The Need for a Robust Knowledge Assessment Framework: Discussion and Findings from an Exploratory Case Study

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Abstract: The primary aim of this paper is to highlight the need for a robust Knowledge Assessment Framework (KAF). The development of a KAF is important for organisations for three reasons. Firstly, the use of knowledge assessment allows firms to pinpoint knowledge gaps. Secondly, it allows firms to manage knowledge more effectively. Thirdly, it gives organisations a diagnostic tool with which to gauge their knowledge base. The effective management of knowledge can be considered a competency that enables a greater level of service to be extracted from other resources within the organisation. The results of this study highlight several points for organisations interested in understanding their knowledge base. The analysis moved beyond simply looking at the framework itself and offers some interesting insights.

Keywords: knowledge, knowledge management, knowledge assessment framework, case study

1. Introduction

This paper will be divided into two parts. In part one, the paper will discuss the need for a robust KAF and some criticisms of the current OECD approach to knowledge assessment. In part two, some of the key findings from deploying a KAF at firm level will be discussed. This research was carried out in Ireland between January 2009 and December 2010 in two medical device organisations. For reasons of confidentiality, the medical device organisations used in the case studies will be referred to "Medi-case A" and "Medi-case B". Any individual responses from employees used in this paper will also use pseudo names. Though there were twelve key findings in the original research, this paper will discuss five, due to paper length and restraints. Knowledge indicators in the past have proven too broad and methods have proven unsuccessful in trying to understand the complex activities that make up an organisation's knowledge base. Furthermore, it is imperative that firms in the high-technology sector encourage knowledge assessment because it is an important part of understanding the fabric of the organisation. To achieve this, however, a better understanding of the indicators of knowledge is needed. This is an area for further research.

The debate persists as to the manageability and measurability of a concept such as knowledge − whether all forms of knowledge (tacit/implicit/explicit) can be managed and of the compatibility of the terms knowledge, measurement and management. Studies seem to focus on general conceptual principles of Knowledge Management (KM) and KM initiatives (Spender and Scherer, 2007; Hahn and Subramani, 2000). They offer few insights in the area of knowledge assessment as a means to try and assess knowledge gaps or to explain KM phenomena. A narrow focus on performing outputs deprives inquiry of self-reflection and critical scrutiny (Zining and Sheffield, 2006). Moreover, KM literature has focused on internal sources of knowledge generation and has not sufficiently taken into account the measurement of this stock internally or externally as a way of learning about an organization's knowledge intensity. The literature, therefore, lacks a holistic view of the concept of organizational knowledge indicators and the management of them. As McAdam and McCreedy (1999: 92) state, "*given the change and emergent nature of the field over the past two to three years, it is now an appropriate time to try to have a more in-depth enquiry into KM discourse to attempt to clarify how KM can be more beneficially researched and applied to organizations*". The motivation for this research rests on exploring more effective ways of assessing and managing knowledge at organizational level. This will be achieved by using KM to derive a conceptual framework and operationalize it using exploratory case studies at organizational level.

This paper aims to contribute at a practitioner level. One of the outputs of the research will be more effective KM insights that can lead to better strategies and practices for organizations in the public and private sector. It is important that firms are aware of the importance and significance of knowledge assessment at firm level. In addition, organizations will have an opportunity to improve their understanding of their knowledge base and in turn their best practice when managing

knowledge. They will be able to identify where in the organizational structure knowledge is performing poorly and develop strategies to enhance their strengths and counter weaknesses. Reports will be presented to both companies used as case studies following the analysis of the data gathered.

A further contribution of this research is in its adoption of a case study approach. An in-depth interview approach; which dominates qualitative case study-based research found in KM literature (Peng et al., 2012; Davenport, 1997; Martiny, 1998), will be employed. KM is considered to be a "*soft*" and often "*abstract*" discipline (Fitzgerald and Howcroft, 1998; Allee, 1997). The application of the qualitative approach to answer criticisms of OECD approaches will allow for an in-depth study of knowledge assessment at organizational level. This will provide a richer, analytical and empirical base for KM initiatives within companies. Also the development of research probes for future research in this area will prove useful. In future research, quantitative methods, by their nature, could aid in new studies and facilitate replication (Peng et al., 2012; Gill and Johnson, 1997) among other organizations.

The main focus of the paper is the presentation of a KAF and its exploration at organizational level. The study will use the findings from the framework to best inform areas of KM while also aiming to offer new ways of looking at knowledge indicators. The research will further our knowledge of KM by extending the understanding of knowledge assessment under that umbrella. The study's focus is on knowledge assessment at organizational level, and also is an exploratory departure for KM-based research in Ireland (Moffett and Humphreys, 2012; OECD, 2006; 1996a; Lev and Daum, 2003; Wagner and Sternberg, 1991), which will progress the understanding of manageable and measurable forms of knowledge. The research will contribute to KM literature as it offers critical analysis of the literature and, in doing so, reveals both ongoing debates within the literature and inconsistencies regarding the definition and conceptualization of knowledge and the characteristics of manageable knowledge. A critical analysis of the literature confirms inconsistencies relating to the conceptual and definitional issues surrounding knowledge. The research findings will highlight how organizations create and share knowledge and will give the reader an opportunity to obtain some indicators of knowledge, or at least a better understanding of the indicators. It is proposed that the identification and operationalization of the indicators of knowledge within the case firms will offer a deeper understanding of assessment at organizational level. The key objectives of the paper are as follows: 1.) Discuss the need for a robust knowledge assessment framework. 2.) Present five case findings that highlight the more critical areas that the KAF was able to explore.

