Five Grounded Principles for Developing Knowledge Management Systems

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Abstract: The practice of developing knowledge management systems in organizations is hindered by a lack of research into (a) what is a knowledge management system, (b) how to develop a knowledge management system in practice, and (c) what role (if any) information technology should play in supporting a knowledge management system. Hence the use of ad hoc, proprietary approaches by practitioners. This paper addresses this gap in research and in practice by presenting five principles from a set of 12 that that emerged through a grounded theory study of the practice of developing knowledge management systems in organizations. The paper focuses on how each of the principles (i) emerged from, and was validated in, evidence collected from developing knowledge management systems, (ii) is connected to related work in the literature, and (iii) informs the practice of developing knowledge management systems. The principles have fundamental implications for the practice and research of developing knowledge management systems in an organizational context. In practice, the principles offer practitioners useful insights into developing knowledge management systems in a way that delivers value to organizations. In research, the principles address several problematic aspects of the literature, particularly concerning divergence, fragmentation and inconsistencies in definitions for knowledge management systems, the purpose for developing knowledge management systems and the role of IT in supporting knowledge management systems. Furthermore, the paper helps distinguish between information systems, which are often used in knowledge management and knowledge management systems whose characteristics, according to the principles presented are very different.

Keywords: knowledge management, knowledge management systems, knowledge management systems development, communities of practice

1. Introduction

This paper is concerned with practice that emerged in an 8-year research enquiry into how organizations can effectively develop their knowledge management systems (KMS); the research methodology is detailed elsewhere (e.g. Moteleb & Woodman 2009) but elements are summarised in this paper as needed.

1.1 The problem of developing KMS

Personal professional observations and professional observations by knowledge management (KM) practitioners show that organizations have been facing difficulties in developing their KMS and in achieving value from their KM initiatives. These observations are supported in the work of authors such as Gallivan *et al.* (2003), Malhotra (2005), Rizzi *et al.* (2009), who reported many KM projects failing to achieve their anticipated results. This paper reports on outputs from research into the practice of developing KMS in a way that delivers value to organizations.

A review of related literature shows divergence, fragmentation and inconsistencies in the work of the few authors who addressed the subject. Divergence is apparent in definitions for KMS between a technological perspective and a social perspective on what is a KMS. Whereas, some authors such as Davenport *et al.* (1998), Alavi & Leidner (1999, 2001), Zack (1999a, 1999b), Hahn & Subramani (2000), and Chen (2004) consider KMS to be a class of information systems (IS), other authors such as Savage (1996), Rubenstein-Montano *et al.* (2001), Hlupic *et al.* (2002) and Adams & Lamont (2003) argue that KMS involve more than just IS. The literature also exposes fragmentation in addressing critical issues concerned with the practice of developing KMS that are particular to the research reported in this paper: what is a KMS in an organizational context and how to develop one in practice (cf. Rubenstein-Montano *et al.* 2001, Rubenstein & Geisler 2003), to what purpose KMS are developed (cf. Zack 2000, Malhotra 2005, Spender & Scherer 2007) and what role (if any) IT can play in supporting KMS (cf. Hahn & Subramani 2000, Hildreth & Kimble 2002). Furthermore, inconsistencies are evident in the work of some authors, such as in the influential work of Alavi & Leidner (2001) who, for instance, acknowledge that not all KMS involve IT, yet they define KMS as *IT-*

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based systems that aim at enabling KM processes in the organization. The start point of the work reported here are these confusions evident in the literature.

1.2 Research setting

This research was conducted through four action research-based projects (McKay & Marshall 2001) in two organizations. Data collected during the projects that developed KMS was using grounded theory coding (Glaser & Strauss 1967; Corbin & Strauss 2008). Detail of the selection and use of action research and grounded theory is described in (Moteleb & Woodman 2009). The latter methodology is inherently self-validating: when applied systematically, grounded theory delivers a set of grounded propositions. However, to produce validated principles for guiding practice, we chose to map those propositions to practice and to the literature that informed practice.

The first is a marketing and multimedia consultancy based in the UK referred to hereafter as ORG1. ORG1 specializes in the development of integrated marketing solutions using state-of-the-art technology from conception to delivery in areas such as design, new media and communication. ORG1 aspired to expand their services and ability to take on more clients and projects, while reducing dependency on the owner-manager. Work with ORG1 encompassed two projects representing two action research cycles spanning one year each between 2005 and 2007.

The second organization was a Franco-British recruitment consultancy that specialized in IT recruitment in Europe, referred to hereafter as ORG2. ORG2 provided a wide range of HR and recruitment services including HR and policy consultancy, HR requirement analysis and job specification, job advertising and selection, executive search and contract recruitment. ORG2 sought to enhance growth and competitive advantage using innovative business processes and IT. Work with ORG2 included two projects representing another two cycles spanning one year each between 2006 and 2008.

In the following sections the methodology for developing KMS and the principles described have emerged from practice in a theoretically and practically validated manner.

1.3 Overview of the methodology for developing KMS

The project uncovered (Moteleb & Woodman 2009, Moteleb *et al.* 2009) a fully participative KMS development (KMSD) approach to be carried out by a team from an organization usually aided by external, impartial practitioner-consultants. The resulting KMS belongs to the organization which designed and which originated it: unless an organization changes dramatically, its KMS is never completed or terminated, and its behaviour can never precisely be predicted by the organization. It is carried out either in overlapping phases or in an iterative, possibly agile style:

Phase 1 – Sensemaking the Problematic Situation is about making sense of the current, problematic situation in the organization. Because all parties need to share aims and objectives for the work, not mention evaluation criteria, this phase usually precedes the launch of a formal KMSD project and gives its rationale and targets.

