RETAINING PROFESSIONAL TACIT KNOWLEDGE AND EVIDENCE OF EXPERIENCE THROUGH ELECTRONIC RECORDS MANAGEMENT

Hui Chen[1] and Miguel Baptista Nunes[2]
[1]*School of Information Management, Central China Normal University, Wuhan, China*
[2]*School of Information Management, Sun Yat-sen University, Guangzhou, China*

ABSTRACT

The purpose of the study reported in this paper was to identify how experience and tacit knowledge can be externalized and articulated in a way that they can be the object of electronic records management (ERM) as well as establish the areas of convergence between ERM and knowledge management (KM). The study employed an inductive qualitative approach based on a single case study of a successful software (SW) development private company that specializes in SW for archive management. 25 participants from this Chinese software company were selected based on their role in SW design and development and were interviewed using a semi-structured interview script. Gathered data were analysed by using an a *priori* thematic analysis approach, which was focused on the processes of externalisation for tacit knowledge into explicit knowledge that can be used by using ERM. The findings of this research suggest that evidence of experience is best defined by story-telling and unstructured narratives that capture tacit knowledge and are then easily managed through ERM. Knowledge which is derived from experience often affects and helps to improve the performance of agents in human activity systems of all types, ranging from business organizations to social networks. However, both tacit knowledge and evidence of experience are hard to capture, represent and maintain by organizations since they reside in individual's minds rather than in information repositories. Therefore, more than theoretical research and propositions there is a need to devise clear processes to translate and externalize tacit knowledge into explicit one that can then be stored, shared and used. This study contributes to this practical and applied KM and ERM research and provides new and practice grounded insights in this area.

KEYWORDS

Experience, Tacit Knowledge Externalization, Electronic Records Management, Knowledge Management, Knowledge Sharing, Software Development Process, Chinese Software Industry

1. INTRODUCTION

Knowledge, as a unique and valuable resource, has played a significant role in allowing organizations to improve their competitive advantage (Gao et al., 2008; Amalia and Nugroho, 2011). In nowadays globalised and knowledge-based economy age managing knowledge represents a complex and crucial challenge for organizations and respective management activities (Drucker, 1992; Amalia and Nugroho, 2011). Knowledge, described as "actionable information" (Jashapara, 2004, p.16), improves decision-making, enhances the effectiveness of business actions, enables organizational creativity and therefore strengthens companies' competitive advantage. The characteristics of knowledge are complex, humanistic and dynamic and thus difficult to capture, represent and maintain for any organization (Nonaka, 2005). Bhatt (2002) claimed that only a small part of the knowledge used in business processes is held by the organization, whilst the most significant part is internalized by individuals. Consequently, Nunes et al. (2006) stressed the significance of the loss of knowledge assets when knowledgeable employees leave and propose that KM is a crucial approach to strengthen the ability of organizational management in the global competitive and dynamic environments.

The basic principle of KM is creating and sharing knowledge in organizations in both explicit and tacit formats (Renzl et al., 2005). Explicit knowledge is expressed and codified in language, data, memos, instruction manuals, reports, standard operating procedures, documents, database and records (Koskinen, 2003; Awad and Ghazri, 2004, p.47). Tacit knowledge represents the experience from the individual, expressions of dynamic human actions informed by "evaluation, attitude, point of view, commitment and emotion" (Pathirage et al., 2007, p.116). Most practitioners and academics believe that the most valuable knowledge assets are embedded in this tacit form and developed and internalized by the individual (Bhatt, 2002; Mooradian, 2005). Although Wilson (2002) claimed that there is no possible way to manage knowledge that is held in people's minds and memory, Nonaka and Takeuchi (1995) insisted from the start that this tacit knowledge can be first converted into explicit knowledge before it can be managed. This process of tacit knowledge externalisation is nonetheless very complex, since it is related with individual, interactive and dynamic human processes. Consequently, tacit knowledge is hard to capture, represent, share, disseminate and maintain by the organization.

As Sanderson (2001) proposed, ERM can arguably be seen as the best method for documenting externalised tacit knowledge provided that, as suggested by Stover (2004), this knowledge can be structured through an effective process of codification into explicit knowledge and then managed in a digital repository. This type of explicit knowledge management is a well-developed practice in most organizations and includes all kind of records, ranging from earlier practices based on traditional paper-based records to more current approaches based on electronic records (Lindvall et al., 2003). This does not necessarily equate with traditional database technology, neatly structured around Boolean logic and well-defined records, but rather related to a more heterogeneous conceptualisation of digital repository models as proposed by Lappin (2010), which may include heterogeneous document repositories, which may contain emails, training materials, internet memos, formal documents and reports (Nunes et al., 2006).

However, these concepts of ERM and KM are often discussed in isolation. Even though some authors (e.g. Sanderson, 2001; Stover, 2004; Gregory 2005) and government institutions (e.g. UK Public Sector) have tried to connect ERM with KM, these two concepts are still generally discussed independently at a theoretical level and are not always clearly integrated in

the knowledge and information management processes in the world of practice. The link here seems to be obvious and as proposed by Gregory (2005), ERM systems that collect and manage expertise and professional knowledge have the potential to become "a centre of knowledge, expertise and excellence" for the organisation. Nonetheless, the real problem of translation of such conceptual insights into practice has always been in the difficulty of operationalising highly theoretical concept of tacit knowledge, which is closely associated to not very clearly defined concepts such as experience, into tools (ontologies or classifications) that can be used by the more technically minded and pragmatic practitioners of ERM. Therefore, there is a need to study and enable such a bridge with the aim of identifying relationships between KM and ERM, establishing the areas of convergence as well as identifying how experience and tacit knowledge can be externalised in ways that are suitable to be exploited by ERM. This is of particular concern in the SW sector, one of the industry segments with highest staff turnover and lowest company survival rates.

2. SUMMARY OF LITERATURE REVIEW

There is an abundant and solid body of literature and research focusing on KM and ERM, but these two areas are still being dealt at very high level and rarely directly linked with each other or serving the operational needs of the very specific organizational environments where they are needed. This paper aims at establishing a bridge that will enable a structured approach to the transference of tacit into explicit knowledge, so that it can then be systematically managed and exploited by ERM. The literature review was used as a process of theoretical sensitization as proposed by Nunes and Al-Mamari (2008), that is, served to help understand the theoretical context for the research and define the basic concepts around electronic records, ERM and knowledge.