1.1 Background

KM, since the early 1990s, has established itself among practitioners and academics as an area of study for ensuring organizational competitiveness and, ultimately, longevity. U.S. spending alone on KM initiatives grew by 16%, to account for $73 billion in 2007, according to a report by AMR research (McGreevy, 2007). As a discipline, however, KM shows immaturity. A plethora of definitions for the term Knowledge Management exist with the only consensus seeming to be that it refers to organizational knowledge and ultimately leads to organizational competitiveness. The OECD recognizes that "*knowledge management practices seem to have a far from negligible effect on innovation and other aspects of corporate performance. But there is little systematic evidence of just how great an effect knowledge management has. Among the various categories of knowledge-related investments…knowledge management is one of the areas about which little is known in terms of quality, quantity, costs and economic returns*" (OECD, 2004:1).

KM, as a discipline, has been somewhat limited in its attempts to comprehend its underlying and fundamental concepts; in essence, it is striving to manage what it does not fully understand. Some authors in the area who have studied the concept of knowledge and management have realized that the terms are indeed mismatched (Alvesson and Karreman, 2001; Malhorta, 2002; Wilson, 2002) or have been too broadly used (Ruggles, 1998; Wilson, 2002). What is needed is a classification of the types of knowledge that, firstly, can be managed and, secondly, impact on organizational performance and even classification of the types of KM. Researchers seem to have difficulties in defining what KM or knowledge is and "black box" the issue (Moffett and Hinds, 2010; Lloria, 2008; Alvesson and Karreman, 2001). Writing in the area of KM comes from both academic and practitioner sources with some seeing the field as one driven by consultancy companies rather than academic research in which there is a disconnect between the theory and practice (Wilson 2002). Each needs to inform the other sufficiently. The field of KM does however, originate from a worthy base – an

economically fuelled recognition of the growing importance of knowledge as an input to the organization when compared to the traditional material inputs "*as free natural resources and cheap labor are exhausted, the last untapped source of competitive advantage is the knowledge of people in organizations*" (Davenport, 1997: 191).

To date, KM has predominantly focused on the existence and importance of knowledge internal to the organization as evident from KM definitions. Bassi (1997) defines KM as the process of identifying/ creating, capturing and applying organizational knowledge to exploit new opportunities and enhance organizational performance. Research in the area of KM has tended to focus on knowledge workers (Drucker, 1959), knowledge organizations (Sveiby and Risling, 1986), and knowledge creation and sharing (Nonaka, 1991; 1995; 1998; 2007) within these organizations. Research, such as Matusik (2002) and Appleyard (1966), attempted to create a typology of knowledge external to the organization, although increasingly, research has showed that knowledge is dispersed outside the firm's boundaries and among other companies, customers, suppliers, universities, national labs, industry consortia, start-up firms and individual minds (Chesbrough, 2003). Given the importance of knowledge in all areas of daily and commercial life, it stands to reason that organizational knowledge, both internal and external, should become part of any organization's KM strategy. As Ruggles (1998) states "*KM is more than just a sales pitch. It is an approach to adding or creating value by more actively leveraging the know-how, experience and judgment resident within, and in many cases, outside of an organization*" (p.80). Other important aspects of KM that are worth noting are absorptive capacity (Cohen and Levinthal, 1990), interorganizational relations (Doz and Hamal, 1998), and resource-dependency theory (Pfeffer and Salancik, 2003). These aspects also should be acknowledged for their perspectives on internal and external organizational knowledge.

The variety of terms is a problem that Alvesson and Karreman (2001) dub the "*relabeling effect*". The tacit/explicit dimension was one of the first distinctions of knowledge to be made in organizational literature. The distinction has its roots in the work by the philosopher Ryle (1949: 25). He distinguishes between the "*knowing that*" of theory and the "*knowing how*" of practice. Polanyi (1962, p.56) further expanded on this to discuss the two inseparable aspects of knowledge: "*knowing what*" and "*knowing how*". Based on Polanyi's work, Nelson and Winter (1982) introduced this tacit/explicit distinction into the organizational literature when they defined tacit knowledge as "*knowledge that cannot be articulated*". Tacit knowledge has a personal quality and is deeply embedded in action and context, making it difficult to formalize and communicate. Kogut and Zander (1992), who discussed information and know-how, state that information is defined as knowledge that can be transmitted without loss of integrity. One of the syntactical rules for deciphering are known, while know-how is based upon Von Hippel's (1988, p.76) definition, "*know-how is the accumulated practical skill or expertise that allows one to do something smoothly and efficiently*". Explicit knowledge is that which has been codified and refers to knowledge that can be transmitted in formal, systematic language.

In 1962, Arrow offered an explanation of tacit knowledge as knowledge which is not easily captured in transferable form, but is acquired through observation or interaction, or simply learning-by-doing. In 1994, Von Hippel added to this idea that as the holder of tacit knowledge is unaware of or unable to express what they are doing, tacit knowledge tends to be sticky, and therefore is best transferred through direct experience. Both Arrow (1962) and Von Hippel (1994) are seen to echo Polanyi by referring to a master-apprentice relationship similar to mentoring in organizations, while Gertler (2001) argues tacit knowledge can be transferred both internally and externally through communities of practice. Polanyi (1966; 1969) posits that knowledge exists on a continuum ranging from tacit to explicit. By his definition, tacit knowledge is knowledge that cannot be articulated. As Polanyi (1966: 4) states "*we know much more than we can tell*". Polanyi uses the example of the bicycle to describe the difference between tacit and explicit knowledge (Cook and Brown, 1999). He posits that tacit and explicit are forms of knowledge at each end of the continuum. Each form of knowledge can often be used as an aide in acquiring the other; however, neither tacit nor explicit knowledge can be used solely to acquire the other. Explicit knowledge cannot by itself enable one to ride a bicycle, and it does not by itself enable a rider to decide which way to turn (Cook and Brown, 1999). Polanyi also offers the example of a person's ability to recognize a familiar face in a crowd as testament to the nature of tacit knowledge. "W*e know a person's face and can recognize it among a thousand ... indeed a million ... yet we usually cannot tell how we recognize a face we know*" (Polanyi, 1966: 4). Tacit knowledge can, however, be communicated in situations of close physical proximity over a long period of time, such as in master-apprentice relationships. Though, it is questionable whether the actual version or interpreted version of the master's tacit knowledge is transferred. Whether tacit and explicit

