Abstract: Interorganizational and social relationships can be seen as part of the intellectual capital of a firm. Existing frameworks of intellectual capital, however, fail to address how relationships should be managed to generate more intellectual capital. Drawing on the interaction approach and the fields of intellectual capital and knowledge management, this paper develops a framework for managing relationships. The framework is illustrated with a case study. It is also noted that firms can improve relationship management and thus generate more intellectual capital.

Keywords: Intellectual capital, structural capital, human capital, interorganisational relationships, social relationships, relationship transformation

1. Introduction and purpose

Establishing and maintaining relationships are costly processes that should be considered as investments. Consequently, relationships and the uses to which they can be put should be seen as part of the stock of capital of the firm. In fact, relationships can be seen as part of the firm’s intellectual capital. However, the fields of research focusing on relationships, on the one hand, and on capital investments, on the other, are rarely integrated. Therefore there seems to be limited understanding of investments in relationships and limited terminology available for describing this process. There also seem to be limited recommendations for managers available as how to manage this process. The purpose of this paper is, therefore, to link the literature on relationships to the literature on intellectual capital and to provide a framework for generating intellectual capital through investments in relationships.

The rest of this paper breaks down into six sections. Below the concept of “relationship” is further developed (2), followed by a discussion on intellectual capital (3). The subsequent section argues that relationships can be seen as part of the firm’s intellectual capital (4). In the next part, an empirical illustration of this phenomenon is provided (5), resulting in a discussion of how different types of relationships are transformed in firms for different purposes, drawing on literature from the knowledge management area (6). The paper then pulls together its different strands, while also providing some recommendations for practice (7).

2. Relationships: A multidimensional concept

Increasingly in business research, relationships are considered valuable intangible assets. Here a relationship is considered an intangible connection between two actors that can be defined according to a number of dimensions including commitment, trust, cooperation; communication, influence and mutual adaptation (see e.g. Hakansson & Snehota, 1995). An important distinction between different types of relationships must be made, though. This distinction concerns the unit of analysis, i.e. who are considered to be the parties of the relationship. The literature separates between the organization as actor and the individual human being as actor. I.e., there are interorganizational relationships between firms and other organizations, and there are social relationships between people.

At the interorganizational level, relationships are typically considered as institutionalized, their existence not depending on the actions of single human beings. While individuals carry out those activities that initiate, build and maintain relationships, organizations are considered as partners in relationships. Interorganizational relationships can be formalized, e.g. through contractual or other legal bonds, or they can be informal. Some involve exchange of products (goods, services, knowledge etc.) for monetary compensation, i.e. exchange relationships. Others are based on e.g. competitive pressure or regulative frameworks. In essence, an organization is seen as having relationships with all those other organizations that it affects or is
Relationships with business purposes develop over time. The assumption is that the relationship is a cumulative process. The way a single transaction is carried out is based on experience from the previous transactions, rather than being carried out in social vacuum. This has been described as different stages in the relationship life cycle (Dwyer et al., 1987; Wilson & Mummalaneni, 1986), a process during which parties get to know each other, and relationship elements like trust, investments, mutual understanding and commitment develop.

### 3. Intellectual capital

There are various definitions of intellectual capital, although the term is generally used to describe intangible assets on a company level, referring roughly to the difference between adjusted equity and market value of a firm (Edvinsson & Malone, 1997). During the last decade, two different approaches to intellectual capital can be identified, measurement of intangible assets and measurement stressing decision making (Habersam & Piber, 2003). The notion of intellectual capital has been widely discussed since market value often exceeds book value. According to some researchers, the reason why the market is willing to pay more for a firm than the value of its tangible assets can be traced to the intellectual capital of the company and its expected future economic value. There are therefore obvious motives for an interest in intellectual capital. On the other hand, intellectual capital is highly problematic to control due to its intangible character and it is complicated to establish exactly what intellectual capital is (Zhou 2003).
Creating absolute models of indicators of intellectual capital is not really possible (Mouritsen et al., 2005).