2.1 Electronic Records in Organizations

2.1.1 Background of Electronic Records

As Shepherd (2006) proposed, there is a need for organizations to treat records as a significant asset in the success and competitiveness of the business. Saffady (2009, p.3), in particular, qualified electronic records as "indispensable information resources for daily operations, as well as long-term planning and decision-making" in most organizations. Both authors highlight the important position that records occupy in a business context, no matter what forms they may have. Importantly, almost all business transactions depend on the proper creation and maintenance of recorded information and consequently for the last three decades organizations have allocated the highest priority to their IT investments in the automation of organizational records (Penn et al., 1994; Shepherd and Yeo, 2003). Digital electronic records are seen as the "most valuable and authoritative" sources of operational information (Saffady, 2009, p.19). In most cases these records far exceed their predecessors in paper documents, by including information that is selected, filtered and aggregated. This view is reinforced by British E-Government Policy Framework, which stressed that electronic records "unlock the content previously difficult to access in paper form, enable more effective sharing of information and contribute to knowledge network flows" (Public Record Office, 2001, Executive summary, p.2).

2.1.2 Nature of Electronic Records

Smith (2007, p.23) described records as:

> *"Recorded information regardless of form or medium created, received and maintained by any organization or individual in the pursuance of its legal obligations or in the transaction of its business and providing evidence of the performance of those obligations or that business". (Smith, 2007, p.23)*

The ISO 15489-1 (ISO 2001, Clause 3.15), the first international standard for records management providing the guidance for international organizations, governmental and non-governmental sectors, gave a less encompassing but more precise definition of records:

> *"Information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in the transaction of business". (ISO 2001, Clause 3.15)*

As a worldwide international standard, ISO 15489-1 provides a universal framework for the understanding of "records", which identifies and stresses a consistent view on the informational value of data and legal evidence of organizational activities (McLeod, 2003; Oliver and Foscarini, 2015). It also provides a clear process for handling of active information and historical information within the record's lifecycle. Therefore, important emergent standards, such as the DOD5015.2-STD (Department of Defense 2002, DL1.1.65), published by the Department of Defence of United States; the MoReq2 (model requirements for the management of electronic records) issued by European Communities; and authors such as Saur (2005) have acknowledged, taken advantage of, used and even adopted the initial propositions by ISO 15489-1. In particular, the processes of records movement, including active and historical information, represent explicit corporate memory, which are significant for sharing, managing, and reusing in organization (Saur, 2005; Public Record Office, 2001).

Referring to the electronic format itself, there is a variety of definitions from different perspectives. Smith (2007, p.21), and the MoReq (2001, Clause 2.1, p.11) described electronic records as records in electronic means rather than physical forms. Similarly, Saffady (2009, p.230) defined electronic records as "record that contains machine-readable, as opposed to human-readable, information." These definitions are viewed from the perspective or means in which the records are created, stored or transmitted.

Smith (2007, p.21) also stressed that the format of electronic records can "consist of one or more objects, e.g. web page, file, folder, e-mail or document". It is clear that these views adopt a direct metaphor to explain records as documents. However, Shepherd and Yeo (2003, p.12-15) are very cautious in their explanation that "not all documents are records".

According to the description given by Moreq2 Specification (2008, Clause 2.1), a document is "recorded information or object which can be treated as a unit". It claims that a document is unstructured information, which forms a basic communication device by collecting and representing data. Unlike documents, electronic records have a more rigorous process of structuring, management and examination and can contain information that may be structured or unstructured. Management of structured electronic records is normally associated with the use of databases (relational, distributed, etc) and information systems that exploit these databases support users in storage and retrieval processes. On the other hand, as

proposed by Saffady (2009, p.12), management of unstructured electronic records in the organization is rarely systemically considered or even recognized as a need. This is of course a dated statement in the changing and rapidly evolving world of information systems and unstructured, text base digital repositories are not at all uncommon. In fact, many databases today include facilities to store free text and digital objects and database designs are increasingly aware of the need to include this type of information. However, it is in the retrieval of these objects that developments are needed, namely by using metadata, meta-tagging (e.g. XML) or direct digital analysis of the objects, such as text, voice, face or even iris recognition.

2.1.3 Nature of Electronic Records Management

Since records can provide strong evidence and reference for organizational functions requirements, decision-making, business operations and other activities performed by individuals, groups and organization, it is important to manage them systematically (Shepherd and Yeo, 2003), especially since electronic records are valuable, authoritative, numerous and varied (ISO 2001; Lemieux, 2016).

ISO 15489-1 (ISO 2001, Clause 7.2) describes "authoritative records" as having the four main characteristics of authenticity, reliability, integrity, and usability. The updated revision ISO 15489-1 (ISO 2016, Clause 5.2.2) particularly emphasis on the use and reuse of records in the digital word, that the efficient, effective, economical and systematic management of records should make sure of these four characteristics given above. ISO 15489-1 (ISO 2016, Clause 3.15) therefore stated a definition of records management as a:

> *"[...] field of management responsible for the efficient and systematic control of the creation, receipt, maintenance, use and disposition of records, including processes for capturing and maintaining evidence of and information about business activities and transactions in the form of records" (ISO 2016, Clause 3.16).*

Since it is a universal standard, the concepts put forward by ISO apply to both paper-based and electronic records. However, the management of electronic records is more complex, since it involves IT and therefore requires a full systems analysis of requirements and functionality. As Smith (2007, p.21) proposed, an electronic records management system (ERM) is:

> *"[...] a system that manages electronic records throughout their lifecycle, from creation and capture through to their destruction or permanent retention, and that retains their integrity and authenticity while ensuring that they remain accessible." (Smith 2007, p.21)*

This systematic management of electronic records offers organizations standard processes and workflows to ensure accountability and responsibility over maintaining evidence of business activities and transactions in the form of records in order to store as asset for business benefits.

2.1.4 Stages and Phases of Electronic Records Management

The lifecycle of records is a significant foundational understanding in the theoretical conceptualisation of records management process that ranges their creation to their disposal. The National Archives of the USA have firstly introduced the concept of "life cycle" into recordkeeping systems and to the archives community in 1934.