knowledge are two distinct forms of knowledge or on opposite ends of a continuum is one area of debate amongst researchers. In Ryle's (1949) framing, he described them as two distinct forms of knowledge. Brown and Duguid (1998) adapted a similar view as they propose that "*know-how*" is different from "*know-what*". Polanyi (1966) and Taylor (1993) posit that tacit and explicit knowledge exists on a continuum. Tacit knowledge provides the background understanding on which an individual's explicit knowledge rests.

As the KAF will attempt to explore knowledge at organizational level it is worthwhile then to explore the dimensions of knowledge. Since its connection with the organizational learning literature, research in knowledge has continued to grow. In the KM literature, researchers have tended to focus their discussions on two dimensions of knowledge: the tacit/explicit dimension and the individual collective or group dimension (Cook and Brown, 1999). Spender (1996a) argues the best way to comprehend the concept of knowledge is to understand the different types of knowledge. The various definitions of knowledge offered, point to the existence of two basic kinds of knowledge:

- That which is internal to the person (embodied) (Nickols, 2000) or practical skills, encultured knowledge as argued by Alvesson and Karreman (2001).
- That which has been articulated (disembodied) (Nickols, 2000).

2. The need for a KAF

As highlighted by the OECD (2006) and Lev and Daum (2003), there is no control, census or assessment framework to give an understanding or to gauge knowledge at organisational level. The OECD has developed macro-level indicators; however, these on their own are not sufficient enough to explain complex knowledge activities at firm-level. In addition, a consistent picture of knowledge only can be achieved by combining several indicators (Kurtossy 2004; Sirilli 1992; Grupp 1990). The OECD has recognised the importance of knowledge assessment and that organisations are now more strongly dependent on the production, distribution and use of knowledge than ever before. It is also recognised that in order to facilitate any kind of knowledge assessment, distinctions have to be made between different types of knowledge (know what, know who, know why, know how) that are important to the knowledge-based organisation (OECD 2006; 1996a). Knowledge Management (KM) is useful in this regard. In 2004, the OECD's study on the significance of KM suggested that KM practices are being used more frequently, but it also recognises the association between such practices and innovation and productivity, even if the link is not that well understood (Brinkley, 2006). There is consensus within the literature that accepts that knowledge can be assessed indirectly, using impact indicators that the OECD (2006, 2002b, 1996a) has suggested (Kurtossy 2004). The indicators presented by the OECD are, however, aimed at the macro-level of evaluation and based upon higher-level knowledge performance. The importance of knowledge in the modern economy has been established (Forfás 2011a). The OECD (2006, 1996a) has suggested, along with writers in other disciplines (Lev and Daum 2003; Wagner and Sternberg 1991), that there is no company knowledge record, census, or assessment instrument that can gauge knowledge at the organisational level. In the absence of such a tool, the OECD has presented certain indicators for knowledge. These indicators do not necessarily enable an organisation to provide or account for an organisational knowledge base; however, they do create a starting point with which to build upon. Indeed as early as the mid-1990s (OECD 1996a), it was established that there were several key reasons why knowledge indicators, no matter how carefully constructed, could not approximate the traditional quantifiable economic indicators. These reasons are: 1) There is no stable formulae or recipe for translating inputs into knowledge creation into outputs of knowledge; 2) Inputs into knowledge creation are difficult to map; 3) Organisations lack systems that can serve as a basis for aggregating pieces of knowledge that are essentially unique; 4) The obsolescence of knowledge is not documented; therefore, the creation of new knowledge is not documented. The OECD suggests in its various reports that only through improved understanding of knowledge indicators can the knowledge-based economy and the knowledge-based organisation truly benefit. The indicators are: Knowledge Inputs, Knowledge Stocks, Knowledge Networks, Knowledge Learning and Knowledge Outputs. The OECD has made several recommendations with regard to knowledge assessment. The primary conclusion the OECD makes is that the present understanding of what is happening in knowledge organisations is constrained by the extent and quality of the available indicators (OECD 2007a; 1996a). It is also suggested that while advances are being made in theories and methodologies, these will not be fruitful unless they are applied to the right data. The OECD (2002a) advised that more qualitative work is needed in the form of case studies and field studies to produce the "right data". Indeed, traditional frameworks were designed in an era when organisations and economies were simpler and the role of

knowledge was not fully acknowledged (OECD 1996a). As a result "*this measurement framework is not offering reasonable explanations*" and "*the effects of networks, the role of tacit learning ... are among the phenomena which presently elude us*" (OECD 1996a:43). To fill these gaps research is needed that must improve, extend and provide new knowledge indicators. The OECD (2002:85) calls for "*the development of relevant indicators*". A clearer picture of knowledge at organisational level must be achieved. Because of the central role of learning in organisations, it also is recommended that there is a need for new indicators for learning.