In the most frequently cited model of intellectual capital, however, Edvinsson and Malone (1997) have divided it into two main sub-categories, human capital and structural capital. Human capital refers to the employees of the company and their creativity, competence, social skills etc., but also to company values, culture and philosophy. Roos et al. (1997) express this as human capital being the soul of the company and Edvinsson and Malone (1997) note that the company cannot own human capital. Structural capital, on the other hand, covers a number of different notions related to the company rather than to the specific employee. Structural capital is divided into organizational capital (innovation and process capital) and customer capital (Edvinsson and Malone, 1997), in short what is “left at the office when the employees go home” (p.11). See Figure 1 below for an overview

![Figure 1: Intellectual capital. Source: Edvinsson & Malone (1995:52), adapted.](image)

Roos et al. (1997) create a similar distinction. Intellectual capital is broken down into human and structural capital, human capital in turn being broken down into competence, attitude and intellectual agility, while structural capital is broken down into relationships, organization, and renewal and development. Another similar and often mentioned model is “The Intangible Asset Monitor” proposed by Sveiby (1997). Other authors could be cited, but the logic behind most models is similar regarding what are considered the components of intellectual capital, although the categorization varies somewhat (see Andriessen, 2004, for an overview of categorizations).

Theorising about intellectual capital has primarily been concerned with knowledge resources as a static entity, and less so with the dynamic process of generation and maintenance of intellectual capital (Roos et al. 1997). I.e., research has more focused on definitions, distinctions and methods of valuation of intellectual capital, than looking at how it comes about. Consequently, a significant drawback of current intellectual capital theorising is that it largely fails to explain relationships between different elements of the various intellectual capital models (Leitner & Warden, 2004). Further, intellectual capital models do not specify how intellectual capital is used in the process of creating value, even if this aspect is arguably more important than the identification of components of intellectual capital. However, in order to interconnect individual components of intellectual capital as well as to link them to value creation, the strategy of the company is of great importance. At least as a performance monitoring system, intellectual capital is intimately connected to firm strategy (Mouritsen et al., 2005). This indicates that another type of model or framework might be necessary (Leitner & Warden, 2004), where intellectual capital components are regarded as driving factors rather than static components. However, not even models related to corporate strategy (value chain scorecard, BSC etc.) are able to provide a reasonable picture of the flow between different components the firm’s intellectual capital or how the combination of the components generates value.

4. Relationships as intellectual capital: a missing component

In the discussions above, one can see a connection between the notions of relationships and intellectual capital, although apparently few studies take this approach (see Das et al., 2003, for a study of strategic alliances and intellectual capital). Roos and Roos (1997) and Roos et al. (1997), however, argue that relationship capital
should be seen as part of the firm’s structural capital. Human capital is argued to include competence, attitude and intellectual agility, but not relationship capital, which is only seen as belonging to the structural capital category. The way, in which relationship structural capital is defined, however, focuses on relationships with “customers, suppliers, alliance partner, shareholders and other stakeholders” (Roos et al., 1997:43). I.e., in their view relationship capital corresponds to interorganizational relationships.

Our discussion on relationships distinguishes between social relationships (between individuals, which can be professional or non-professional) and interorganizational relationships (between firms). We note that social relationships can be an important source for the formation and maintenance of interorganizational relationships, but where do social relationships of employees (and the uses to which these can be put) figure into established models of intellectual capital? We would argue that social relationships of employees can be said to belong to the human capital category, while interorganizational relationships of the firm belong to the structural capital category. Interorganizational relationships are “left at the office when the employees go home” (cf. Edvinsson & Malone, 1997:11), while social relationships cannot be owned by the company.