> *"[A record] has a 'life' similar to that of a biological organism in that it is born (creation phase), it lives (maintenance and use phase), and it dies." (quoted in Hare and McLeod (1997, pp.2-5) and Penn et al. (1994, p.12))*

This analogy with biological life is both vivid and clear pointing out that records have several birth-to-death stages. This concept of "lifecycle" as a theoretical framework has been firmly established and widely used by records management practitioners and academics. However, this framework is also not without controversy. There is a long ongoing debate on the usefulness of lifecycle management in regards to electronic records. Barry (1994) pointed out the lifecycle concept treated records as tangible objects and physical entities in an immobile paper world. The nature of electronic records is dynamic, active and changeable. Sometimes pertinent actions and activities on electronic records may happen in more than one stage of lifecycle simultaneously. For these reasons, a new concept of "records continuum" was proposed and defended by National Archives of Australian (1996) in dealing with electronic records in order to replace the "lifecycle":

> *"A consistent and coherent regime of management processes from the time of the creation of records (and before creation, in the design of recordkeeping systems) through to the preservation and use of records as archives." (National Archives of Australia 1996, Part1: Clause 4.22)*

2.2 Knowledge in Organizations

2.2.1 Nature of Knowledge

In order to understand the concept of knowledge, it is necessary to distinguish the related concepts: data, information and knowledge. There are numerous discussions on the conceptualization of these three terms. It is obvious that organizations have faced problems of data inundation during the emergence of electronic data in 1960s (Grover and Davenport, 2001; Gunnlaugsdottir, 2003). Data can be described as unorganized and unprocessed facts, a set of discrete facts about events (Davenport and Prusak, 2000). But, data needs to be organized, processed and reformatted, in order to be useful, that is transformed into information (or explicit knowledge). Therefore, information is "data provided of relevance and with a purpose" (Drucker, 1988). Business transactions are processed, classified, aggregated and stored on a daily basis. Consequently, the volume of data created is very high and often requires further synthesis, aggregation and processing into information. Information refers to "shaping the data to arrive at a meaning in the eyes of the perceiver" (Awad and Ghazri, 2004, p.36) which has purpose related to the context.

Knowledge is interpreted information based on individual's beliefs, organisational culture, and industrial environment, that is, knowledge is information put into operational use in a specific context. Thus, deriving knowledge from retrieving and selecting information is a crucial approach to manage information (Kogut and Zander, 1992; Awad and Ghazri, 2004, p.37). Knowledge is more than just the processing of information and should be considered as "the highest value, the most human contribution, the greatest relevance to decision and actions, and the greatest dependence on a specific situation or context" as well as "the most difficult of content type to manage" (Grover and Davenport, 2001, p.6). These definitions emerging from theoretical propositions or practitioner experiences and needs, highlight the importance and value of knowledge and its relationship with the more established manageable organizational assets of information and data. However, knowledge is a more complex and dynamic concept, one that philosophers have been debating, describing and explaining for over two millennia. Hence, there is still no commonly agreed definition on how individual cognition results in knowledge and or even the nature of knowledge in itself. Therefore, it is important for the purpose of this study to establish the research's team clear position on these issues.
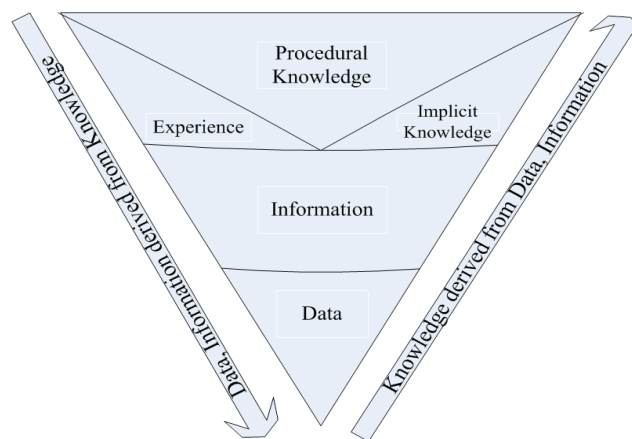

Figure 1. Extended model of the Jashapara (2004) proposition on data, information and knowledge

In terms of understanding the nature of knowledge in human activity systems such as organizations, Figure 1 presents an elaboration and improvement of the model originally proposed Jashapara (2004, p17), which relates and integrates experience (tacit knowledge that derived from experience), procedural and implicit knowledge that are important for this study. This model incorporates Jashapara's (2004, p.17) dual relationship between knowledge generation and information, but adds complexity to the knowledge component that is required by this study. It is theorised here that implicit knowledge and procedural knowledge are forms of explicit knowledge and that experience and tacit knowledge are fundamental elements in individual's cognition alongside explicit knowledge. The following sections will discuss and attempt to characterize these different types of knowledge and relate them to the work practice in organizations.

2.2.2 Types of Knowledge

There is consensus on the typology of knowledge in KM literature, which can be traced from the logical behaviourist school of thought. From this perspective, knowledge can be categorized into two main types: explicit knowledge (know-what) and tacit knowledge (know-how) (Polanyi 1966; Nonaka and Takeuchi, 1995). Salmador and Bueno (2007) define tacit knowledge, as values, ideas, customs, routines, emotions and experiences that are difficult to formalize and externalize. On the other hand, explicit knowledge can be expressed in language, data, instruction manuals and other documents and records. Explicit knowledge can be processed, transferred and transmitted from individual to individual, as well as from organization to organization. It is immediately apparent form these two definitions that due to its more precise nature the later type of knowledge is much easier to capture, store and manage than the former.

However, this dichotomy in the conceptualization of knowledge is often viewed as an over simplistic division. There are other propositions, such as Choo (1998) who has identified three types of knowledge: tacit knowledge, explicit knowledge and cultural knowledge. Nunes et al. (2006) identified a different knowledge typology, which includes tacit knowledge, explicit knowledge and implicit knowledge. Awad and Ghazri (2004, p.44-45) introduced another approach of categories into knowledge which contains procedural knowledge, declarative knowledge, semantic knowledge, and episodic knowledge. On a more pragmatic note, Boisot (1998) developed a knowledge typology based on four different types, which consists of personal, proprietary, public knowledge and common sense. Wiig (1993) proposed yet another variant classifying knowledge into four types: factual, conceptual, expectational, and methodological. More recently Chen et al. (2019) proposed somatic and cultural knowledge as drivers for tacit knowledge acquisition.