2.1 Criticisms of the OECD approach

Intangibles, by nature, are difficult to measure. The primary criticism of the OECD's indicators is not the indicators themselves, but that they are based primarily around broad, "fuzzy" macro terminology and that they are predominantly quantitative in nature, without taking into consideration other more suitable approaches to knowledge assessment (Brinkley 2006; Godin 2004:18). The problem in developing these knowledge indicators is in itself an indication of the unique character of the knowledge-based economy. Firms need to escape the conventional concepts and measures used to track knowledge phenomena. They need to do this to fully understand their knowledge base. One of the primary justifications for this research is that the OECD has acknowledged this and has suggested that these quantitative statistics are not enough on their own (OECD 2002a). It has become increasingly clear that indicators such as knowledge inputs need to be examined within the realm of a more qualitative-based approach (OECD 2002a). The effects of knowledge on the business cannot be determined exclusively by financial assessment linked to a pyramid of ratios (Prieto and Revilla 2005). Only field studies provide unlimited access to accounts of personal experience (Zinning and Sheffield 2006). Quantitative methods are not always applicable to all research questions (Karami et al 2006). Qualitative research provides valuable insights and understanding of the problem setting (Zining and Sheffield 2006; Karami et al 2006), and this research presents "*consistent definitions, discourses and concepts*" that are needed in KM research (Zining and Sheffield 2006: 1). A significant obstacle to adequate knowledge assessment is that many firms create enormous amounts of indices that are difficult to maintain and update. By using knowledge indicators derived from the OECD and operationalising them using KM, the research findings presented in this paper may be used as a foundation for future studies. A 2007 report on the worldwide use of 25 management tools, by consultants Bain and Company (Burton-Jones 2008:4), claimed that, based on usage, "*knowledge management tools*" (defined as "*systems and processes to capture and share*") have moved up from 21st place in 1996 to 8th place in 2006, ahead of tools such as the balanced scorecard. Paradoxically, the same report claims these tools were rated by users as being among the least effective (Burton-Jones 2008). Covin and Stivers (1998) found that while 63% of CEOs believe intangible measurement is important, only 10% were using the results for the formulation of strategy. This may mean firms are developing the wrong indicators. Research found Irish firms (Burton-Jones 2008; Brennan 2001) are making little progress in actually understanding or assessing intangibles, such as knowledge, and when these assets are referred to in annual reports it is with no great depth or clarity. A further criticism of the OECD approach to knowledge assessment is the over-simplification and broad use of terms (Brinkley 2006). The OECD suggests three broad ways in which knowledge can be assessed. They suggest that organisations must: *1) Enhance knowledge diffusion:* Support of innovation will need to be expanded from mission-orientated projects to diffusion-orientated programmes. Frameworks or firm collaborations and knowledge diffusion are needed to enhance knowledge infrastructures within organisations; *2) Upgrade human capital:* Strategies are needed to promote broad access to skills and competencies and especially the capability to learn. This includes providing broad-based formal education and establishing incentives for firms and individuals to engage in training and life-long learning; *3) Promote organisational change*: Firm-level organisational changes to increase flexibility, particularly relating to work arrangements, networking, multi-skilling of the labour force and decentralisation. Governments can provide the conditions and enabling infrastructures for these changes through appropriate competition, information and other policies. The issue with these strategies is that they have few practical applications. Traditional statistics and indicators based on input and activity data still dominate the OECD measurement methods and, above all, the concept of knowledge (Godin 2004). "*It may also be that the links between innovation, competitiveness and conventional productivity measures are not well understood in services and even less so in knowledge-based services*" (Brinkley 2006:7). There have been some efforts in new fields (mobility and personnel) to account for the nature of knowledge; however, nothing fruitful. According to Brinkley (2006) and Godin (2004), there has been far less, if any, work on the central characteristics of the knowledge indicators for the supposed knowledge-based economy. Indeed, "*the major innovation remains simply the collection of several indicators from different sources under a new label*" (Godin

2004:21). The primary conceptual work carried out on knowledge assessment has to do with the collection and development of indicators under the umbrella of the knowledge-based economy (Godin 2004). Evidence documenting the trends in the knowledge-based economy is in fact anecdotal. This is a damning indictment of the OECD's knowledge indicators. Godin (2004) describes these indicators as synthetic and attractive that generalise using statistics, but without delving into any meaningful understanding. In Figure 1 below, the pre-deployment conceptual KAF is presented. The aim of the subsequent sections is to highlight some of the findings from deploying a KAF at firm-level.
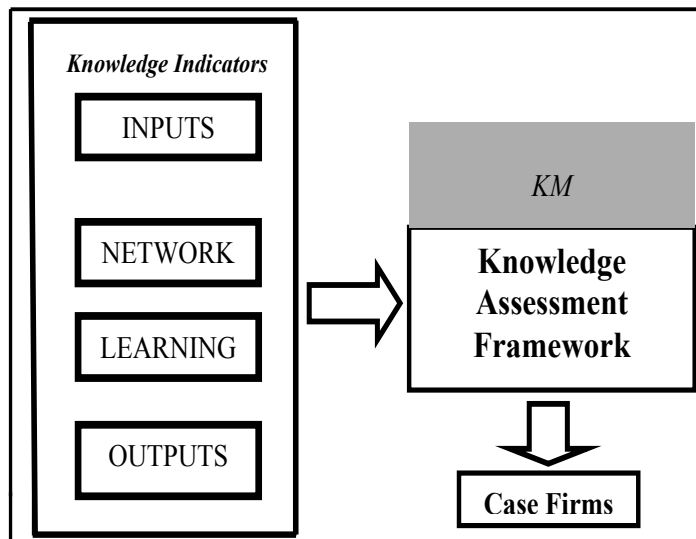

