empirical studies in KM adopt a machine metaphor in order to understand firm structures (Morgan, 1986). The image of a firm as a machine, when considering knowledge as dynamic, is now problematic. As the machine image of the firm relies on the deployment of rules and control mechanisms in order to simplify firm processes, in order to achieve a

predictable, stable, rational based firm as the means to understand the process and the inter change of knowledge. Even though it is now recognised that the business environment is constantly changing, the above metaphor for understanding KM and the firm as a machine still dominates the way in which KM is viewed and understood as a co-ordinated strategy in the firm.

KM as a subject domain, like many other subject areas in organisational studies, has experienced numerous changes, especially in terms of how we understand the epistemological nature of knowledge. KM thinking is shifting from strategies which have been pre-occupied with the dissemination and integration of firm knowledge to develop learning based climates. This change represents a shift in thinking of KM, from strategies that stress dissemination and initiation to those that promote learning. To date, the goal of any firm KM strategy has been concerned with the process of capturing, codifying and centrally distributing organisational knowledge to share in the firm's network of agents. KM has been viewed in the literature as a management discipline that focused on knowledge operations or knowledge use within the firm. However, this view fails to address the fundamental question of where firm knowledge comes from or how is it generated? The assumption of this particular view of KM, is the individual agent and the extent to which they have access to and can leverage information necessary, in order to complete the required task where and when it occurs.

### **A complexity perspective**

Knowledge creation, as a process of learning, in the firm can be categorised in three streams of epistemologies (Slappendel, 1996) an individualists, a structuralist and an interactivist perspective. An individualist perspective assumes that individuals are the major source of learning in the firm. A structuralist perspective assumes that knowledge creation is relative to the organisational characteristics. In traditional management science, organisational knowledge has been dominated by a focus on the individual and structural determinants of knowledge creation. A third perspective however, is the interactive process (Van de Ven and Dooley, 1999), emerged from a change in focus as to how knowledge is created in the firm, which originated from a need to understand the interrelationships between the individual and collective action and firm structure.

If knowledge in the small business firm is viewed as a complex evolving knowledge system (CEKS), which co-evolves within the firm's social ecosystem, then the process by which we think about knowledge (such a change in perspective of knowledge) comes a different way of acting and relating, which inevitably results in differing ways of developing knowledge in the small business. When complexity is taken in the context of social science, very little research or application of such theory has been developed in social systems which are located in the small business firm. The knowledge-based small firm does not practice information, but rather they practice knowledge development. In order to understand and place context to KM practice in the firm, one must establish an epistemology of knowledge, a theory of how learning occurs in the social networks contained in the firm. Complexity in the knowledge-based small business firm arises from the existence of the firm's inter-relationships, which subsist (survives) between the firms agents and in the social structures that are inter-connected, consisting of elements within a system and between a system, and its environment which exist in bounded instability. CEKS is composed of diverse agents holding different knowledge types, which interact with each other, mutually affecting each others knowledge and behaviour. These patterns of behaviour are not constant, but rather varied. Thus the system is constantly changing and adopting to the condition surrounding it, and through these interactions occurring in the system.

Gell-Mann (1994) understands complexity as a root definition of the word "plexus" meaning entwined, which is a derivative of the noun "complexus" and the English word "complex". Thus complexity is associated with the intricate inter-connectivity of elements. In living systems, Plotkin (1993) puts it that knowledge is the relationship between any part of a living creature's body and particular aspects of order through knowledge, which enable living things to adopt and evolve. As with knowledge, language and understanding, in the course of evolution, adaptive structures have become increasingly varied. The need for knowledge agents to interpret the world as a set of mental and cognitive images has important implications for how each agent's acts and experiences the world and generate knowledge.

Baskin (2003) notes that understanding and knowledge begins in the context of the firm, representing a model of social interaction, in which the firm agents experience the firm and its knowledge requirements. Some important issues of this are, firstly, the firm can be viewed as the vehicle by which firm agents absorb cultural-specific meanings and knowledge. Secondly, these agents, through gaining knowledge and new meaning, adopt behaviour patterns as knowledge agents interact with each other thus constructing new meaning in order to explain the habitual behaviour patterns.

Human knowledge agents live simultaneously in two co-evolving, yet very different worlds. The first world is the external world of people, things and events, where the knowledge agents participate in the life around them. This external world is always beyond the knowledge agent's ability to perceive in totality. Complexity suggests, that this external world is so woven through with multiple causes and complex feedback loops that the human mind cannot fully comprehend it. Bohm (1980) suggests that the external world, the "implicate order", is so rich that we can only perceive selected elements of the, "explicate order". As a result the knowledge agent lives and functions in a second world, the internal world, in which the agent's mind creates order to understand the external world. These two worlds are deeply interconnected, in that the details of any knowledge agents perceptual world are selectively taken from the external world. Like other living entities, the knowledge agents perceptions filter out significant amounts of information "skewed towards the features of the world which matter", the survival of the knowledge agent and the knowledge required. The interaction of this created world picture with the external world forms a powerful feedback loop. The process with which knowledge agents most often organise the external world, is through knowledge gained by the use of narratives and experiences, or tacit understanding.