From all these propositions it became clear that authors differentiate knowledge types according to the contexts of their studies, the needs created by specific research questions and their own epistemological positioning. Another conclusion that clearly emerges from these very different propositions is that the different types of knowledge are not necessarily different from each other, but are rather overlapping and at times complementary. Moreover the two generic types (explicit and tacit knowledge) proposed by Nonaka and Takeuchi (1995) are seem to be a very broad dichotomy that encompasses almost all of the other types, but exactly because of this broad nature lacks in detail and fine gradation that is required in most research projects.

This study aims at studying KM in an industrial sector and therefore, as proposed by Nunes et al. (2006), aims to study the knowledge that is contained and "hidden within procedures, management and work practices of the organizations" of that sector. When an individual or group participates in organizational events or activities, experience as an outcome is acquired through the practitioner's actions and an increased understanding and reflection on what factors led to success and those that put the activity at risk. Experience is accumulated when action happens in a series of events. Knowledge that is derived from this experience will then affect and help to improve the performance of the next action or series of events (Awad and Ghazri, 2004, p.93). The experience of a specific practitioner is normally acquired continuously and through repetitive series of events. Based on the argument from American philosopher John Dewey (1938, p.35), experience "takes up something from those which have gone before and modifies in some way the quality of those which come after". Furthermore, in Dewey' theory of experience increased understanding and tacit knowledge acquisition are an individual and continuous process.

"As an individual passes from one situation to another, his world, his environment, expands or contracts. He does not find himself living in another world but in a different part or aspect of one and the same world. What he has learned in the way of knowledge and skill in one situation becomes an instrument of understanding and dealing effectively with the situations which follow". Dewey (1938, p.44)

Consequently, the present experience is also influenced by the interaction between previous experience and current situation. Therefore, the definition of experience adopted for this study includes the experience accumulated during current work practice as well as knowledge and understandings used in previous environments. As such, experience is in individuals' minds, is very complex by nature and therefore difficult to share. Knowledge emerging from experience is therefore tacit and it is a fundamental success factor in organizational activities and, as such, should be captured, codified and shared across the organization. Experienced individuals and the tacit knowledge accumulated during their professional practice are the key contributors to the good performance of organizations. Whenever people leave and this tacit knowledge is lost, organizational memory is reduced (Carley, 1992).

Table 1. Industry Knowledge Taxonomy (Chen et al., 2019)

Types of Knowledge	Traditional Representation of Knowledge		Origin	Epistemological Scope
	Tacit Knowledge	Explicit Knowledge		
Implicit Knowledge		√	Sector	What is the knowledge that is necessary to work in a sector? (e.g. quality standards, methodologies, methods, tools, etc.)
Procedural Knowledge	√	√	Organization	What is the knowledge that is necessary to work in an organization? (e.g. process handbook, organizational norms, organizational culture, etc.)
Experience	√		Individual	What is the knowledge that individuals recall and use to work?

Table 1 synthesizes the basic epistemological theoretical foundation adopted for this study and expands Nonaka and Takeuchi's (1995) traditional dichotomous propositions. This proposition is based on the cross relationship of explicit and tacit knowledge with three other different types of knowledge:

- Implicit Knowledge –refers underlying knowledge and understandings pertaining to the subject domain(s) of a specific sector. This knowledge is usually well-understood by individuals and groups in operational conditions, but very often neither specifically explained nor described. Moreover, practitioners in a particular field take this knowledge for granted and do not have the cognizance of or feel the need to express it explicitly. This knowledge is contained in the routines of professional activities from a group, and as a knowledge asset, has the explanatory potential to help the organizations to create, understand and exploit successful innovations both in product and in procedures (Smedlund, 2008). Organizations need to be more

careful in the process of codification and articulation of implicit knowledge according to Smedlund (2008, p.68), who proposes a "decentralized network structure" for managing this type of knowledge. In fact, implicit knowledge may become a severe problem if internal perceptions of what is used in a particular sector does not follow closely the evolution of the sector and becomes outdated. This could originate a mismatch between what is perceived to be accepted practice in the organization and what is actually required in the sector. Importantly, the more experienced the practitioner, the more convinced they are that they are aware of accepted practices. This assumption can very often be incorrect.

- Procedural Knowledge - The knowledge that is specific to each organization within the sector and is both explicit and tacit in nature (Chen et al., 2012). Procedural knowledge is considered as "an understanding of how to do a task or carry out a procedure" (Awad and Ghazri, 2004, p.44). More specifically, procedural knowledge is often related to information technology in order to enable activities such as "design modelling, problem solving, system approaches, project planning, quality assurance and optimization" (McCormick, 1997, p.144). Therefore, practitioners in organizations require procedural knowledge that informs them how to perform organizational tasks or carry out professional activities in the context of the organization they are working in. However, procedural knowledge in use in an organization depends closely on the knowledge that exists in the particular sector where the organization operates. This sector specific knowledge is used by the organization as implicit knowledge, i.e. knowledge is taken for granted in the sector and "which is hidden within procedures, management and work practices of the organization" (Nunes et al., 2006, p.106). This implicit knowledge directly influences, informs and limits procedural knowledge (e.g. quality standards, universally adopted methods, ethical constraints, etc).