Phase 2 – Envisioning an Improved Situation is concerned with collective envisioning of a desired improved situation that clearly addresses the business problems (challenges and/or opportunities) that have resulted from initial conversations in sensemaking. The focus here is still on business but from the positive perspective of constructing something new than the negative one of diagnosing problems. Here the team engages in conversations, e.g. in workshops, to envision improved situations and what it means in terms of changing business processes and work behaviour. The outcome is an explicit, continuously emerging vision of the improved situations to which an organization aspires: it is continuously emerging because it changes over and over, as other phases come into play and ideas about the future are refined.

Phase 3 – Designing a KMS is where the team proposes how the envisioned improved situation can be represented in a KMS by knowledge *agents*, knowledge *flows* and knowledge *interfaces*. Knowledge agents, are essentially 'active entities' that are capable of holding and interacting with knowledge; they include people, documents, elements of business, etc. Knowledge flows represent knowledge that is transferred between the active entities, the agents, and knowledge interfaces are the points of interaction. The concept of knowledge interfaces includes the medium for potential knowledge flows and the rules (protocols), which constrain them. So, for example, one knowledge

agent could hold knowledge about all procurement projects and a knowledge interface would link it to a supplier (another knowledge agent), with the flow defining what procurement knowledge the supplier do (or could) receive or send.

Phase 4 – Exploring IT Options for the KMS is where the team considers potential technologies to (partially) support the KMS design that has been expressed in terms of knowledge agents, flows and interfaces. Potential technical implementations are considered according to degree to which they are likely to integrate organizational, social and technological aspects of the KMS and according to cost, complexity, availability, etc. The main activities are to engage stakeholders in exploring suitable technologies to support the representation of knowledge agents, flows and interfaces and to decide on a technology strategy of buying, building, or integrating IT components and applications to support the KMS

Phase 5 – Managing the Evolutionary Potential of the KMS is concerned with ensuring that the KMS evolves in keeping with the changing organizational needs and the changing environment of the organization. Its purpose is not 'technical' in that it is not purely to do with the KMS (and its use of IT or not). It has a monitoring and maintenance function but its purpose is also to detect oncoming changes in apparent 'signals' and 'trends' and to cycle back through the earlier phases making sense of the apparent changes, envisioning new work behaviour, etc. Inevitably the owners of the KMS may decide to start a new initiative

1.4 Principles for KMSD methodology

The five-phase methodology outlined above is guided in practice by a set of principles that underpin it – that have been exposed by grounded theory methods. Indeed we consider that the term 'methodology' is only valid if philosophical principles can be explicitly stated that underpin the 'methods' used. In the following sections we discuss five of these principles that are essential for practitioners to understand if KMSD is to be carried out in a repeatable, systematic manner that offers value to organizations.

In each of the five following sections one of the emergent principles are discussed. They are compared to relevant aspects of the published literature; each discussion concludes with recommendations to practitioners for developing KMS. Allied to these principles are sets of themes and concepts, such as locating or communicating knowledge; these are mentioned in the discussions but for brevity are not detailed here.

2. Complexity principle: KMS address complexity in problematic situations

The organizational situations addressed using KMS in this research exhibited properties similar to that of complex adaptive systems, i.e. change, unpredictability and uncertainty, hence the connection with complexity thinking. Teams in both organizations, aided by external researcher-consultants, found it difficult to address complexity in their problematic situations using IS solutions. Instead, the teams realized that addressing complexity required unconventional approaches, which led to the emergence of the KMSD methodology. According to Laszlo & Laszlo (2002), complexity thinking is concerned with the study of evolving systems that engage in the self-organizing dynamics of self-maintenance, self-renewal, and self-transcendence. Like complex adaptive systems, KMS are continually evolving in situations characterized by unpredictability and the state of edge-of-chaos. Outputs of a complex adaptive system are "neither predictable from, deducible from, nor reducible to the parts alone" (Goldstein 1999). Unpredictability in sensemaking of the organizational problematic situations in this research, however, was apparent not only in difficulties in predicting outputs based on inputs to the KMS, but also in difficulties in identifying and understanding all inputs during the development process. For example, as situations were continually changing in organizations, teams found it difficult to foresee who needs to talk to whom, about what and how. Furthermore, an edge-of-chaos property indicates that complex situations can create behaviour that is neither definitely predictable nor unpredictable, because there is enough chaos to preclude all prediction, but also enough order to maintain functionality (Smith & Humphries 2004). Organizational situations studied in this research were fluctuating between states of stability and edge-of-chaos. For example, ORG1 had repeatedly been in a state of edge-of-chaos, due to their entire internal development team changing twice in two years and their external contractors continually changing.

Following on from the above relationships between KMS and complex adaptive systems, this research used concepts from complexity thinking (Richardson 2008) to interpret business processes

and work behaviours in the organizational problematic situations. Yet, the emergent methodology for developing KMS could not be entirely interpreted by, or contrasted with, concepts in complexity thinking, due to scarcity in methodologies that address complex adaptive systems in organizations. Sense-making (Weick 1995), however, is one methodology that apparently stands out in complexity thinking since it was first developed in the early 1970s (cf. Dervin 1998). This section focuses on contrasting the emergent KMS methodology with the sense-making methodology by examining concepts in Snowden's (2002) sense-making framework, "Cynefin", which we consider to be particularly pertinent in this area.

The Cynefin framework originated in the practice of KM with the aim of helping practitioners to approach complex problems in new ways based on the view that "humans use patterns to order the world and make sense of things in complex situations" (Kurtz & Snowden 2003). The framework categorizes organizational situations into four domains as illustrated in Figure 1, which has been updated from the 2003 version to use the terms Snowden now favours. The nature of situations in each of these domains is different. According to Kurtz & Snowden (2003), the right-hand domains are those of order:

- the "simple" (or "known") domain of known cause-and-effect relationships, where straightforward rules apply and predictive models can be used with certainty, as cause-and-effect relationships are "generally linear, empirical in nature, and not open to dispute", and
- the "complicated" (or "knowable") domain of knowable cause-and-effect relationships, where "entrained patterns" allow for structured models based on assumptions, as cause-and-effect relationships may not be fully known, or may be known only to a limited group of people.