Knowledge can be regarded as a product of the self-reinforcing feedback loop, by which human beings connect their internal perceptual worlds with the external world. In that each agent generates knowledge as they test images of their internal worlds in the external world. Knowing, in this context is developed as agents interact with the external world as well as each other. In such interactions, agents respond to an unconscious level, and if their response creates the desired results, they will repeat that response in similar situations. This new knowledge gained, is then translated through interactions, in order that each agent is consciously able to explain what may have happened. Boge (2001) notes that "agents live in the anti-narrative", in other words, each agents experience of knowledge is the ongoing experience which they accumulate in order to explain what is happening around them.

### **Research Study**

The research takes a qualitative based approach to data collection and analysis, using case study based strategy. Case study as a research tool in the domain of sociological based studies aid to bring an understanding to a complex issue by emphasising detailed contextual analysis and the relationships contained. The approach adopted, places emphasis on processes and meanings, rather than on an examination or measurement in terms of quantity, amount, intensity or frequency, (Van Maanen, 1982), allowing the focus to be placed upon the shared social context of the pilot case stakeholders involved in those knowledge processes. Data consists of field notes and transcripts from interviews held with participant's representative from a range of professional fields under the general category of knowledge work. The data was analysed using the constant comparative method, which involves the development of initial categories and meanings as the data is collected and analysed. All coding and analysis was triangulated, thus incorporating a variety of theoretical standpoints and possible alternative explanations.

Knowledge-based small firms have been defined using the current European Commission criteria for SME's. Accordingly the pilot cases in this paper are defined as firstly, a micro-firm which has less than 10 employees and with a turnover of 2 million euro, a small enterprise, which has between 10-49 employees with a max turnover of 10 million euro, and finally a medium sized firm, which has between 50-250 employees and a max turnover of 50 million euro. The small business firm tend to be informal and non-bureaucratic with few imposed structural rules and procedures. Control tends to be based around the owner/managers personal supervision and formal policies tend to be absent (Daft, 2004).

### **Findings**

The transfer of information and knowledge in the firm occurs via a network of human interaction. Alwert and Hauffman (2003) argue that between 50 – 95% of all exchanges in the knowledge-based small firm are verbal. Gorman (2002) stresses that knowledge can only be developed through the process of social interaction, which is the case in terms of human interaction and learning. The main issues associated with KM in the small knowledge based firm, is the lack of a framework or understanding of knowledge. Another common issue, is the difficulty of letting firm agents codify their knowledge, and finally the difficulty in capturing tacit knowledge. The knowledge developed and used by the manager/owner is socially embedded and is a function of personal constructs, experience, effectual reasoning and wider social contexts of the small firm. Managers/owners are more willing to review and retain flexible and informal routines in order respond, to or explore new opportunities (Cope 2003). In this context, knowledge in the knowledge-based small firm can be derived in part from learning via reflection, and the involvement of other knowledge sets. Via the creation of “learning space”, managers/owners could be more agile, enabling them to configure new problems and solutions in flexible ways (Thakur 1999).

The knowledge-based firms studied tended to be growth-orientated, but the relationship between growth motives and learning is not a simplistic one (Gray and Gonsalves 2002). The consistency and strength of internal ties (teams and people employed) within these firms play an important role in knowledge construction, and consequently learning. The absorptive capacity of knowledge-based small firms, which is dependent on relations and structures, allow the access to and dissemination of relevant knowledge and plays a role in their ability to act on opportunities (Meeus *et al.* 2001). The ability of these firms to create knowledge through relation's, is based on effective modes and means of communication and developing ties of an appropriate “strength” (Yli-Renko *et al.* 2001). The ability of firms to actively manage knowledge and network's, is viewed as important in their competitive “success”, (Bell *et al.* 2004). Proximity to other firms and relationships with larger firms are important. Renko *et al.* (2001) identify a knowledge-based small firm's social capital as the ability of managers/owners to acquire and exploit knowledge arising from external relationships.