- Experience - The individual knowledge of the employees within the organization that emerges from their active engagement in their specific work practices (Chen et al., 2012). Tacit knowledge can only be acquired and obtained through human experience (Nonaka, 1994; Lam, 2000). Experience enables experienced individuals or experts to deal with complex situations much more efficiently and effectively. When an individual or group participates in organisational events or activities, experience as an outcome is acquired through the practitioner's actions and an increased understanding and reflection on what factors led to success and those which put the activity at risk. Experience is accumulated when action happens in a series of events. Knowledge which is derived from this experience then affects and helps to improve the performance of the next action or series of events (Awad and Ghazri, 2004, p.93). The experience of a specific practitioner is normally acquired continuously and through repetitive series of events. Based on the argument from American philosopher John Dewey (1938, p.35), experience "takes up something from those which have gone before and modifies in some way the quality of those which come after". Furthermore, in Dewey' theory of experience (1938, p.44), "as an individual passes from one situation to another, his world, his environment, expands or contracts. He does not find himself living in another world but in a different part or aspect of one and the same world. What he has learned in the way of knowledge and skill in one situation becomes an instrument of understanding and dealing effectively with the situations which follow". Consequently, the present experience is also

influenced by the interaction between previous experience and current situation. Therefore, experience in this study includes the experience accumulated during current work practice as well as knowledge and understandings used in previous environments. As such, experience is in individuals' minds, is very complex by nature and therefore difficult to share. Knowledge emerging from experience is therefore tacit and it is a fundamental success factor in organisational activities and, as such, should be captured, codified and shared across the organisation. Experienced individuals and the tacit knowledge accumulated during their professional practice are the key contributors to the good performance of organisations. Whenever people leave and this tacit knowledge is lost, organisational memory is reduced (Carley, 1992).

Implicit and procedural knowledge seem easier to capture and manage, experience on the other hand is mostly associated with tacit knowledge and results from individual expressions of dynamic human actions such as "evaluation, attitude, point of view, commitments and emotion" (Pathirage et al., 2007, p.116). Therefore, since it results from individual and dynamic human processes, these are hard to capture, represent and maintain by the organization. Moreover, what component of these experiences, perspectives and emotions are deeply rooted in the context of the very different organizational sectors, settings and cultures as well as and requiring an in-depth understanding of specific operational needs. Maybe due to this complexity, there are very few studies actually addressing the association between tacit knowledge codification and experience.

This paper aims to provide an early response to this lack in the literature by providing a categorization of experience associated with tacit knowledge in the SW sector in China. It is expected that this categorization will help define and identify what aspect of professional and personal experience should be captured and represented as tacit knowledge so that it can be codified, classified and shared in the real working practice.

3. RESEARCH METHODOLOGY

3.1 Research Question

There is little doubt that the software industry is a knowledge-intensive industry (Dingsoyr, 2002). It is also evident that successful KM implementation can improve the development of software, support in facing of changeable business environments, enable transitions to new and constantly emergent technologies as well as very high personnel turnovers that characterize the sector (Dingsoyr, 2002; Mishra and Bhaskar, 2011). Therefore, in the form of a SW Company described below, influenced and shaped the research question for the study that was formulated as follows:

> *How can experience (tacit knowledge) be preserved through electronic records management (ERM) within the working practices of the software/IT industry in China?*

3.2 Research Design and Approach

In attempting to respond to the above research question, this study employed an inductive qualitative research approach and a research design that consisted of a combination of critical literature review and a case-study.

3.2.1 Research Design

This study began with reviewing literature which provided a lens to identify those issues that were important to examine and needed to be studied (Creswell, 2003). Therefore, this study reviewed literature from academic journal publications, conference proceedings and public reports on the two main areas of interests: Knowledge, KM, ER and ERM. The findings of the literature study provided three major conclusions:

- There is a lack of research that explicitly studies the links between electronic records management and KM.
- Since there is no existing theory linking these two concepts, the study should adopt needed to take an inductive approach that would allow theory to emerge from the data collected.
- Finally, it became apparent that it was necessary to use an exploratory case-study approach so that the theory could be grounded to the reality of practice.

In response to these conclusions the overall research approach selected as a combination of case-study and an interview based a *priori* thematic analysis as proposed by King (2004). This research did not literally use "template analysis" in the strict sense proposed by King (2004), but a more purist thematic analysis as a way of coding and representing qualitative data. Data here meant the interview transcripts. Coding meant the identification and interpretation of themes and sub-themes identified in the data. Representation meant the production of conceptual maps which summarized and linked the themes identified by the researchers and organized them in a meaningful and useful manner.

The a priori themes were identified using the knowledge management assessment tool (KMAT) developed by Jager (1999). The KMAT is designed to help organizations to undertake rigorous assessment of their knowledge management practices and therefore is particularly appropriate to respond to this study's research question in the context of the case-study. This model proposes five assessment factors:

- Leadership: emphasis to use knowledge management to reinforce the organizational strategy and core competences. Knowledge management has to be compatible to the way the organization is managed.
- Technology: represents how the organization facilitates communications between individuals. Information and communication technology can be used to collect, store and disseminate information.
- Culture: reflects that establishing a collaborative and sharing culture in the organization is critically important.
- Measurement: focuses on how the organization quantifies its knowledge capital and how the knowledge assets are implemented.

- Process: concentrates on the action steps of create, identify, collect, adapt, organize, apply, and share knowledge.

These five factors were taken as the a *priori* categories for the thematic analysis employed in this the qualitative investigation. These a priori categories formed a framework that was used in directing the processes of data collection tool development (interview script), data gathering (interview) and analysis (*a priori* thematic analysis).

3.2.2 The Case-Study

In order to respond to the research question, this study adopted a single case-study of a private SW company, specifically the Electronic Records and Archives Department of the Beijing based UNIS Software Systems Co Ltd. (UNIS Archives). UNIS researches and develops video surveillance systems, storage systems, platform software, and other such as archives software. UNIS Archives' business is centred on developing and exploiting electronic archive systems as well as providing professional consulting for digitalisation of archives management. Examples of UNIS Archives' projects are the "Digital Archives Management for the Jiangsu Electric Power Enterprise" and the "Information Management Platform of the Chinese State Grid Corporation". In recognition of their contribution to the field of archives in China, UNIS Archives has been granted the "Best Operational Systems" award by the National Archive of China.

There were two main reasons behind the selection of this UNIS Archives Company as case study. Firstly, the company is specializing in archive management systems and that meant that the participants have sufficient understanding and knowledge about ER, and are acquainted with the process of ERM. Secondly, the one of the researchers had experience working in this company and still retains good contacts that enabled access to the company. This made UNIS Archives an ideal case-study.

3.2.3 Data Collection and Analysis

Semi-structured interviews were used as the data collection technique to gather in-depth data (to respond to the research question). The structure was guided by a *priori* categories discussed above. Interview questions themselves were based on open-ended questions, which enable the researcher to focus on the significant questions and to elicit substantial perspectives, opinions and ideas from the interviewees. All questions were originally developed in English and then translated into Chinese. The English questions aimed at allowing discussion of structure and design among the predominantly English research team. The Chinese translations are used to interact with informants during the interview process.