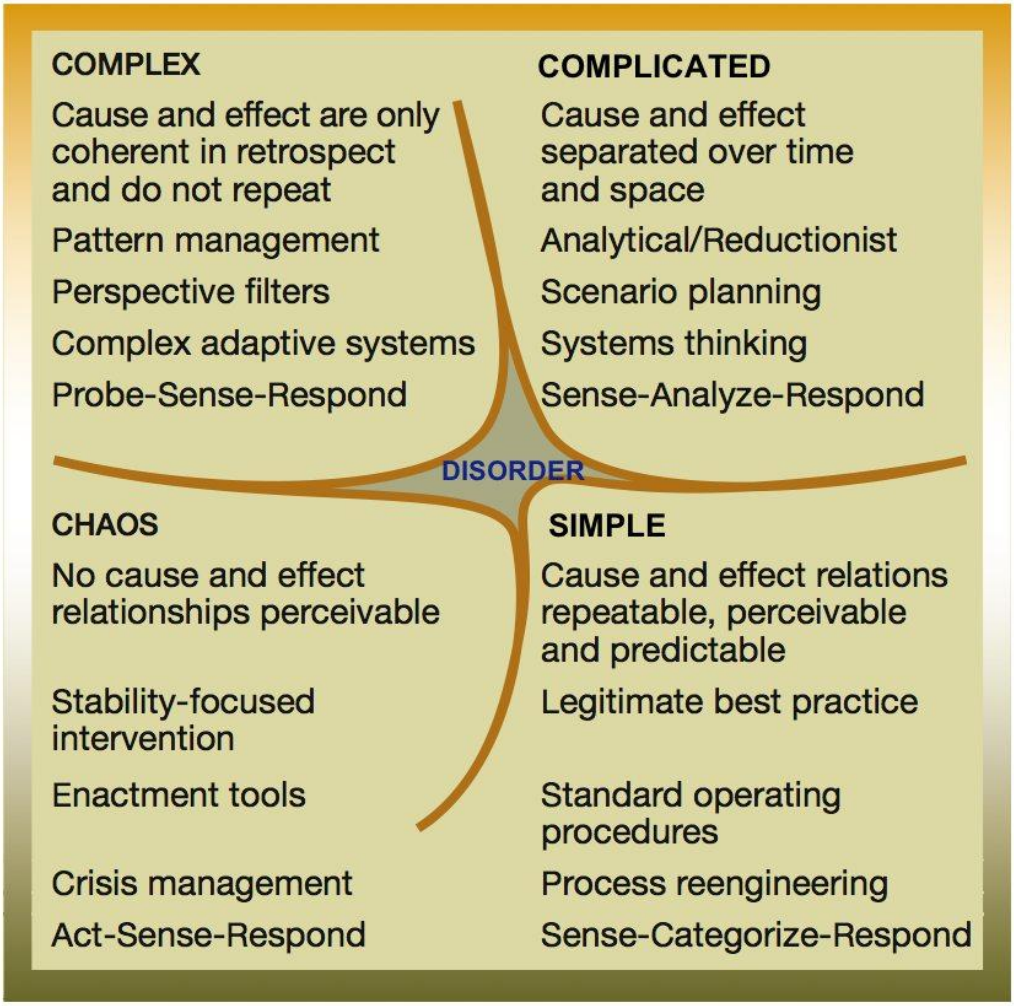

Figure 1: Cynefin domains (based on Kurtz & Snowden 2003).

Predictability in the two ordered domains makes an *information* system a suitable solution because situations in these domains mostly deal with knowledge that can be captured and embedded in formalized processes (i.e. explicit knowledge), e.g. through documented operational procedures.

In contrast, the left-hand domains are those of un-order:

- the complex domain, where cause-and-effect relationships are only perceivable retrospectively, and
- Chaos, where cause-and-effect relationships are not perceivable until the situations move to one of the aforementioned mentioned domains (Kurtz & Snowden 2003).

Thus, the complexity of situations in the un-ordered domains renders it difficult to apply simple, structured IS solutions, unless these situations are changed such that they are moved to an ordered domain, because unpredictability and change in business processes make it difficult for structured rules and procedures to apply (Markus *et al.* 2002, El Sawy & Majchrzak 2004).

In terms of the Cynefin framework, the organizational situations in this research were continually moving from one domain to another. However, the first phase of our methodology (Moteleb et al. 2009), sensemaking, positioned problematic organizational situations mainly in the complex domain (i.e. between the domains of chaos and complicated/knowable). Such situations exhibited both nonlinear relationships and positive and negative feedback. This made relationships between cause and effect distant in time and space (Stacey 2011). Furthermore, in these complex situations, "emergent patterns" can be perceived but not predicted (Kurtz & Snowden 2003), because while cause-and-effect relationships exist between "agents", "both the number of agents and the number of relationships defy categorization or analytic techniques" (Kurtz & Snowden 2003).

Thus for this first principle to have practical effect when developing a KMS, the role of the practitioner changes. The practitioner should not decide but guide a team of problem stakeholders in an organization to determine using sense-making whether a KMS would be considered as a candidate solution, based on the level of complexity in their problematic situations.

3. Non-reductionist principle: KMS are different than the sum of their parts

Phase 1 of the KMSD methodology, sensemaking, showed in the four projects that the emergent concepts in the problematic situations were interlinked and interdependent. For example, concepts such as TO IMPROVE COLLABORATION were interlinked and interdependent with concepts such as TO BUILD ON EACH OTHER'S WORK and with concepts such as REDUCING TIME TO BE PRODUCTIVE and DYNAMIC ORGANIZATIONAL STRUCTURE. Complexity in organizational challenges itself renders it difficult for teams to analyze the problematic situations by breaking them into its constituent parts (as typically practised in IS development). These two factors make it difficult to explore the problematic situations in isolation from each other. Instead, the teams, assisted by the researcher-consultants, collectively engaged in Phase 2, envisioning, to create a vision for future improved situations as a whole. The output was a holistic vision for improved future situations that clearly addressed the organizational problematic situation was being identified in the sensemaking phase (phases overlap and loop back; they are not process steps). Hence, the vision accounted for the different perspectives of the organizational stakeholders. Based on the above discussion, it is proposed that the behaviour of the KMS is different than the sum of the behaviours of its parts.