5. A brief empirical illustration with comments

Below is presented a brief summary of a case study of the internationalization process of a Swedish industrial SME (see Agndal, 2004). Internationalization is a good context for studying the phenomena in focus in this paper. More or less since the inception of the internationalization field, the dominant theoretical perspective has regarded internationalization as a process of knowledge internalization (see e.g. Johansson & Vahlne, 1977), and later the importance of relationships came strongly into focus (Johanson & Mattsson, 1988; Axelsson & Johanson, 1992; Blankenburg Holm, 1996).

5.1 Method

The project from which data are drawn focused on charting international relationships of 16 Swedish industrial SMEs, primarily through interviews with 52 key informants. By focusing on the relationship as the micro unit of analysis, it is possible to generate a comprehensive picture of how internationalization processes form over time, and how these processes are influenced by existing and newly formed relationships. In essence, it can be shown how structural and human capital impact internationalization process formation and how new intellectual capital is generated. The vignette below is selected because it is particularly illustrative.

5.2 GC Inc.

GC Inc. manufactures and markets garbage compactors. The firm was founded in 1971, currently has 90 employees and a turnover of US$20 million. Internationalization began shortly after the firm was founded with sales to a UK distributor encountered at a trade fair. GC Inc. soon ran out of capital, though, and was acquired by an industrial group. This gave GC Inc. access to distributors in most of Western Europe and the US. In essence, the acquisition seemed to generate considerable structural capital for GC Inc., interorganizational relationships rapidly expanding in number. However, with the introduction of new products, it became apparent that the industrial group’s foreign distributors were not well suited to marketing GC Inc.’s products, which were aimed at different market segments. Therefore, in 1981 the manager of GC Inc. acquired the firm. He then set out to find new distributors. Interestingly, in the case of Norway, the Netherlands and France, the new distributors were firms started by employees of the former distributors, wanting to work specifically with GC Inc. Thus, existing interorganizational exchange relationships formed the basis for new interorganizational exchange relationships. In intellectual capital terms, existing structural capital was used to generate new structural capital.

The manager of GC Inc. again wanted to expand into the US market. For several years GC Inc. had been working with a Swedish supplier, a firm managed and owned by an acquaintance of GC Inc.’s manager. The owner-manager had sold his firm a few years earlier, however, and had moved to the US. GC Inc.’s manager then suggested that his acquaintance should start a new firm there to become GC Inc.’s US distributor, which also happened. In this instance, a social relationship, at that time a non-professional or non-task one, formed the basis for a new interorganizational exchange relationship. Thus, what may be termed human capital was employed to generate structural capital.

After an intense period of finding new distributors in the early and mid-1980s, a more reactive stance to new relationship initiation emerged. A break in this trend occurred in the mid-1990s when GC Inc. hired a new member of staff who had been working in Latin America for a long time. His personal contacts there were used to find several new distributors. Again, it can be noted that human intellectual capital was used, although
here the social relationships may be termed professional (i.e. task-related). When this individual left CG Inc. a few years later, the distributors remained with GC Inc. I.e., the relationships had, in effect, been institutionalized and structural capital had been generated from human capital.

More examples could be cited, but these will suffice for the discussions at hand. This case clearly indicates that social as well as interorganizational relationships are important aspects of intellectual capital. The case indicates something even more interesting, though. Apparently, structural capital in the form of interorganizational relationships can be transformed into human capital in the form of social relationships, and vice-versa. Below, this phenomenon is explored further.

6. Relationship transformation: insights from knowledge management

As noted above, much of the literature on intellectual capital focuses on its constituent components. Unlike many writers in the field, Nahapiet and Goshal (1998) also stress the creation of intellectual capital. They argue that this can be done in two ways, either through a process of combination or through a process of exchange, i.e. either through recombining existing resources or through exchange activities with other parties. Based on our observations, these thoughts are a useful starting point for further discussion on the importance of relationship transformation processes in the creation of intellectual capital. Relationships are created and deepened through exchange, and existing relational resources may be recombined to form a basis for new relationships.