Overall, there were 25 participants. The sampling was devised so that informants from the SW development practitioners in the company, namely: one share holder, two managers, six project managers, nine SW developers, one human resource and one salesman. All Interviews were conducted in Mandarin Chinese, interview processes were digitally recorded and then transcribed and codified.

As discussed above gathered data were analysed by using an a *priori* thematic analysis as proposed by King (2004). Data were examined and interpreted, coded and constantly compared against themes and concepts that emerged from the theoretical framework. The NVivo SW was used to support this analysis. All data used in this paper was anonymised in order to protect the identity and privacy of the interviewees.

4. RESEARCH FINDINGS

The SW industry has long been recognized as a knowledge-intensive industry (Dingsoyr, 2002). This type of company is usually characterised by opposition to the more traditional labour-intensive or capital-intensive companies (Nunes et al., 2006). As discussed by Chen et al., 2018) from a KM perspective, the knowledge intensive nature of the SW companies leads to significant risks:

- there is a crucial reliance on tacit knowledge;
- there is a high risk of loss of knowledge and efficiency due to high turnovers of staff;
- there is a high vulnerability due to fast rates of change.

The difficulty is that since tacit knowledge resides in the minds of individuals (Alavi and Leidner, 2001) and results from individual's experiences and understandings (Marwick, 2001), it is therefore hidden or non-verbalised; intuitive and unarticulated knowledge (Cavusgil et al., 2003). The efficiency and productivity of effective project managers, designers and programmers is therefore not only related to technical skills but also to individual's insights, hunches, intuitions and skills that are highly personal and difficult to formalize, and as a result are hard to communicate or share with others (Nunes et al., 2006). This was clearly expressed by interviewees, especially by programmers that want to progress in their careers:

"Well, after having visited the various provincial subdivisions of our customers, I think the communication and negotiation with customers and language and presentation skills are very necessary, In the past, I think the technical capability was the most important, but now ... (smiles) ... I think that other aspects of the profession are much more important. At his stage [of my career] I think the ability of communication is essential." (I11.3.24.PM)

"In fact, in the working in our global society, no matter studying or work, all depends on the communication between people. Therefore, this communication is particularly important. In fact, during the process of SW implementation, only about 30% of the work needs technical capacity, and 70% needs negotiation and communication skills. Communication skills are particularly important." (I23.5.14.PM)

There is therefore clear evidence that UNIS Archives' staff and managers have clear understanding that tacit knowledge and experience are crucial. Moreover, as noted by Chen et al. (2019) as a result of a study of SW practitioners' knowledge sharing, SW professionals are "continuously in need of learning, refreshing and accumulating tacit knowledge, partly because it is required by their companies, but also due to a sound awareness of continuous technical and technological changes that only to increase with the advances of information technology". Nonetheless, SW practitioners may be very good at sharing technical knowledge and tacit knowledge related to technical problems or solutions, but the same cannot be said about all the wider setting of their professional activity. That is, sharing tacit procedural knowledge and experience as defined in Table 1. This may be due to disproportionate technological focus as expressed by several of the programmers:

"Each time we produce code and materials for one job, we will collect that code. These are the things we collect. If we need to use this code again, we retrieve it, modify a little bit, and then re-use it. There is no need to code everything from the start to the end. This would be a waste of time. Because this is code you used before, if you keep it, you do not need to code it again. This you can also share with others." (I14.5.1.D)

"I think that in order to improve my work efficiency, I do not want to repeat coding for similar modules. Yes ... I do not want to repeat programming for functions that I or others have previously developed, and use the code in the libraries I already have. I share these with others [...]. This is a perfect method to improve efficiency in software development." (I18.5.31.D)

Despite acknowledging the importance of these "other aspects of the profession" (I20.5.23.D), programmers seem to be particularly uninterested or unable to share this type of knowledge that is more tacit in nature and therefore more difficult to express. One of the programmers gave a poignant statement of why he would not normally share experience, revealing a certain level of insecurity and self-belief to justify it:

"Personally speaking, [I would not share] because I have not reached to a certain level. However, if other people have needs [and ask me], I would be happy to share my own experience. Although I cannot share with colleagues here, because I might have the least working experience when compared with others." (I17.8.6.D)

Leadership at UNIS Archives recognised this problem as crucial:

"[For a company], the tacit knowledge [from individuals] will be useless if it is not transferred into explicit format. It would not become explicit knowledge if we just verbally talk about it. The company's tacit knowledge is all hiding inside individuals' minds. If it can be converted into explicit [knowledge], it will become an intangible asset of a company and not so easily lost." (I15.9.8.M)

Therefore, the company created a "collaborative system" (I17.11.15.PM), which is available through their intranet and staff can use to share stories, experiences, reports and even annual self-assessment reports as well as to communicate internally within the organization. Because the system is in essence a web-based content management systems (CMS) operated through web-based forms. Although the externalisation of the tacit knowledge is made through stories, narratives and self-reflection, these are recorded with a specific structure, key words, project identification, etc. So, it could be seen generally as an ERM system. The explicitly stated purpose for this "collaborative system" was one of maximising experience and resources by creating an adequately documented repository that can be used widely across the organisation and "save time and save the costs of the projects indirectly" (I6.9.33.D).

"We need to pay attention to recording code, technology or design ... or even negotiation solutions that we have used in one project, and categorize and document them as well. [...] Then, when we have a similar project next time,

we can just search for them and use them directly. If we have documented them properly we will be able to re-use them easily, if not [if not properly categorized, systematically stored] … no use!" (I5.7.12.M)

In order to further study this "collaborative system" the research team used the KMAT assessment tool as discussed above.

4.1 Leadership

In a previous similar study, Chen et al. (2011) found that top management support for KM and ERM strategies is crucial for the success of this type of initiative. Chen et al. (2011) defined this support in terms of the "spirit of encouragement and motivation" that results from "management buy-in and ownership" of the KM and ERM initiatives and strategies. This support is all the more necessary if the initiative attempts to externalise tacit knowledge and preserve it in the format of electronic records. This was found as well in UNIS Archives where leadership showed clear evidence of not only support, but also of sound understanding of the basic concepts behind the strategies.