This finding is connected to the property of holism in complexity thinking (Goldstein 1999; Kauffman 1995; Richardson 2008; Sanders 1998; Stacey 2011; Thietart & Forgues 1995; Wheatley 1999). In precise complexity terms holism denotes that the behaviour of the whole is 'different' than the sum of the behaviours of its parts (Richardson 2008). According to Kurtz and Snowden (2003), the notion of holism depends on which domain a situation is located:

> *In the ordered domain … the nature of systems is such that they are amenable to reductionist approaches to problem solving; the whole is the sum of the parts ... In the domain of un-order, the whole is never the sum of the parts; every intervention is also a diagnostic, and every diagnostic an intervention; any act changes the nature of the system.*

Reducing KMS to their constituent parts in the organizational situations studied was, therefore, inadequate for understanding the behaviour of the system, due to complexity inherent in the problematic situations of these organizations. Thus, the uncovered methodology for developing KMS, like in complexity thinking, challenges conventional reductionist principles and assumptions. Principles and assumptions that dominated organizational thinking such as 'control', 'order', 'predictability', 'rational choice', 'intent', and the deterministic world of cause-and-effect, while true within some contexts, e.g. Snowden's (2002) ordered domains, they are not universally true. Instead, holistic interpretations and approaches were favoured in the studied problematic situations in this enquiry, as

KMS addressed essentially complex situations, characterized by an ever-present change, unpredictability and uncertainty.

Reviewing the three fundamental properties of complex adaptive systems in the context of the practice of developing KMS in organizations exposed the following.

- As with to the property of holism, the behaviour of the KMS is different than the sum of the behaviours of its parts. Therefore, developing KMS in practice requires organizational problematic situations to be addressed as a whole – not to be decomposed in analysis and aggregated in solution.
- In line with the property from complex adaptive systems of unpredictability, the outputs from KMS cannot be simply predicted from inputs to the system due to unpredictable interactions within the system. Therefore, 'best practice' and 'good practice' may prove successful in some situations, e.g. in Cynefin's ordered domains, but not necessarily in others. Instead, 'lessons learned' is a more applicable notion in KMS, through observing and managing trends. Moreover, inputs may not all be known at the start of the development process. What matters in sensemaking, therefore, is to plausibly formulate problems and not necessarily to accurately define them. Continual refinement in problem definitions can be reached through iteration.
- In accordance with the complex-adaptive-system property of the state of edge-of-chaos, "systems behave in a relatively stable manner until they reach a critical threshold, which represents the edge of chaos" (Smith & Humphries 2004). This movement of organizational situations means that a KMS cannot be managed in any simple sense, because complex arrangements can create behaviour that is neither definitively predictable nor unpredictable.

It follows that the behaviour of a KMS is different than the sum of behaviours of its parts. The KM practitioner, therefore, should engage a team of stakeholders in creating a holistic vision for improved situations in the future that addresses the problematic situations as a whole, and not analyse problematic situations by breaking them into their constituent parts.

4. Just-in-time principle: KMS enable just-in-time knowledge sharing

Emergent concepts in Phase 3, the design phase, showed that a KMS is about facilitating the communication of relevant knowledge to relevant users, when, where and how it is needed. As it was difficult to determine a priori what knowledge will be required by whom, when, where and in what format, the design of the KMS was kept flexible to cater for new requirements as they emerged. This finding from practice contrasts with a tendency in the literature to define KMS as the settings, infrastructure, policies, etc. required for delivering the right knowledge, to the right person at the right time and the right place (e.g. Quintas *et al.* 1997, Devedzic 2001, Hlupic *et al.* 2002).

The argument in the literature implies that an organization can pre-determine (a) what the right knowledge is, (b) who the right persons are (both the person who requests and the person who supplies the knowledge), (c) where and when the right place and time are, and (d) how knowledge is required or how it will be used. Knowledge that can be expressed (i.e. explicit knowledge) may be pre-determined in this way, but the kind of knowledge that the organizational stakeholders in this research considered to be valuable (i.e. tacit knowledge), could not be separated from its situational context, i.e. could only be determined just-in-time as situations unfolded.

In contrast with the literature, therefore, the design phase showed that KMS are concerned with on-demand, just-in-time identification of (a) relevant knowledge, (b) relevant knowledge agent, (c) suitable place and time, and (d) suitable way to communicate knowledge. This is because unpredictability, uncertainty and continual change of organizational situations make it difficult to pre-determine what knowledge will be required by who, when, where and how. This is an observation also by El Sawy & Majchrzak (2004), who argue the need for "real-time" KM to address complexity in critical, unknown issues that require "identification, interpretation, articulation and resolution" as they emerge, and hence also reinforcing the principle that KMS address complexity in organizational situations.

Research into what knowledge is in an organizational context was found useful in explaining what is considered to be relevant knowledge by the stakeholders, and how it can reach the relevant agent at a suitable time, place and in a suitable way. Nonaka & von Krogh (2009) argue that according to organizational knowledge creation theory, knowledge is defined in three parts: (i) "individuals justify the truthfulness of their beliefs based on their interactions with the world", (ii) knowledge is the

"actuality" and/or "potentiality" of "skilful action" and (iii) "knowledge is explicit and tacit along a continuum" (Nonaka & von Krogh 2009). Thus, knowledge is viewed to be the result of, and inherited in, actions and interactions of the stakeholders of the organization.