The case above indicates that relationship transformation processes do indeed go on in real life, and that firms create human and structural intellectual capital. The issue is somewhat more complex than initially hinted at, though. One issue of special importance is how social relationships can be transformed into interorganizational relationships and vice-versa. I.e., how can a firm make use of social relationships of their employees and ensure that relationships are not lost if employees leave the firm? Similarly, how can firm foster good social relationships between its employees and employees of other organizations to improve business interaction? Simply put, how can social relationships be transformed into interorganizational relationships and how can interorganizational relationships be transformed into social relationships? How can these processes be understood and described? Can parallels be drawn from other research fields?

In recent years, the field of knowledge management has been concerned with intellectual capital (see e.g. Zhou & Fink, 2003; Sveiby, 1997) and some writers have focused on knowledge creation through knowledge transformation and exchange in a social context (Chua, 2002). Interestingly, the notion of relationship transformation is similar to the well-known ideas of knowledge transformation as discussed by Nonaka and Takeuchi (1995). They present a framework arguing that “tacit” and “explicit” knowledge can be transformed into new tacit or explicit knowledge through four different processes. By tacit knowledge is understood knowledge that is “[…] personal, context-specific, and therefore hard to formalize” (Nonaka & Takeuchi, 1995:59). By explicit knowledge is meant “[…] knowledge that is transmittable in a formal, systematic language” (p. 59). The four transformational processes are denoted as follows: transforming tacit to tacit knowledge is referred to as socialization; transforming explicit to explicit knowledge is referred to as combination; transforming tacit to explicit knowledge is referred to as externalization; and transforming explicit to tacit knowledge is referred to as internalization. Socialization of knowledge takes place through sharing experiences, while combination entail systematising different strands of knowledge, primarily through formal methods. Externalization of knowledge is a process of forming explicit and communicable knowledge out of knowledge residing in individuals, while internalization is an individual’s process of learning from outspoken or formalized knowledge (Nonaka, 2004; Nonaka & Takeuchi, 1995).

Several parallels can be drawn between social relationships and tacit knowledge on one hand, and interorganizational relationships and explicit knowledge on the other. Like structural capital (of which explicit knowledge could be said to be a part), explicit knowledge stays in the firm. Like tacit knowledge, social relationships reside in and are tied to individuals and cannot be owned by the firm. Other similarities between relationship formation and Nonaka and Takeuchi’s (1995) framework as a whole can also be identified; Knowledge transformation cannot be undertaken in isolation. Like relationship formation it requires interaction. Also, relationships, like knowledge, are created by individuals rather than by organizations as such. The organization, though, can provide conditions for facilitating the exploitation of relationships, just like the organization can facilitate or hinder knowledge transformation.
Thus, Nonaka and Takeuchi’s (1995) framework of knowledge transformation might be useful to gain insights into relationship transformation processes and consequently generation of intellectual capital. Indeed, their framework (1995:62) can serve as inspiration for the formation of a two-by-two matrix of relationship transformation (see table 2).

Table 2: Relationship transformation

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
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<tbody>
<tr>
<td>Social relation</td>
<td>Social relationship</td>
</tr>
<tr>
<td>Interorganizational relationship</td>
<td>Socialisation</td>
</tr>
</tbody>
</table>

From the firm’s point of view, social relationships form an important part of the human capital category of intellectual capital. The firm, however, is concerned with task-related social relationship, i.e. those relationships that can be of use to the firm. Individuals, through interaction with other individuals, develop such task-related social relationships, normally when acting in their professional capacity as representatives of their employers. As task-related social relationships involve individuals, they can be transferred between different firms as individuals change places of employment. Firms can influence the formation and maintenance of social relationships, e.g. through providing individuals with legitimacy and arenas where such relationships can be formed. Here we refer to this as socialisation, which is similar to the process of socialization in Nonaka and Takeuchi’s (1995) framework.