Figure 1: Framework synthesis

3. Key case findings

3.1 Cross-functional sharing

One of the first issues that became evident was problems around knowledge sharing, specifically the lack of sharing across groups at Medi-Case A and Medi-Case B. Many KM studies focus on knowledge sharing. They have focused primarily on conceptual studies (Szulanski 1996; Widen-Wulff and Ginman 2004; Hendrick and Vriens 1999; Alvi and Tiwana 2003; Huysman and Wulf 2006; Sherif et al 2006: Hall 2001; Ipe 2003) or empirical approaches (Abrams et al 2003; So and Bolloju 2005; Wasko and Faraj 2005; Yang and Chen 2007). Only one study could be found that focused on the case-study approach (Pan and Scarbrough 1998). In it, the researchers examine knowledge sharing at Buckman Lab from a socio-technical perspective. The lack of focus on case studies in KM is not uncommon (Choi et al 2008). As highlighted in the literature, the OECD (2002a) as well as other authors such as Nonaka (2007) called for a deeper understanding of knowledge indicators at organisational level. This is one of the major advantages of the case study approach (Yin 2009) because the depth of data lends itself to in-depth findings and insight. Knowledge sharing involves the transfer of knowledge from one person, group or firm to another (Choi et al 2008; Szulanski 1996). Knowledge sharing as a central pillar of KM is critical to the realisation of its full value. Knowledge sharing is recognised as one of the most significant problems facing KM (Chow and Chan 2008; Bechina and Bommen 2006). Abdullah (2009) found support for good knowledge sharing as an antecedent to progressive knowledge strategy and management values. However, it also was found that knowledge sharing is one of the largest problems for managers; this also was evident within Medi-Case A and Medi-Case B. Evidence from Medi-Case A shows the existence of extensive cross-functional sharing problems, especially between business units. Within the business units it is quite active, but many employees do not know what occurs in other groups and other business units. Perhaps the nature of knowledge itself can help to better understand these issues.

Understanding the nature of knowledge is a key factor in effective knowledge sharing. Explicit knowledge can be shared more easily through many formal methods of training and development (Nonaka 2007; Zach 2005). Tacit knowledge is more difficult, but also more important to share (Nonaka 2007; Polanyi 1962). Since knowledge hoarding is a common human action, it must be reversed through greater cultural preparation in engaging with staff (Hislop et al 2000), effective management communication, and better evaluation, feedback and appropriately tailored reward

schemes (Hsu 2006). Physical proximity does not seem to matter (Skyrme 2004) as employees who are physically close do not share. This may be linked to the fact that many cases are "target-orientated". A few experts champion the key knowledge at each organisation and employees depend on them for their day-to-day knowledge acquisition. They do not need to depend on fellow employees as they can go to the knowledge champions in their informal network. This leads to knowledge gaps because few have the knowledge and few control it. The act of knowing what is going on within other groups is not a priority for employees, especially if it does not affect the life-cycle or targets of their current projects. Nonaka (2007) says that if it is the job of employees to know what is, it is the job of management to know what ought to be. Employees do not value knowledge. Perhaps management do not either. One of the possible reasons for the divide at Medi-Case A and Medi-Case B is that there is an element of resentment, especially between the various groups within the Innovation Centre and the manufacturing floor (two of the areas field work was carried out). "*There's a perception that this is the Oval Office up here*" (Respondent 18). Oftentimes, the Innovation Centre would need to know information or changes that were happening, but these were not communicated. However, the lack of cross-functional sharing occurs equally on both sides. The framework highlights that both organisations espouse KM and the commitment to KM, but are quite insular in nature when examined more closely. A system that explicitly calls for knowledge sharing and systematically reinforces this attribute is evident in high-performing firms (Hsu 2006). Hsu (2006) posits that a more integrative approach via the people, inclusive of the available systems, has a greater chance of success than piecemeal approaches. The framework highlights that this insular behaviour also occurs at Medi-Case A. Employees are equally guilty in that they do not see the bigger picture; however, in addition to the lack of cross-functional sharing there is a lot of "*I'll hold what I know*'" (Respondent 8), which describes the situation of knowledge hoarding. In fast-growing, goal- and target-orientated organisations like Medi-Case A and Medi-Case B, it becomes very easy to be cocooned; however, they must be aware of the projects and scenarios outside of this cocoon.

3.2 Informal network dependence

The analysis of the case studies showed unequivocally that, across both organisations, a dependence on the informal network is present. Because of the lack of knowledge experts, be it functional or subject-matter, the creation and sharing of knowledge within both Medi-Case A and Medi-Case B is largely dependent on a small percentage of employees. It is now realised that the creation, acquisition, sharing and reuse of knowledge is most prominent in informal networks and communities. However, the rapid adoption of technologies in recent years is challenging the understanding of what constitutes an informal network. Recent research by Su, et al., (2007) has found that throughout the workday, knowledge workers constantly switch between multiple networks, all of which are a complex mixture of formal and informal, face-to-face and computer-mediated, intra-organisational and extra-organisational, and work-related and private interactions. The framework highlights that the presence and use of informal networks at Medi-Case A and Medi-Case B is substantial. Furthermore. the management of both companies do not realise to what degree this is the case. Evidence from the cases suggests that both organisations are open, informal places of work. This, coupled with a less formal network at each company, might suggest there is the potential for an over-dependence on the informal network. One of the main pieces of evidence to support this finding is that many of the systems that are supposed to be used to support the sharing and transfer of knowledge oftentimes are not used or not prevalent. There also is evidence that lack of time could be another contributing factor. An interesting aspect, however, is the position of management. Management look to formal KM systems to achieve creation, acquisition, sharing, and reuse of knowledge. They also depend on these formal systems to train employees. They do not realise that these formal methods are underused and, more often than not, abandoned for more informal methods.