Knowledge, therefore, is contextual in that it is embedded in, and changing with actions and interactions. This knowledge can only be partially expressed (e.g. the actuality of skilful action), while part of this knowledge remains inexpressible, i.e. tacit (e.g. the potentiality of skilful action), and hence is only shared through means and media appropriate to the organizational stakeholders. However, since tacit and explicit knowledge are inherently inseparable (Hildreth & Kimble 2002, Nonaka & von Krogh 2009), the explicit part of knowledge (e.g. who holds it, in what format, how it can be used, in which context) was taken as a pointer to the tacit part. This view is supported by Nonaka & von Krogh (2009), who argue that "explicit knowledge is always grounded in tacit knowledge". Thus, successful KM initiatives need to maintain a balance between tacit and explicit knowledge (Hildreth & Kimble 2002). In this research, IT provided explicit pointers to tacit knowledge among stakeholders through the representation of knowledge flows and interfaces among knowledge agents. However, tacit knowledge was mainly communicated through non-IT means and media. Both the IT and non-IT parts formed the KMS. These findings in practice are consistent with the work of authors such as Davenport & Prusak (1998) and Hildreth & Kimble (2002), who argue that IT should be used to enable people to share tacit knowledge directly and not try to represent tacit knowledge.

The importance of context has also been addressed by "socio-technical" scholars in research concerned with IS as "social systems" (Land & Hirschheim 1983 cited in Avgerou 2001). The work of Dourish (2004) is pertinent in this area, as he takes a complexity perspective on 'context' that can be summarized by the following four statements:

- rather than considering context to be mere information, 'contextuality' is viewed to be a relational property,
- context is not pre-determined, but rather defined dynamically,
- context is not stable, but changing with the changing situation and
- Context arises from the activity, hence cannot be separated from content.

The second and third statements are particularly relevant to the principle of just-in-time KM, as the identification of relevant knowledge, relevant agents, and suitable place, time and way was determined by a situational context that was changing according to the changing situation. Accordingly, Dourish (2004) argues persuasively that "context isn't something that describes a setting; it's something that people do. It is an achievement, rather than an observation; an outcome, rather than a premise".

It follows from the above that it is imperative to design the KMS to enable on-demand, just-in-time KM. Accordingly, the team of the stakeholders of the organization, aided by the KM practitioner, should design the KMS in a way that allows on-demand, just-in-time identification of relevant knowledge to the relevant knowledge agents, where, when and how they need it. This is achieved by representing knowledge flows and interfaces among the knowledge agents, which provides the organizational stakeholders with a means to locate knowledge of value to them. This representation can be supported by IT, however the communication and interaction with such knowledge is done by non-IT means that is suitable to the organizational stakeholders and determined just-in-time as a need emerges.

5. Sociotechnical principle: KMS encompass organizational, social & IT aspects

During the design phase, and even in the sensemaking and envisioning phases, the teams were inclined to express design choices in terms of IT solutions that they knew and had been excited about. For example, management of ORG1 were repeatedly expressing their problematic situations by reference to commercial software applications that they thought were the right solutions for addressing their challenges, while management of ORG2 expressed their problematic situations in terms of a bespoke IT solution that they tried but had failed. Although IT options to support a KMS may be considered in high-level terms during the design phase; a KMS is not only about IT, but about how the organization can design the necessary set of structures, practices and interactions (i.e. the representation of the knowledge agents, flows and interfaces) required for achieving their vision for knowledge-related business practices and work behaviours in the future. Choices made in developing

KMS were thus guided and constrained by concepts (and their properties and dimensions) around locating, communicating and interacting with knowledge, as reported earlier. Accordingly, a KMS was defined as the necessary set of structures, practices and interactions, within an organizational setting of people, processes, behaviours, infrastructure, etc., which will facilitate locating, communicating and interacting with knowledge. Thus, it is proposed that KMS design encompasses organizational, social and IT aspects. In short a KMS is truly a sociotechnical system (Fox 1995).

The practice of developing KMS in organizations is primarily based on information technology (IT) and uses ideas from information systems (IS) development methodologies. This is supported by the work of authors such as Alavi & Leidner 2001, Anantatmula & Kanungo 2010, Hahn & Subramani 2000, Heisig 2009, Rizzi et al. 2009; Schultze & Leidner 2002, Zack 1999b. For example, Hahn and Subramani (2000) state that organizations have made "significant IT investments in deploying knowledge management systems (KMS)" to support their "Knowledge management initiatives". Zack et al. (1999) posit that IS consulting firms have created KM practices to implement KM in organizations. This paper Authors argue that developing KMS using IS development methodologies is not adequate because of the complexity and contextual nature of situations addressed using KMS in organizations.

The discourse in the scarce literature concerned with KMS in organizations is mainly focused on IT. The literature on what constitutes KMS and how to develop KMS in practice, shows that the authors who address the topic generally regard KMS as a class of IS and focus on IT in the design of systems solutions to apply KM in organizations (see Alavi & Leidner 2001). The practice of developing KMS in organizations in our research contrasts with this view in the literature. Although the teams of stakeholders in the four projects were sometimes inclined to express design choices in terms of IT solutions that they know and have been enthusiastic about, they realized during the development process that KMS are concerned not only with the IT infrastructure to support KMS in organizations, but also with the organizational settings of people, processes, behaviour, etc. Differences between knowledge types (i.e. explicit and tacit), as discussed in proposition III, may make a difference to how the KMS is designed and what IT options are considered to support the KMS. However, it is the organizational teams who determine this according to the unique context of their problematic situation and envisioned solution. For example, 'know what' may be easier to share inside the organization through communities of practice and it could be supported by simple IT solutions such as organizational-based social networks. However, according to Brown & Duguid (1998), 'know how' may be harder to share because it is "sticky", i.e. intimately bound to individuals, hence will not be necessarily communicated just because the technology is available.