Social relationships of employees should be regarded as an investment that should be controlled in order to be more beneficial to the firm. Similarly, from the individual’s point of view, it should be of interest to create social relationships based on the relationships that firms are part of. In essence, interorganizational relationships form the basis for social relationships and human capital is developed in a process much like the process of transforming explicit knowledge into tacit knowledge referred to as internalization in Nonaka and Takeuchi’s (1995) model. I.e., through social interaction, what is at the beginning an established interorganizational exchange relationship between two firms, leads to the formation of a social relationship. Here, we refer to the process of building social relationships based on interorganizational relationships as personalization.

Task-related social relationships can then be used to develop interorganizational relationships. Through a process that we refer to as institutionalization, structural capital is generated for the firm. A relationship is thus turned into structural capital when it survives single humans, i.e. the contact is no longer dependent on the individual – it has been institutionalised. We see this, e.g., when a relationship continues after an individual has left a firm. Therefore, institutionalisation changes the intellectual capital from human capital to structural capital.

Of course, existing interorganizational relationships can also generate new interorganizational relationships, like the transformation of explicit knowledge into new explicit knowledge. This is referred to by Nonaka and Takeuchi (1995) as combination, and is an issue much dealt with in the literature on interorganizational relationships. Here we refer to the process of generating new interorganizational relationships based on existing ones as extension.

7. Conclusion and managerial implications

This paper argues that intellectual capital in the form of interorganizational and social relationships is very important for business success. It also shows that social relationships can form the basis for creating interorganizational relationships and vice-versa, which is part of a vital process of human and structural intellectual capital generation. The main theoretical contributions of this paper lie in linking the interorganizational and social relationship literature to the literature on intellectual capital, and providing a framework for relationship transformation by drawing on some of the literature on knowledge transformation. However, what are the implications of these arguments for managers?

For social and interorganizational relationships to be of value to firms, relationships must have enactable or enabling dimensions. This is part of the intellectual capital of the firm. Chang and Birckett (2004) point out two dimensions of managing intellectual capital: (1) intellectual capital should be maintained and (2) intellectual capital should be employed efficiently. Relevant questions to consider, however, are to what extent firms actually allow for intellectual capital generation, and how these processes are managed. Four ideal types can be identified if a two-by-two matrix is constructed (table 3), the
axes of which consist of levels of human capital generation and levels of structural capital generation.

Table 3: Ability to generate intellectual capital

<table>
<thead>
<tr>
<th>Ability to generate structural capital</th>
<th>Ability to generate human capital</th>
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<tbody>
<tr>
<td>Low</td>
<td>Low ability to generate and exploit intellectual capital</td>
</tr>
<tr>
<td>High</td>
<td>High ability to generate human capital but low ability to exploit it to generate structural capital</td>
</tr>
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</table>

This matrix indicates situations where firms provide arenas for human capital generation, but lack the ability to transform this into structural capital. Accordingly, firms may also have the ability to create structural capital, but lack arenas for creating human capital. In the ideal type of firm there are arenas for human interaction and mechanisms for transforming social relations into interorganizational relations and vice-versa, thus generating intellectual capital for the firm.

The processes of intellectual capital generation may, thus, be facilitated by the firm through the provision of arenas for social interaction and the implementation of more efficient and consistent routines for formalization of social relationships. From a firm’s point of view, there is an incentive to highlight the organization and control of social interaction in order to increase the benefits this might lead to. Firms should also strive to implement systems for tracking extant human capital (e.g. employees’ social relationships) and create structures to consistently exploit human and structural capital, not unlike knowledge management systems implemented in many larger firms. An important aspect of managing intellectual capital is, thus, how to increase transparency of intellectual capital. Habersam and Piber (2003) identify four different levels of transparency: what can quantified, what can be written down, what can be explained, and what cannot be explained. This applies also to relationship management and exploitation. Some relationships can be precisely characterised according to certain pre-determined criteria, others can only be recorded more generally, while some relationships cannot be meaningfully recorded at all even if they offer potential for exploitation, and in some cases not even this is possible or meaningful. Perhaps the greatest managerial challenge lies in identifying which relationships belong to which categories, how these should be recorded and shared, and how great their potential for exploitation is.