Looking at the participation in informal networks, the literature suggests individuals in these networks share the same organisational language and behaviour and are faced with similar issues related to their knowledge tasks, supporting efficiency and, thus, general performance (Wenger 1998; Brown and Duguid 1991). In addition, the combination and recombination of firm-specific knowledge that is physically dispersed throughout the organisation may facilitate integrative creative performance, since these acquaintances are more common than community of practice members in having important knowledge that is non-redundant (Granovetter 1973). Because there is a lack of formality, engineers can go in and out of a problem but without ever properly documenting what they did. This suggests that one can talk to the knowledge owner to acquire that knowledge. As this environment fosters an open approach and relies on knowing who knows what, it is apparent that employees who are in this environment longer have an advantage. "*I'm here seven years, so … I know who's who*" (Respondent

10). This poses its own problems as it is difficult and inefficient to find out who knows who or what. Because it is so informal, many do not use the formal network approaches, such as Knowledge Cards or Agile or Link, and believe "*it's not exactly a very good way of doing it because ... it's just word of mouth*" (Respondent 11).

However, due to less frequent interactions and lower intensities of social pressure found in informal networks, employees may be less willing or less committed to exchange knowledge without some type of return (Hislop et al 2000). The relationship between participation in the informal network and individual performance would be mediated by internal knowledge exchange or the need to acquire that knowledge. Support for this was found at both Medi-Case A and Medi-Case B, where the relationship between participation in informal networks and performance was dependent on the need for internal knowledge and the need to acquire knowledge for a particular project or task. At Medi-Case B, for example, much of the knowledge is learned from people in an informal way, and thus the internal network is very informal; if one were a scientist or an introvert, they may find it difficult to navigate. As a result, some find the organisation is not very structured or data-driven, so they rely on their social links and interaction with others. The results suggest individuals who participate in the exchange of knowledge and help within informal networks are more likely to become central individuals within the firm's internal networks. These central individuals play the role of knowledge champions (Wenger 1998) and, as discussed earlier, incidents of siloing or hoarding may occur. Additionally, through their central position and collaboration with others (Szulanski 1996), these champions are able to gather knowledge more efficiently and effectively from areas across the firm to fit their own local needs than individuals in less central positions or employees new to the firm. This positively impacts employees' individual performances. While the findings regarding observations from Medi-Case A and Medi-Case B do offer somewhat similar results, they show the advantages of participating within the informal network as opposed to relying solely on formal systems within the organisations. However, there are consequences of a dependency on informal networks. Firstly, there are huge time inefficiencies at the companies. Secondly, there is a lack of proper use of some of the systems provided. Many employees end up spending much of their time navigating the informal network only to lose sight of the knowledge they seek to acquire, delayed in the task of acquiring it. They end up doing two to three hours of work at home many nights of the week. The cases show this is because they spend their day trying to find information through talking to others. Because of the overreliance on the informal network, there is the potential for both organisations to lose the power of having something more formal. The informal network only goes so far; one cannot possibly have a connection to every expert within the broader organisation.

3.3 Time issues

The framework has highlighted evidence in both Medi-Case A and Medi-Case B that fundamental time resource problems are present. Most of the projects within Medi-Case A and Medi-Case B operate within a prescribed timeline. This timeline is purely customer-driven. For example, Medi-Case A is purely driven by trying to "*get the thing done and not really having any scope or bandwidth to be improving the way that we're doing things in any significant way*" (Respondent 6). Problems around locating, acquiring, sharing and reusing knowledge were identified. A knowledge management system (KMS) often was implemented to counteract these problems instead of looking at where the knowledge resides and the extent to how it is structured (Hahn and Subramani 2000). Examples of KMSs are User Productivity Kit (UPK) and Knowledge Cards in Medi-Case A, and Agile, Compliance Wire and Link in Medi-Case B. These initiatives take considerable time to use, time which many of the employees do not have. The initiatives also result in what is perceived as little output. The organisations are so target-driven that employees simply do not have time to use the systems or effectively partake in KM initiatives. Successful KM implementation depends on resources (Wong 2005). Financial support inevitably is required if an investment in any KM or technological system is to be made. Human resources are needed to coordinate and manage the implementation process and to take up knowledge-related roles. Organisations also have to make time available for their employees to perform KM activities, such as knowledge acquisition, sharing and reuse. Similarly, providing time and opportunities for people to learn is important (Martensson 2000). In addition, according to Davenport and Volpel (2001), attention is one of the scarcest resources in many companies. They call attention management a key component of successful KM. Since resource availability is a primary concern in large organisations, it has to be properly considered when implementing any KM initiative (Wong 2005). Despite the potential usefulness of previous KM strategies, this research presents a situation where organisations still face difficulties in bridging strategy and practice. The difficulties arise when solutions to problems become ineffective or simply

underused because of time constraints. The first initiatives that are discarded are initiatives around KM.