The main objective of UNIS Archives is to be the top Archives/ERM SW provider in the Chinese region. Customers can be found in a wide range of sectors, such as electricity, communications, energy, finance, insurance and other large group of enterprises and institutions all over mainland China (around 10 provinces).

"Well … first I think we have a very bright future in development, because we are primarily focused on China's Power Grid Project. Therefore, the business is basically guaranteed. Second, the social security and remuneration for employees are relatively good. Most important … are the benefits for employees' travel. Because our company's general headquarters are in Fujian. As you know, the projects from the State Grid are basically located all over the country. So we need run over everywhere … even to some subordinate units of the provincial companies. This poses difficulties and expenses, but … (smiles) … gives us an extraordinary advantage over others that only work in Beijing for instance." (I11.6.20.PM)

During the process of SW development, experience is "formed in people's minds" (I11.14.6.PM). Management of UNIS Archives see their broad base of customers nationally and the very diverse experiences that their staff are exposed to as their main competitive advantage over smaller more local companies. Therefore, several informants, noticeably the managers, expressed that it was important to transfer the tacit knowledge that is created in their employees' minds as the result of these diverse experience into explicit formats. Otherwise "when this person moves into another company, the knowledge asset would be lost" (I8.9.12.D). This is viewed by managers as fundamental in an industrial, sector like the SW industry, where rates of staff turnover are dramatic.

Having established the need record and manage knowledge about these different business environment, the company (mostly due to direct initiative of their CIO) created the "collaborative system" described above in order to accumulate individual knowledge and expertise that may sustain the company market position. Staff is required to share past experiences, solutions, negotiations and other stories, which are formalized, structured and formatted into what can be equated as electronic records.

> *"I need to encourage our employees to record their experiences. They input all their experiences into the system themselves. We also have a people that manage the system and defines access to these stories. They transform shared knowledge into records in a standardized format. They also make all records available on our system." (I15.10.1.M)*

> *"They do it because we give them a related bonus at the end of year. Otherwise ... they would not do it. Programmers only like to share code and technical things. They also do not like to write or do what is in their mind they think is wasting time. We need to give them incentive or they will not do it." (I8.15.2.M)*

These statements clear show that not only are managers extremely interested in the creation and success of the "collaborative system", but that they are keenly aware of the characteristics of their staff and have created and put in place a corresponding reward and recognition systems. This deep understanding of KM and ERM and management ownership of the initiative is uncommon in the SW industry. This seems to be due to the archive and ERM settings focus of the company, which requires a different epistemological and theoretical lens when compared with more conventional business and decision making SW.

4.2 Process and Technology

In support of the explicit KM strategy described above, UNIS Archives has created a number of tools to enable and support the desired knowledge-intensive environment. In terms of support for experienced based tacit knowledge externalisation and preservation, the company relies on their "collaborative system" as it was referred to by all interviewees. The research team asked if there was an official name for the system, but apparently this is how it is generally referred to in the company.

> *"In order to encourage them to share their experience, we ask them to post articles of shareable knowledge on our company collaborative system." (I25.8.40.M)*

This system was built based on the company's proprietary CMS platform. Basically, it is available to all staff through their intranet. Stories, narratives, reflections, comments are submitted using structured web forms (title, author, project, key words as well as open text boxes), this are then vetted by the authorised staff who checks for appropriateness, ethical issues, privacy and confidentiality. Submissions are then made available at different levels of hierarchy. Once submissions are available online, other members of staff can comment and often very intense discussion ensues from different interpretations of situations or different technological perspectives. Employees in the different geographical locations (different locations in mainland China) may therefore share experiences about projects in similar business projects. Some very successful contributors become very popular among a work force that is composed by hundreds of programmers, analysts, designers, configuration managers and archives experts. This seems to have become a significant additional extrinsic motivation factor.

"If my experience could be recognized under certain circumstances ... I think I would want to share. But I think this knowledge will not be necessarily recognized by others. [...] So ... Yes, before sharing, I still would have some considerations and hesitations." (I13.11.17.D)

These stories were supposed to be submitted during project review periods and after project or stage completion. That was the guidance provided to staff. But analysis of using the system for more than 5 years, has revealed that staff is now submitting stories whenever something unexpected or interesting happens during their participation in projects. This more concise story telling seems to attract more attention than global project self-reflections.

Moreover, the CMS also collects and stores end of the year individual self-assessment reports. These are now being made public to the entire company. Surprisingly, this is not seen as a breach of privacy but as an opportunity to share. This may be counter-intuitive in the West, but in the context of this company in China it seems to work positively. One of the project managers illustrated how he used the chance afforded by having to do this document to reflect and share his experience with his colleagues:

"I have shared [my experience with colleagues] through my annual report of working in the company. In the report, I write the real story and practical experience I gained through the year ... not just something copied from the Internet. The knowledge that I have now written down comes from my insights [of working in customers' implementation sites], and this was good opportunity that I had [...] to recall my memory about the working practice and reflect upon it ... and also ... that I had the courage to write these down properly." (I10.4.4.PM)

As mentioned in this quotation the self-assessment is produced annually at the end of the business year and requires employees to make a self-reflection of their activities during the year, highlighting positive and negative aspects. As per company prescription, this report needs to have at least 50% negative self-criticism, not just a self-congratulatory summary of their work and performance. This may a specific Chinese characteristic, but certainly one of value in terms of preservation of knowledge associated with problems, difficulties and barriers encountered. These documents are then made available internally through what is perceived to be a part of the "collaborative system" with the aim of allowing the sharing of experiences and work practices among all employees.

Therefore, in this study, the "collaborative system" is composed by extremely simple technological solution that associated to an adequate and well supported process results in an effective ERM system that successfully supports experience based tacit knowledge to be externalised and shared. It seems to be very successfully operated in UNIS Archives and appears to have gained the strong interest and support from both management and developers.