Drawing from the empirical evidence of the pilot case studies, complexity theory offers a perspective from which we can evaluate and understand learning. The most important characteristic of CEKS are non-linearity, dynamic behaviours, emergence and self-organisation, which is clearly evident. The findings of this field work indicates that the owner/manager in the knowledge-based small firm need to consider the process of KM practices which encourage open firm learning. They further need to consider a holistic approach to understanding knowledge creation via learning. McAdam and Reid (2001) found this to be a general and serious problem in knowledge-based small firm. Learning is seen as essential for the development and co-ordination of new knowledge in the firm. Swan (2001) advocates acknowledging the socially mediated and constructed nature of knowledge, by viewing learning and KM as processes, in which knowledge is constructed through the inter-dependence of firm knowledge agents and firm interactions.

## **Discussion**

One of the most fundamental reductionist assumptions with regard to knowledge in the knowledge-based small firm is that knowledge, can be transferred offering the suggestion that knowledge is objective, operating in a universal world of objectivity in which every agent thinks and understand the same. This assumes a casual relationship between experience, interpretation, and representation. CEKS arises and functions through non-linear and dynamic behaviour by viewing knowledge as dynamic; the question that arises from this is how knowledge creation and learning is effected. Within CEKS all elements are relational, Stacey (2001, pp.115-116) states “what conditions the experiences is not just what is received, but the interpretations we bring to bear on the experiences. How we represent the experiences, symbolises, and metaphase, has as much influence on the experience itself, as the experience has on the representation, symbols, and metaphors. In essence a recursive relationship occurs between the experiences and the representations that cannot be disengaged. In this context, the casual flow from the object to the experience of interpretation breaks down. We cannot separate the experiences from the representation, nor the representation from the experience.

By recognising the recursive relationship between experience and representation we begin to acknowledge the non-linear character of this relationship. Understanding knowledge as an object or resource tends to favour explicit over tacit, individual knowledge over that possessed by groups. But what an individual knowledge agent knows and the manner in which that knowledge is practiced, emerges from the interplay between tacit and explicit knowledge, and is therefore inherently indeterminate and continually emerging (Tsoukas, 1996). Knowledge, in this context needs a language in order to be transmitted, represented and shared, which is sustained by the social networks processes. From this standpoint, individual experiences are not considered in isolation, as knowledge is the product of interaction and communication. In order for experiences and understandings to be thought of as relevant knowledge, they have to be experienced as meaningful by the social collective. This emphasises how connections amongst parts of the system can enable learning and adoption. As a system the firm is able to gather information about its environment, their behaviour and then, use this information for guiding future decisions and actions.

These connections among different parts of the system allow not only for information transmission among the collective knowledge agents of the firm, but also open up the possibility of generating and sharing new meanings, thus providing the increased capability to share and develop new knowledge. By thinking in terms of the knowledge-based small firm as a social collective, comprised of diverse individual knowledge agents and their relationships this suggests that knowledge agents are able to organise themselves and the knowledge they share by their level of connections when they need to discover or share knowledge or re-evaluate their current environment in which they are functioning. The benefit of this view is the conceptualisation of the knowledge-based small firm as a structure, which is fluid, but sensitive to the needs of the connected elements, as well as in connection with its environment in such a way that co-evolution is possible. This position stresses the interactive and co-evolving nature of both the firm and the knowledge agents as well as the process of co-emergence of knowledge through the connection, interaction and relationships between diverse entities in the firm. By understanding knowledge as something constituted within a complex system of interactions, our understanding of the nature of knowledge is thus affected. Knowledge in the context of a complex firm system comes to be understood as operating in a dynamic network of interactions, a network that does not have definitive objective boundaries. This suggests that knowledge is inter-subjective, in that a firm agent cannot conceive of the subject as something prior to the network of knowledge within the firm, but rather as something constituted in the firm network. Complexity of knowledge recognises a dualism between the objective/subjective dichotomy of knowledge and knowing, the dialectical relationship which exists between knowledge and the system, in which knowledge is situated and understood. Both individual and collective organisational knowledge of the system do not exist independently, thus making it impossible to first sort out the system or context, and then to identify the knowledge in the system.

This suggests that knowledge which exists in complex systems has a history and that it cannot be conceived of without taking context into account. In the case of a simple system, traditional KM practices would achieve this, but in the case of a complex system like the knowledge-based small firm there are a number of issues. These issues are directly related to the incompressibility of the complex system because there is no accurate representation of the system which is simpler than the system itself. The issue which is alluded to, in the use of knowledge in the knowledge-based small firm, is that of knowledge boundaries, which is compounded by the dynamic nature of the interactions in the complexity of the system. Considering that the system is developed and builds upon rich interactions which are constantly changing. Any activity in the system changes the structure throughout the remaining elements in the system, and can have effects that are very difficult to predict as a result of the large amounts of non-linear interactions.