There also is evidence that it is not only systems that suffer because of lack of time. The first initiatives that tend to be discarded often are perceived as "non-value" initiatives or those that are perceived to hinder meeting customer targets. At Medi-Case B, for example, implementing lessons learned initiatives are ineffective because "*it's the time part*". It is apparent that these initiatives would benefit projects going forward, as posited by Snider (2008) and Graham and Thomas (2007). The lack of time to treat lessons learned properly and have a tangible benefit for the organisation is the main barrier, along with the poor culture that is not promoting these initiatives. In addition, there does not seem to be the managerial drive to promote the required culture. The inefficiencies caused by the informal network dependency has caused many employees' workload to spill over into their free time. For example, "*my hard work time is at home in the evening when I leave. Like you'll work ten or twelve hours in here and then you'll do two hours at home at night, actually doing my own work*" (Respondent 27). There also was a lack of resources with regard to mentoring. It is clear from the examples above that much of the "value add" initiatives go by the wayside because there is not enough time available to support them. Despite what is being said in the literature, it is difficult for managers to implement KM initiatives if the cultural drive of the organisation does not foster their implementation. Much of the early KM literature looks at ways to codify knowledge (Hahn and Subramani 2000; Hansen et al 1999) and assumes knowledge can be effectively extracted and codified through document-to-person approaches, where artefacts are then stored and indexed in databases that enable easy retrieval (Hansen et al 1999). There are examples of this at both Medi-Case A and Medi-Case B. Though many of these initiatives, such as Link and Talent Navigator, are being used to codify, people still have very limited free time, and it is primarily about people hours and making sure "*you still get yourself your targets*" (Respondent 10). Employees often will find it difficult to locate the right person with the relevant knowledge. When they figure out the right person, it might be difficult for that person to give time to help them. This could be a result of the hoarding, the time issues or possibly a combination of both. Additionally, if an employee attempts to help another employee and it is perceived that time is being wasted, "*their boss is going to say, 'what the hell did you spend half today doing?*'" (Respondent 14), so the culture is not exactly sympathetic to fostering sharing. Spender and Scherer (2007) argue that this problem of not "wanting" to give the time to a fellow employee may be down to "*ownership of the means of production*" (2007:5), or the ownership of different sources of knowledge. However, the framework highlights possible informal network dependency and time restraints, which challenge this.

3.3 Lack of formal systems use

The previous section discussed employees' dependency on or tendency to use their informal network and the subsequent issues with knowledge re-use. According to many KM authors, including Miller et al. (2012), Hahn and Subramani (2000), Davenport (1998) and Hansen et al. (1999), there is a general recognition of the importance of KMS, including those manifested in a variety of implementations, including document repositories, expert databases, discussion lists and context-specific retrieval systems incorporating collaborative filtering technologies (Davenport 1998). This is accompanied by a technology-induced drive to implement systems with "*inadequate consideration of the fundamental knowledge problems that KMS are likely to solve*" (Hahn and Subramani 2000: 1). There is a lack of use of the formal systems. The primary solution offered by senior management for many knowledge issues at both Medi-Case A and Medi-Case B is that various formal systems have been proposed and introduced to tackle problems; for example, UPK is used for knowledge capture/training, Knowledge Cards are used for knowledge documenting, Link locates knowledge and is a knowledge network, Talent Navigator also locates knowledge, Agile deals with knowledge documenting, and Compliance Wire is used for training/learning. They are inefficient and ineffective in both cases. Davenport and Prusak (2000) suggest that formal systems failed to live up to expectations and only a few of the formal systems developed in the 1980s were still in use in the early 1990s. Part of the reason for this was because formal systems attempted to capture knowledge as explicit decision rules. Decision rules have a limited scope and are not able to cater for rapidly changing environments (Davenport and Prusak, 2000). Also, formal systems suffered from overly high expectations and excessive levels of hype. A typical pronouncement, written two decades ago might have suggested that it was too early to estimate the magnitude of the contribution formal systems will make to human capability and to the effectiveness as managers and perhaps more than a little reckless to rank it now along with steam power and electricity. But the contribution will be in that class and will be indeed profound (McDermott, 1999).

There is a lack of balance or consistency within Medi-Case A's formal network. Some use the formal network that is in place, others do not; this is inconsistent throughout the organization. Zach (1999) suggests there is a need to balance the two by formalising what needs to be and leaving the informal as is. This balance has eluded Medi-Case A, and UPK was introduced to alleviate the problem with a centralised system that would act as a conduit for knowledge throughout the entire company. However, the issues remain. For example, if someone in Medi-Case A needs to know the owner of training; it can take asking several people before becoming aware, while the information is readily available on UPK. As previously discussed, there is a reliance on the informal network at both companies. Agile suffers from information overload and there is a general animosity toward the system. However, from a regulatory perspective, it has to be used by employees in their training regime. Link was introduced at Medi-Case B to function as a formal knowledge network and to pick up keywords and skill-sets and match them to profiles. Its function was to aid in sharing ideas. Though it is available to everybody at Medi-Case B, it is underused and is not marketed or put in the limelight enough to make employees at ground level aware of its potential. Link is therefore underused. Coupled with the evidence that suggests that employees primarily use their informal network the potential of a useful system is undermined. It is argued that the program scope (formal systems) must not be too substantial for the organization's available resources (Wong, 2005). Investment decisions in KM should be based on a sound consideration of resources, not on the belief that it is "*nice to have*" (Respondent Ten). In addition, proper budgeting of resources is crucial for KM. Arguably, one of the key issues for any organization in achieving effective KM is to deal with their resources, especially the availability of time. This implies it is key to be able to understand, acquire, allocate and manage these formal systems in unison with available resources to achieve organizational success (Wong, 2005).

The framework also highlighted that many employees had not heard of Link or had no interaction with the system because they did not rely on it or did not have the time. Moreover, when trying to locate skill-sets or knowledge, many stated there was *"no system there for that kind of stuff ... even just realising people's qualifications or where people could help out"* (Respondent Sixteen). This is despite the clear availability of three systems within the company. The lack of systems awareness and the lack of use of the system were interesting. When the lack of awareness of the systems was reported to management, they were surprised and admitted that the Innovation Centre would be championing these systems, when in fact the opposite was true. Collaboration across Johnson and Johnson is lauded as being important because knowledge sharing is important to the success of the organization. This shows another disconnect between management and the Innovation Centre. This means that if there was a problem outside Medi-Case B, even knowing Link could be used, they probably would not use the system to pose the question. Management acknowledge that the lack of Link awareness is "*definitely a problem for us*" (Respondent Thirty). Perhaps an over-emphasis on knowledge codification (Burton-Jones 2008) without providing the necessary strategies on the ground results in the negative connotations associated with the KM tools.