References


Knowledge Sharing in a Community of Practice: a Text-Based Approach in Emergent Domains

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Abstract: The shared use of specialist terminology amongst the members of a community of practice is explored as evidence for the existence of the concept of communal lexicon. A computer-based method of investigating the extent of terminology is described – this method uses both univariate analysis, specifically frequency distribution of single and compound words, and multivariate statistical analysis, particularly factor analysis. The results show that terminology sharing may act as a metric for knowledge sharing and knowledge diffusion among different (sub-) communities. The case study chosen to demonstrate the efficacy of the terminology-sharing method is drawn from cancer care – especially breast cancer care, where texts produced for and by the three main components of the community are examined – namely the experts, the professionals and the patients.

Keywords: Knowledge diffusion and sharing, community of practice, communal lexicon, corpus linguistics, special language terminology, multivariate analysis.

1. Introduction

The fusion of knowledge, within and across domains, is critical for the sustenance of individual domains and for the well being of the society as a whole. Knowledge management literature shows that the application of knowledge and the feedback from end-users, in itself contributes as substantially to the knowledge of the domain experts as does the research output of the experts. The classical case studies of Japanese white-goods manufacturers, Matsushita and Cannon (Nonaka and Takeuchi, 1995) of the German conglomerate Siemens’ recovery as major telecommunication enterprise during the 1990’s (Davenport and Prusak, 2002), and of knowledge transfer within the photocopier division of Xerox Inc, clearly indicate the benefits the research laboratory derives from its interaction with the professionals and the end-users. The professionals include design engineers, marketing executives, accounts clerks, merger and acquisition lawyers – those who have to understand, critique and apply the knowledge developed in laboratory.

A large organization, with its different highly specialized interest groups may become a community – with shared values, common goals, a belief in the organization, and the community shares a tension as well. The tension is between a commitment to keep the identity of the organization whilst being prepared for change – both large and small-scale change. It appears that the vital force behind the successful organization is its willingness and ability to foresee change and adapt to it. Above all, a community of practice – a group of people who share a set of problems, or passion about a topic, and who deepen their knowledge and expertise in a given area, by self motivation interacting on an on-going basis (Wenger et al, 2002:4) – shares a common language that facilitates interaction amongst the members of the community. The interaction between people is very manifest when they use language – for linguists like Herbert Clark (1996) the use of language is a form of joint action that, in turn, is based on actions of each of the individuals involved in language based communication. Our work is an attempt to understand how knowledge communities emerge by observing their principal form of ‘joint action’ – the use of language within the community.

Like any other social community, members speak different dialects of the same common core language – working, middle and upper class English, Hindi, or Arabic. Each division of the community uses the common core for a different purpose: but despite the dialectal and pragmatic differences, and in some cases mutual unintelligibility, the community shares a communal lexicon. Each division may have their exclusive words, which may in time be shared or not shared across the community. The community sometimes accepts new words to denote new concepts, objects or events, and rejects some of its current stock of words related to obsolete concepts, objects or events.

Our investigation is based on the acceptance of the notion of a common lexicon, and we believe that an examination of documents produced by different members of a community of practice either synchronically, at the same time, or diachronically, over a fixed period of time, will indicate the extent of a community’s cohesion or otherwise. We are interested in the dimensions of
variation at the level of word usage across a community of practice. The dimensions are an indicator of the extent to which words – or more accurately specialist terms – that are generally used to label concepts are shared across the community.

2. Motivation

The notion of a community of practice is a qualitative one and is underpinned by more abstract concepts like common ground. This term is used in language acquisition to suggest one can acquire language if there was to be a common ground between the larger linguistic community and the individual learners and that once the learner has accomplished the mastery of language, his or her contribution to the community will increase. Herbert Clark (1996) is one of the main proponents of that concept in applied linguistics, Davenport and Prusak (1998) and Wenger (1999) have stressed this concept in knowledge management: An organization facilitates exchange of knowledge through a common vocabulary that is used in formal and structured documents within the organization, for example, research reports and marketing brochures. Knowledge is equally well shared through informal and unstructured documents including organizational stories, interoffice memos and emails.