Findings from the practice of developing KMS in the organizations studied showed that KMS design should encompass organizational (processes), social (people and their behaviour) and technological (infrastructure) aspects. This is consistent with the work of some authors and practitioners such as Davenport & Prusak (1998), Edwards et al. (2005), Gold et al. (2001), Hlupic et al. (2002) and Quintas et al. (1997). For example, Davenport & Prusak (1998) argue that KM encompasses organisational, human, and technological issues. According to Gold et al. (2001), for effective KM, a KMS should incorporate structure, culture and technology, along with knowledge process architecture of acquisition, conversion, application, and protection. Edwards et al. (2005) include other aspects such as financial, economic, and legal aspects. However, these other aspects were not considered by the teams of stakeholders in the organizations studied in this research. According to Hlupic et al. (2002) "both the 'hard', technological, and the 'soft', organizational and human, aspects are important for knowledge management". This requires, therefore, a more holistic approach that encompasses "culture, people, process and technology" (Quintas et al. 1997).

It follows from the above discussion that in designing the KMS, the team of stakeholders of the organization, aided by the KM practitioner should explore the organizational and social aspects in the KMS, in addition to the technological aspect.

6. Multiple-view principle: One view of the KMS does not fit all

In the action-research projects studied consideration of IT solutions to support the KMS design revealed that the representation of knowledge agents was perceived differently by different stakeholders and that the representation of knowledge flows and knowledge interfaces was contextual. This means that the a knowledge flow may be valid between two agents in one context, but not another and that restrictions applied to a flow in one context may not be appropriate for another. For example, the teams revealed that the same knowledge connection could be viewed

differently by either end of the knowledge connection (an individual can relate projects with similar tasks, whereas a project can relate individuals with similar expertise). Similarly, knowledge value, purpose, and nature also differed according to knowledge perspective. Moreover, these representations were changing according to the changing situations. Hence, according to the above discussion, one view, hence one representation, of the KMS does not fit all the various perspectives on the KMS by the various stakeholders.

Findings from exploring IT options to support the KMS revealed difficulties in identifying one view of the KMS that would fit all the users, or even a set of views for the different groups of stakeholders. These findings were also reinforced by a review of findings from the envisioning and design phases, which revealed that users have different perspectives. For example, during the design phase the members of the organizational teams of stakeholders exposed different perspectives on the relationships among knowledge agents, flows and interfaces.

Thus, developing the KMS with one view to fit all users, or even with a defined set of views for groups of users, not only was found to be difficult to implement due to the complexity of the organizational situations, but also was perceived to be practically useless because it contradicted with their visions for effectively locating, communicating and interacting with knowledge. These findings are supported by the work of authors, e.g. Boland & Tenkasi (1995), who argue that "producing knowledge to create innovative products and processes in [knowledge organizations] requires the ability to make strong perspectives within a community, as well as the ability to take the perspective of another into account".

These findings in practice contrast with approaches taken by IS development methodologies, which mostly aim at designing one view of the IS for a representative sample of the organizational users. According to Hahn & Subramani (2000), IS development methodologies "generally sample typical or representative users to determine requirements and perform user testing". Unlike IS development, therefore, KMS should cater for the heterogeneity of systems users. This is also a position taken by authors such as Hahn & Subramani (2000), who argue that homogeneity of systems users – with respect to their objectives in using the system – is an assumption implicit in IS development, which is not suitable in KMS. Heterogeneity of systems users is especially present in lateral flexible organizational forms, such as the ones reported in this thesis, as they rely on "peer-to-peer collaboration (as opposed to a vertical hierarchy) in achieving organizational objectives" Boland & Tenkasi (1995).

Furthermore, findings from practice showed that the different users' perspectives on relationships among knowledge agents are dynamic, changing with the changing roles of the knowledge agents and with the changing organizational situations. Each individual stakeholder assumed different identities in different roles they are performing and these identities changed according to the changing situations. For example, while a programmer in ORG1 assumed a certain identity when working as part of a team, the same person assumed a different identity when working as a project manager, for instance in dealing with clients. This is consistent with the argument by Kurtz & Snowden (2003) that "humans are not limited to one identity". Kurtz & Snowden explain that in complex systems, an agent could be anything that has identity, and these agents constantly flex their identities both on the individual level and on the collective level, and hence will behave differently in different contexts. Similarly, the Knowledge flows and interfaces were found to be contextual, and hence continually changing with change in organizational situations. According to Weick (1995) identities are constructed in the process of interaction between people.

Our findings for practice against a 'one-size-fits-all' approach can be explained in the context of complexity thinking as discussed in the first principle. Our position is consistent with the argument by Boland & Tenkasi (1995), who posit that "the multiple communities of knowing in knowledge-intensive firms overlap in complex and shifting ways, [because] there is a rich structural hierarchy of communities of knowing within the firm, and between the firm and its environment". According to (Snowden 2002), in unordered domains it is difficult to regiment people due to continuous change in views, and unpredictability and uncertainty in what knowledge will be required, by who, when and how. For example, based on the concept of holism, reducing the system to its constituent parts, in this case by sampling typical or representative users, is inadequate for understanding the behaviour, and thus the output, of the whole. These findings in practice also contrast with approaches taken in developing IS, which either enforce or support existing regimented processes or introduce new ones (e.g. precisely defining functional roles and fixing these in software).

It follows from the above discussion that developing one view of the KMS does not fit all users. Thus, a KMS, and hence the IT that partially support it, should be developed in a way that caters for complexity in organizational situations. This is consistent with the work of authors, e.g. Malhotra (2001), who argue a need for designing unconventional systems to deal with "wicked business environments that defy the programmed logic based upon pre-specification, prediction and pre-determination". The implication of this is twofold: (a) KMS should cater for the different identities, and hence the multiple perspectives, of the different instances of the knowledge agents and (b) KMS should allow for changing identities due, for instance, to changing roles of the knowledge agents. According to Boland & Tenkasi (1995), "in order for perspective taking to proceed, the diverse knowledge held by individuals in the organization must be represented in its uniqueness, and made available for others to incorporate in a perspective-taking process".