Talent Navigator is the other system used for locating and archiving skill-sets and its purpose is to make the locating of specific knowledge easier for the user. However, the framework highlights that most employees are not aware of its existence. Even the head of the Innovation Centre does not use Talent Navigator regularly; "*maybe twice a year, maybe three times, when deadlines are coming up"*. Many said it is not user-friendly and that they prefer to use their informal network. It was interesting to see that the system has the capability, but it is not being used. It is worth noting that contractor staff cannot use the system, and Medi-Case B personnel cannot locate any contractors on the system either. Again the framework shows that the primary problem is that "*none of us have the time, to be frank. I mean, if I did, maybe, but I know we are flat out and we don't*" (Respondent Thirty Two). The over-emphasis on these systems tends to focus managerial attention on the codified nature of storing knowledge, rather than on the people and their abilities to create, interpret and share knowledge (Haas and Hansen, 2005). With the use of Knowledge Cards, Medi-Case A recognised that people needed to get more knowledge about different areas. However, enthusiasm for those initiatives waned very quickly. Again there was very little use of this system at Medi-Case A. The problems inherent in the diversion of attention from the motivational, and other problems associated with inducing individuals to volunteer their knowledge, (Burton-Jones, 2008; Blyler and Coff,2003) may also have contributed to the issues discussed.

3.4 A problematic learning cycle is being fostered because of a strategy that focuses on formal systems training

Key knowledge sustainability comes from superior learning capability (Prieto and Revilla, 2005). At both case organizations, learning capability comes through a formal systems-based approach (UPK, Compliance Wire). The main issue is that as Medi-Case A has grown from a small business to a large organization, it does not have the internal wealth of expertise to (1) sustain this growth long-term, (2) provide experts for the areas in which it now expands, or (3) provide training and mentoring to the wealth of new employees needed to sustain its expansion. It has not nurtured the capabilities that it needed to create effective learning while it has grown (Prieto and Revilla, 2005). Within knowledge learning at Medi-Case A and Medi-Case B, both organizations are keen to pursue KM in a way to increase effectiveness and efficiency across a range of initiatives and procedures. However, learning within both organizations happens in a way that is counteractive to this goal. The cases show management's expectation that learning should primarily happen through formal training. The challenge however, for both organizations rests on trying to create enough functional experts and subject-matter experts to cope with their growth. It is the functional and subject-matter experts' responsibility to diffuse this knowledge, expand their expertise and provide the supervision and knowledge for much of the formal systems and training. There is a push to build expertise by putting the experts through "train the trainer courses" and into training positions, which attempts to deliver sharpness. In this way the experts become familiar with the detail and interacting with the formal systems.

Arrow (1994) introduced the idea that new knowledge is produced within a system or by economic process by arguing that learning-by-doing was an important by-product of production that diffused into the system (Arrow, 1962). Many of the subject matter experts interviewed agree learning best occurs by "*getting the hands dirty and learning the hard way through solving*" (Respondent Four). Management take a different view. As discussed, learning at Medi-Case A and at Medi-Case B takes place primarily through automated systems-based training, through UPK at Medi-Case A and Compliance Wire at Medi-Case B. This seems counter intuitive. This is achieved through formal training systems, such as UPK or Compliance Wire for example. A cohort of management believes this saves the organization time (which it may do) and achieves good quality learning (which it does not). The reason that it does not achieve good quality learning is that employees do not receive a proper understanding of processes or procedures from "*click-job*" training. With the push to record processes and "*the way employees work*" in both organizations, inaccurate methods, processes and procedures are recorded and fed back into the training system; "*garbage in and garbage out*". The cycle continues and the situation worsens as the companies expand.

Von Hippel (1994) echo's Polanyi by referring to a mentoring type relationship that can aid in offering an informal approach to training. This would be something untapped at both organizations. Currently employees will go to a training course for two hours and be told why something is "*but until you go and practice it and do it and get a bit more competency in it*" (Respondent Eleven), the process won't be understood. The benefit of mentoring would be that "*you're actually doing a bit of training as well with them* (Respondent Seven) which would produce a long-term benefit. The managers and experts who are best positioned to train, mentor and impart knowledge are the ones doing the jobs day-to-day. This is where Medi-Case A and Medi-Case B would benefit from mentoring or informal sessions. The researcher must also take into consideration that mentoring and apprentice-type relationships may not be possible. Medi-Case A and Medi-Case B are growing organizations. The framework has highlighted that there are too few subject matter/functional experts to cope with the amount of new employees needed to maintain organizational growth in both organizations. Managers acknowledge that knowledge needs to be diffused throughout the organization, and that learning is produced from experience and can only take place as part of an activity-focused attempt to problem solve. However, perhaps it is unrealistic to think that this can be achieved in the current circumstances. As discussed in the literature, the best way to impart rich tacit knowledge is through the close master-apprentice relationship (Polanyi, 1966), which can effectively be achieved through mentoring. The issue here, highlighted by the framework, is that there are no formal mentoring programmes available and that the expertise and skill-sets to provide this crucial mentoring are not available in enough numbers. Much of the implicit knowledge that can be used in effective training is not recorded or captured. There is an over reliance on formal training and this is working to the detriment of effective learning at both organizations. Simply put formal training is not sufficient for complex knowledge work.

4. Conclusion

Assessing one's knowledge clearly is a central goal for organisations to consider in the face of changing market and economic conditions. Being aware of knowledge gaps in any organisation is important and is a driver for organisations to both adapt and reinvent themselves in the face of these various challenges. In this paper, the author highlighted some of the key findings after deploying a KAF at firm level. The insights that are highlighted by the framework also are important for the organisations going forward. The framework is useful as a way for organisations to evaluate where they are lacking in terms of knowledge location, acquisition, sharing, and reuse. The organisation then can adjudicate action to increase knowledge in these areas.

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