Our focus will be on the formal and structured documents and we will be analyzing the language used in the documents at the lexical level and in particular, our focus will be on the so-called lexical words rather than the so-called grammatical words. The fact, notwithstanding that this categorization of the words of a language in itself is controversial; the categorization has an intuitive appeal. Put simply, grammatical words are used much more frequently than all the other words and these words generally comprise fewer letters: e.g. in the English language the word “the” comprises over 5% of any written text followed by “an”, “of”, “in”, “a”, “it”, “that”, “of”, “to”, “is” and “was”. These words make off 25% percent of most texts in English, and it is used for everyday or for general purposes.

The difference is in the usage of lexical words: then words, mainly nouns and adjectives, do distinguish between different specialist enterprises. The frequency of the word “telecommunication” will be very high in Siemens’ documents when compared, say, with documents produced by Xerox Inc; the converse will be true of the term “photocopier”. The choice of lexical words, incorporated in the terminology of the specialist domain changes over time in that the individual terms refer to the key concepts of the domain. The changes in the concepts, or changes in the preferential treatment of concepts, are reflected in terminology of a domain: for example, IBM Corp is no longer for its once world famous electric typewriters, and there is less emphasis on the term mainframe – IBM Corp now claims to be a consultancy company. The lexical content of IBM’s documents – research papers, inter-office memoranda, and marketing brochures - indicate the changes in the strategic outlook of the company. The choice of the certain lexical words, and the low-frequency usage of others, is a hallmark of a specialist domain (Ahmad, 1995). Does the communal lexicon of Clark, Wenger and others, manifest itself in the writings of the different members of the domain community? And more specifically, is there an idiosyncratic lexical signature of the domain community?

Our basic hypothesis is that much like the special language community shares aspects of a natural language with the broader linguistic community (in which the specialists are embedded), a community of practice shares aspects of its special language and preferentially use some constructs of the specialist language, coins its own terms, and avoids using terms used in the broader specialist community. One corollary of our hypothesis is that the changes in the lexical preferences of parts of a community of practice are an indication of knowledge diffusion. In this context it has been argued that one can ‘extract’ aspects of the conceptual system –or more ambitiously the ontology- of a domain using the lexical signature with some degree of success in domains as various as nuclear physics and forensic science, orthopedics and art criticism (see, for example Gillam, Ahmad & Tariq 2005 and Gillam & Ahmad 2005).

3. Method

The detection of the so-called lexical signature of a specialist domain has been of interest to researchers in Language for Special Purposes (LSP). An LSP is the variant of a natural language used in a specialist domain. A study of randomly selected collections of specialist texts, a specialist text corpus, is a good source for the terms and there are methods and techniques for automatically extracting terms (see, Ahmad and Al-Sayed 2005, for details and references therein). Typically, the distribution of individual single or compound words, or uni-variate analysis of individual random variables, is studied to study the nature and function of a given text (Manning and Schutze 1999). However, this uni-variate analysis is based on a number of simplifying assumptions about how a single lexical items
contributes to the ‘make up’ of a text at different levels of linguistic descriptions – lexical, syntactic, semantic, pragmatic- or different levels of conceptual descriptions – epistemological, ontological or logical. We use the distribution of single words to identify a specialist community – more preferentially used words show the ontological commitment of a community (Ahmad and Al-Sayed 2005).