Accordingly, consideration for IT options to support the KMS should explore solutions that allow for personalized and changing perspectives of knowledge agents by enabling them to represent their networks (i.e. other knowledge agents and their relationships) as they view it, and by allowing for the representation of knowledge agents, flows and interfaces to change with the changing situations. According to Boland & Tenkasi (1995), "valuing diversity of knowledge by enabling each type of expertise to make unique representations of their understandings, and assisting actors with different expertise to better recognize and accept the different ways of knowing of others, is the foundation for perspective taking. It can be encouraged by communication systems that include an emphasis on supporting the distinctive needs of separate communities of knowing" Boland & Tenkasi (1995).

7. Summary and conclusion

For an approach to developing KMS to be termed a 'methodology' we argue that the philosophical underpinnings be articulated. This is not a matter of jargon semantics, but part of an emphasis that methods for developing KMS must always be situated in a context, which affects how the practitioner utilises the concepts, procedures and techniques needed in KMSD.

The initial setting of the work reported was four action research cycles in which business problems and research were simultaneously addressed. The grounded theory methodology was used to uncover concepts, principles and practices for developing KMS. The paper reprised the 5-phase methodology for developing KMS, the phases being: Sensemaking the Problematic Situation, Envisioning an Improved Situation, Designing a KMS, Exploring IT Options for the KMS, and Managing the Evolutionary Potential of the KMS. The paper then discussed three key principles for developing KMS:

- Complexity principle: KMS address complexity in problematic situations
- Non-reductionist principle: KMS are different than the sum of their parts
- Just-in-time principle: KMS enable Just-in-time knowledge sharing
- Sociotechnical principle: KMS encompass organizational, social & IT aspects
- Multiple-view principle: One view of the KMS does not fit all

In various ways these principles support some positions evident in the literature. In various ways they are also supported by a divergent literature that gave rise to the action research/grounded theory research methodology. However, in several significant aspects they are at variance with stances taken in the literature, particularly with conjectures and practices to do with the (often-assumed) starting point that a KMS is IT-based and a type of IS. However, these five principles are grounded in a methodology and theory of KMS that has validity because it emerged from practice within a systematically applied research methodology.

These principles have clear relevance to practitioners concerned with developing KMS: there is a need to recognize that a KMS is truly a system that does not finish, whose cause-and-effect relationships are obscure and whose predictability is low; a KMS must be designed in a way that allows on-demand, just-in-time identification of relevant knowledge to relevant knowledge agents, where, when and how they need it; multiplicity and diversity of views and hence utility should be supported in KMS. These principles all have profound consequences for practice, for management, and for IT development, especially as separately and in total they are in disagreement with the practices and principles of IS development.

References

Adams, G. L. & Lamont B. T. (2003). Knowledge management systems and developing sustainable competitive advantage. *Journal of Knowledge Management* 7(2): 142-154.

Alavi, M. & Leidner, D. (1999). Knowledge Management Systems: Issues, Challenges, and Benefits. *Communications of the Association for Information Systems* 1(7): 1-27.

Alavi, M. & Leidner, D. (2001). Knowledge management and knowledge management systems: conceptual foundations and research issues. *Management Information Systems Quarterly* 25(1): 107-136.

Anantatmula, V. S., & Kanungo, S. (2010). Modeling enablers for successful KM implementation. *Journal of Knowledge Management* 14(1), 100 - 113

Avgerou, C. (2001) "The significance of context in information systems and organizational change," Information Systems Journal, 11: 43-63.

Boland R. J. & Tenkasi R. V. (1995). Perspective Making and Perspective Taking in Communities of Knowing. *Organization Science* 6(4): 350-372.

Brown, J. S. & Duguid, P. (1998). Organizing knowledge. *California Management Review*, 40: 90-111.

Chen, H. (2004). Knowledge Management and Text Mining: Overview and case study. In *Knowledge Management Lessons Learned: What Works and What Doesn't*, Koenig, M.E.D. and Srikantaiah, T.K. (Eds). NJ, Medford: Information Today Inc. pp. 239-267.

Corbin, J. & Strauss, A. 2008. *Basics of Qualitative Research*, Sage, London.

Davenport, T. & Prusak, L. (1998). *Working Knowledge: How organizations manage what they know*. USA: Harvard Business School Press.

Dervin, B. (1998). Sense Making theory and practice: an overview of user interests in knowledge seeking and use. *Journal of Knowledge Management* 2(2): 36-46.

Devedzic, V. (2001). Knowledge Modeling - State of the Art. Integrated Computer-Aided Engineering 8, 257-281

Dourish P. (2004), "What We Talk about When We Talk about Context," Personal and Ubiquitous Computing, 8(1): 19-30.

Edwards J., Shaw, D. & Collier, P. (2005). Knowledge management systems: finding a way with technology. *Journal of Knowledge Management* 9(1): 113-125.

El Sawy, O. & Majchrzak, A. (2004). "Critical issues in research on real-time knowledge management in enterprises". *Journal of Knowledge Management*, 8(4):21-37.

Fox, W.M. (1995) Sociotechnical System Principles and Guidelines: Past and Present. *Journal of Applied Behavioral Science*. Vol 31, No. 1, pp91–105

Kauffman, S. (1995). *At Home in the Universe: the Search for the Laws of Self-Organization and Complexity*. NY: Oxford University Press.

Gallivan, M., Eynon, J. & Rai, A. (2003). The challenge of knowledge management systems: analysing the dynamic processes underlying performance improvement initiatives. *Information Technology and People* 16(3): 326-352.

Glaser, B. & Strauss, A. (1967). *The Discovery of Grounded Theory: strategies for qualitative research*. USA, NY: Aldine De Gruyter.