4.3 Measurement

Individual experience, as an intangible asset, is always hard to measure. UNIS Archives managers proposed developed a formula that measure the quality, effect and use of knowledge submitted. This formula is then used in the assignment of bonuses at the end of the year, It is

an important tool, that was explained and demonstrated to staff. In quantitative terms it includes numbers of reads, number posts in response to the initial submission (sometimes weeks of discussions, sometimes zero posting) and in qualitative terms citations of submissions in other submissions, project reports or annual reports. This data is collected directly from the CMS. This metrics seems to make sense if the company sees these submission records as the basic solution to enable the externalizing of tacit knowledge into the records that are supposed to be of used in a tangible way.

> "These contributions by [posting articles] are part of their performance evaluation. The evaluation depends on the volume of articles, and most importantly, the utilization of the articles by others. If people who read an article think it is good, they give a feedback, such as a word or an expression picture [emoticon]. We can then assess if this is a useful article. Positive numbers of contributions, give extra scores at the end of the annual job performance evaluation." (I25.8.41.M)

The measurement at UNIS Archives is largely related to peer perceived value of the posted records in storage. If use and knowledge retention are the primary aim, this measurement process seems to be quite reasonable and a example of good practice.

4.4 Culture

Pressed, encouraged and supported by management, the "collaborative system" seems to have created a culture of sharing knowledge and experiences. It became apparent that interviewees generally accept the strategy of knowledge management and they believe that this externalization of knowledge can "save time and save the costs of the project indirectly" (I6.9.33.D). However one of the interesting aspects of the culture created around the "collaborative system" is a shared understanding in the company of the value of experience and it transcends mere technical knowledge.

> "That is right. When the technological ability has reached to a certain level, you need to explore the other abilities to grow. There is no way to say that your technological skill has reached the top. But after this skill reaches a certain level, for the personal development, I think there are many aspects to pursue, like analysis skills, communication with customers, negotiation of requirements, presentation and reporting skills. These we need to share amongst ourselves to learn and progress." (I11.3.30.PM)

It is therefore clear that employees accepted and interiorised this knowledge sharing culture in UNIS Archives and are well motivated to create, manage, share and use experience and knowledge through the "collaborative system". Knowledge sharing was defined as "a process of exchanging ideas and exchanging opinions, which can produce new knowledge" (I2.15.7.D). Moreover, knowledge sharing with other experts and informed individuals was seen to enlarge the influence and increase the value of knowledge itself.

> *"Well, sharing knowledge ... of course ... it is important. For example, when you play chess with a senior player, your skill will get better; if you play chess with a lower junior, your skill will only get worse. And if all the masters of chess players could talk to each other, and share some experience, then they could only gain more knowledge ... (smiles) ... this is the value-added of knowledge." (I15.6.19.D)*

> *"If sharing with others, you may get something different from other people. It is a process of exchanging and overlapping, which can produce new knowledge." (I2.15.7.D)*

Staff also seems to understand this culture positive and distinctive characteristic of the company.

> *"This is a process of understanding the sharing. When I just joined this company, I learned from my work by myself and did not share with others. But after a period of time, I found out that I was wrong. Because after working here for a period of time, I found that all the techniques I learned by myself, I could find on the web. This web collaborative system is a big platform where everyone can share their thoughts and reflections. If have a new piece of knowledge, and you have another new piece of knowledge. If we share with each other, then I will gain two pieces of knowledge. If I am selfish and you are also selfish, then I believe that it will be difficult to progress just by looking into the Internet." (I14.3.11.D)*

Programmers also seem to have acquired a quasi-philosophical understanding of knowledge that is somewhat unexpected in an extremely technical context such as the SW industry. Examples of these espoused values from the company's culture.

> *"Knowledge and experience are unlimited and tremendous like the sea. In order to deal with the infinite experience, there is a need to identify and classify it through the system. Following this identification and classification, you can easily create and use this knowledge, like using the drawers for our clothing." (I25.28.17.M)*

Finally, the "collaborative system" was clear seen a central focus of the sharing culture. In a workforce that is by professional bias extremely pragmatic, the existence of the platform as a focal point, associated with clear support by management seem to have become the keys for success in creating this sharing culture.

> *"If company can provide a good a platform for people to share and obtain information, it will be really useful. For example, you can log on the platform, and gain other people's knowledge. I think it is real good for individuals in their work within the company." (I11.14.12.PM)*

"Ah, our company is ok. Sometimes, when New Year is coming and the work is relatively less than before, then the boss will give us time to think and post on the system. He sometimes ask us to talk and share our own experience with others before posting." (I13.3.10.D)

In sum, UNIS Archives success in establishing a thriving knowledge sharing culture starts with a very good awareness by management about the process of externalization and interpretation of tacit knowledge into explicit. Decades of focusing on archives SW also enabled them to a strong understanding both of the value of a knowledge repository and the need of an appropriate ERM system, which can then be record, store, preserve and disseminated these individual externalisations.

Their solution is elegant, technologically simple and easy to implement. The combination of this straightforward solution with a with a sound human resource management approach resulted in an organisational culture that embraces knowledge sharing organically.

Theoretical purists could argue that a CMS system is not an ERM system. That this approach may not be a real tacit knowledge externalisation process as it misses socialisation as proposed by Nonaka and Takeuchi (1995). But industrial companies do not deal with complex theoretical constructs, they address real world problems pragmatically and according with available resources, tools and pragmatic solutions. The "collaborative system" adopted by UNIS Archives is an excellent example of a real world process of transforming evidence into records, while making an effort to understand the complex concepts of experience and tacit knowledge. This is an excellent example of translation of theory into practice.

5. CONCLUSION

The case-study presented in this paper offers a real-world example of theory transfer into practice through the exploitation of combined ERM and KM practice-based approach. The collaborative system presented, analysed and discussed is a good example of an ERM system that was conceived, designed, implemented in-house to support KM. In fact, the use of ERM not only supports the very difficult processes of externalization of individual's tacit knowledge, but also brought some unexpected benefits. This study shows that use of ERM also enabled the establishing of a clear and well understood view on how experienced based tacit knowledge can become an important asset that is useful, sharable and reusable. Although there is a clear system of reward put in place, staff seems to be particular interested in the implicit reward associated with the recognition of expertise and seniority among peers. This seems to be an interesting finding and not entirely in accordance with traditional KM theory. The ERM system put in place seems to have enabled a productive process of organizational learning, as well as a clear mechanism for the measurement of the quantity and quality of knowledge. Finally, the ERM system enabled management and employees to understand the value added of knowledge management.

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