## **Conclusion**

In the current knowledge economy in which the small knowledge-based firm operates, the basic concept underpinning KM is now being contested. According to Stacey (2001), knowledge is not a thing or a system, but rather an active process of relating and interaction. In this instance no one agent can own knowledge but rather it is an emergent part of the social process of interaction. Knowledge itself cannot be stored nor can intellectual capital be

measured and certainly either of these elements can be managed. Stacey (2001) recognises the limitations of rational based thinking which currently dominated mainstream KM thinking and practices, and basis his ideas in the science of complexity. This new understanding requires the involvement and recognition that most KM in the last decade has been to all intent and purposes content management. One must look beyond trying to manage knowledge as a thing or resource but rather to understand knowledge as a social practice or process, by focusing on context and narrative as opposed to content. Traditional KM thinking and practices make the assumption that the small firm knowledge agents need to be told what to do within a timeframe and governed by objectives and constraints which are imposed on them. This is a counter intuitive practice as learning thrives best if let free to flow among agents in a system. By taking a CEKS based view of KM practices suggest firm agents are the point of focus in which learning is developed which forms a binding force of interaction between the firm and its agents in which language and dialogue is developed. The firm manager/owner must understand that reality is not static and linear but rather complex, dynamic and unpredictable. As the knowledge-based small firm has flat structure the role of the manager should be facilitating and geared towards creating an open environment of knowledge sharing where agents are allowed to share and question existing knowledge. The metaphor of the firm as a machine needs to be replaced by the metaphor of a CEKS. Instead of viewing knowledge creation and learning as a series of events and activities KM must facilitate a learning process which should be seen as an on-going process, which implies new knowledge will emerge.

Complexity science represents the study of emergent patterns of new order in what are considered chaotic or disordered systems, for example human social systems, flocks of birds, represent perceivable order systems which are in fact highly unpredictable in that they are neither centrally created or controlled rather their behaviour is emergent. By understanding the influence of complexity in human based social networks, such as the small firm could lead to favourable gains in terms of how we develop KM to produce learning based firms. In order to develop a KM practice which facilitates and develops organisational learning an epistemology of firm knowledge, that is, a theory of how learning occurs in human firms needs to be established. Complexity theory offers such an epistemological understanding on the nature and rules of cognition in the knowledge-based social firm. By understanding the manner in which knowledge evolves in the human based firm complexity theory in its perspective of complexity theory offers a framework that can define how knowledge evolves in living systems, by offering a conceptual model developed towards facilitating interaction and learning in social human networks.

Holland (1995) writes "this is more than a terminology; it signals our intuition that general principles rules complex adaptive behaviour, principles that point to ways of solving the attendant problems". To understand how knowledge naturally unfolds in living systems, complexity offers a solid foundation on which practitioners of KM can build tools and techniques for use in the real world by embracing and facilitating learning in the firm's social networks. Learning as a process relies heavily on the presence of feedback loops in the development of new knowledge – learning to view knowledge as rules produced by natural knowledge processes. By recognising that organisational are complex adaptive systems which contain groups of independent, autonomous agents, all of whom share firm goals and operate in accordance with individually and collectively held rules. These rules at the individual and collective level are in constant competition which overtime gives rise to the emergence of new rules or rules to replace old rules. Every new rule can be thought of as a new construction of knowledge which in turn leads to changes in knowledge and practice can be viewed as learning events.

The knowledge-based small firm can be regarded as a network of interdependent units in which collective and individual agents are used in working teams as their building blocks. For this reasoning relationships among these interacting agents and differing components of the firm are complex, being characterised by a variant degree of co-operation and competition. Competition amongst the agent is driven by power and scarce resource of the firm. But simultaneously these firm agents are dependent on each other in order to achieve their required tasks. Because of the degree of interdependence among the agents, how these needs are regulated is a balance between co-operation and depending on one hand and



rivalry and autonomy on the other hand. This is recognised in the need for collective groups of agents to create common frameworks of routine practices and habits, but also to capitalise and encourage difference and variety. Which could allow for creativity and learning within the collective and individual? It is through the interaction and relationships between the firm agents and their exchanges, the stories, experiences, and knowledge, are developed, maintained interpreted and transformed. The small-based firm's key resource is both the individual and collective knowledge of the firms' agents which play a central role in the knowledge creating process. Thus developing a KM strategy which allows a shared context in which individual agents can interact with each other and engage in the constant conversations on which reflection depends. This position stresses the interactive and co-evolving nature of both the firm and the knowledge agents as well as the process of co-emergence of knowledge through the connection, interaction, relationships between diverse entities in the firm (Allen, 2002). Complexity theory offers a strong conceptual focus for KM on which practitioners of KM can build tools and techniques for use in the real world. By embracing this perspective on how learning evolves in living systems methods currently employed by KM practitioners can be improved.

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