Gold A., Malhotra A. & Segars A. (2001). Knowledge Management: An organizational capabilities perspective. *Journal of Management Information Systems* 18(1): 185-214.

Goldstein, J. (1999). Emergence as a construct: history and issues. *Emergence* 1(1): 49-72.

Hahn, J. & Subramani, M. (2000). A Framework of Knowledge Management Systems: Issues and Challenges for Theory and Practice. Proceedings of the *21st International Conference on Information Systems (ICIS 2000)*, Brisbane, Australia.

Heisig, P. (2009). Harmonisation of knowledge management – comparing 160 KM frameworks around the globe. *Journal of Knowledge Management* 13(4): 4-31.

Hildreth, P.J. & Kimble, C. (2002). The duality of knowledge. *Information Research* 8(1): 142.

Hlupic, V., Pouloudi, A. & Rzevski, G. (2002). Towards an integrated approach to knowledge management: 'hard', 'soft' and 'abstract' issues. *Knowledge and Process Management*. 9(1): 90-102.

Kurtz, C. & Snowden, D. (2003). The new dynamics of strategy: Sense-making in a complex and complicated world. *IBM Systems Journal*, 42(3): 462-483

Laszlo, K.C. & Laszlo, A. (2002). Evolving Knowledge for Development: The role of Knowledge Management in a changing world. *Journal of Knowledge Management* 6(4): 400-412.

Malhotra, Y. (1999). Beyond 'Hi-Tech Hidebound' Knowledge Management: Strategic Information Systems for the New World of Business. *BRINT Research Institute,* Working paper

Malhotra, Y. (2001). Expert systems for knowledge management: crossing the chasm between information processing and sense making. *Expert Systems with Applications* 20(1): 7-16, (Retrieved June 20, 2008 from: www.brint.org/expertsystems.pdf).

Malhotra, Y. (2005). Integrating Knowledge Management Technologies in Organisational Business Processes: getting real time enterprises to deliver real business performance. *Journal of Knowledge Management* 9(1): 7-28.

Markus, M. L., Majchrzak, A. & Gasser, L. (2002). A Design Theory for Systems that Support Emergent Knowledge Processes. MIS Quarterly 26(3):179-212.

McKay, J. & Marshall, P. (2001). The dual imperatives of action research. *Information Technology and People* 14(1): 46-59.

Moteleb, A. & Woodman, M. (2009). Uncovering a KMSD Approach from Practice, *Electronic Journal of Knowledge Management (eJKM)*.

Moteleb A., Woodman M. & Critten P. (2009). Towards a Practical Guide for Developing Knowledge Management Systems in Small Organizations. *Proceedings of the 10th European Conference on Knowledge Management (ECKM2009),* September 2009, Vicenza, Italy.
Nonaka, I. G. von Krogh. (2009). Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organizational Knowledge Creation Theory. *Organization Science* 20(3): 635-652.
Quintas, P., Lefrere, P. & Jones, G. (1997). Knowledge management: a strategic agenda. *Long Range Planning* 30: 385-91
Richardson K.A. (2008) Managing Complex Organizations: Complexity Thinking and the Science and Art of Management *E:CO*, Vol. 10 No. 2, pp. 13-26
Rizzi C., Ponte, D. & Bonifacio, M. (2009). A new institutional reading of knowledge management technology adoption. Journal of Knowledge Management. 13(4): 75-85.
Rubenstein-Montano, B., Liebowitz, J., Buchwalter, J., McCaw, D., Newman, B., Rebeck, K. (2001). SMARTVision: a knowledge-management methodology. *Journal of Knowledge Management* 5(4): 300-310.
Sanders, I. (1998). *Strategic Thinking and the New Science: Planning in the Midst of Chaos, Complexity and Change*. NY: The Free Press.
Savage, C. (1996). *Fifth Generation Management: Co-Creating Through Virtual Enterprising, Dynamic Teaming, and Knowledge Networking*. Butterworth-Heinemann
Schultze, U. (1999). Investigating the contradictions in knowledge management. In *Information Systems: Current Issues and Future Changes*, Larsen, T.J., Levine, L. & deGross, J.I. (eds.). IFIP, Laxenberg, pp. 155-174.
Smith, A. & Humphries C. (2004). Complexity Theory as a Practical Management Tool: A Critical Evaluation. *Organization Management Journal: Linking Theory & Practice,* 1(2): 91-106.
Snowden, D. (2002). Complex Acts of Knowing: Paradox and Descriptive Self Awareness. *Journal of Knowledge Management* 6(2): 100-111.
Spender, J.C. & Scherer, A.G. (2007). The philosophical foundations of knowledge management: Editor's Introduction. *Organization* 14(1): 5-27.
Stacey, R.D. (2011). *Strategic Management and Organizational Dynamics: The challenge of complexity*. London: Prentice Hall.
Thiétart, R. A. & Forgues, B. (1995). Chaos theory and organization. *Organization Science*, 6(1): 19-31.
Wheatley, M. J. (1999). *Leadership and the new science: Discovering order in a chaotic world*. San Francisco: Berrett-Koehler Publishers.
Weick, K. (1995). *Sensemaking in Organisations*. London: Sage Publications.
Zack, M. H., Alavi M., Davenport, T., Smith, D. & Ughetta, K. (1999). Aligning knowledge management research and practice. *Proceedings of the 20th international conference on Information Systems* (panel session) pp. 561 – 562. ISBN:ICIS1999-X.
Zack, M. H. (1999a). Developing a Knowledge Strategy. *California Management Review* 41(3): 125-145.
Zack, M. H. (1999b). Managing Codified Knowledge. *Sloan Management Review* 40(4): 45-58.
Zack, M.H. (2000). If managing knowledge is the solution, then what's the problem? In *Knowledge Management and Business Model Innovation*, Malhotra, Y. (ed.). PA: Idea Group Publishing, Hershey.