In social and biological science the focus is usually two or more variables – many variables in fact- appear to affect the behaviour of a person or a system. Here techniques of multi-variate analysis are used to deal with the correlated behaviour of many variables; one of the techniques – with its own simplifying assumptions about how the variables may or may not be correlated- is factor analysis: According to Wikipedia, factor analysis seeks to ‘explain most of the variability among a number of observable random variables in terms of a smaller number of unobservable random variables called factors. The observable random variables are modeled as linear combinations of the factors, plus “error” terms.’. We will be using factor analysis to look at the distribution of compound words with a view to identifying a smaller number of factors. The factors will help us to distinguish various sub-communities that may constitute a specialist community above the level of the community but below that of a specialism as a whole.

Specifically, we wish to examine patterns of correlation between a large number of (multi-word) or compound terms with a view to extract the main underlying factors. Each of the factors or dimensions is independent of the other factors that are extracted (automatically) from a study of the compound terms: Each dimension may be expressed as a linear combination of two or more compound terms; sometimes one term may explain most of the variation along a given dimension. The main intention here is to quantify the intuition that the authors of a specialist text use a number of terms to emphasize or de-emphasize a concept, to highlight aspects of a theory, or to report the results of an experiment. The inclusion of factor analysis as the basis of studying the influence of the compound terms (by computing the variances due to the terms) is, an addition to our reported method, based on Everitt and Dunn’s algorithm of principal component analysis and factor analysis (2001: 50-51, 271).

Our method depends on the creation of a text corpus for the specialism including sub-corpora for different components of a community of practice. The corpus is then subjected to uni- and multi-variate algorithms:

**Univariate Analysis**: Single term and compound term detection

- Single terms are extracted using the ratio of relative frequency of a term in a special language corpus and its corresponding relative frequency in a general language corpus, using averages and standard deviations for computing z-scores of frequency and frequency ratios – the z-score computation involves univariate analysis.
- Compound terms are detected by measuring the collocation of two or more words – joint frequency of distribution of the components of a compound terms within a window of 5 words and the computation of histograms and the z-score of the collocates, both involving the computation of univariate statistics.

**Multi-variate Analysis** Comparison of frequency distribution of the terms across the community of practice:

- Let \( x = \{x_1, x_2, \ldots, x_p\} \) be a set of compound terms; Let \( y_j = a_j \cdot x \), be the jth the principal components of the observations x, such that \( a_j \cdot a_j - 1 = 1 \) and \( a_j \cdot a_i - 1 = 0 \) when \( j \neq i \);
- The variance of \( y_j \) is given as \( \text{Var}(y_j) = a_j \cdot S \cdot a_j \); and
- The total variance of the p principal components is computed from the eigenvalues of \( S \) – called \( \lambda \): \( \lambda_1 + \lambda_2 + \ldots + \lambda_p = \text{Trace}(S) \)
- The jth principal component accounts for a proportion \( \frac{\lambda_j}{\text{Trace}(S)} \) of the total shared variation on the original data, where
- \( \text{Correlation of the ith variable and the jth component is given as} \) \[ r_{ij} = \sqrt{\lambda_j} \cdot a_{ij} \]
- Include only those components j where the corresponding \( \lambda_j \) is greater than unity;
- Compute the factor scores for each group of texts with respect to each factor where the factors are interpreted as exemplars of a particular group within a community of practice.
4. A case study: Breast cancer-care

Cancer care is one of the key planks of health care systems. The investment in cancer research is considerable both at the national and international level. Cancer care involves experts researching the domain and professional medics and support professionals applying the knowledge of the experts. The professionals provide feedback, extend or restrict the scope of the application of expert’s knowledge, and make their own original contribution and establish best practice. Increasingly, patients are being involved directly in the cancer care loop – information is provided to the patients on an on-demand basis and the patients’ feedback is also disseminated.

4.1 Input data

The texts used in this case study were drawn mainly from the US-based American Cancer Society and the National Institute of Cancer. The size of a corpus is usually determined empirically – for general language corpus the size is typically around 100 million words for capturing the massive variation in the different uses of the general language across economic and social classes, across the literacy divide and so on. The size of a special language corpus can be determined by arguing that there is an intrinsic limitation on the size of such corpora as the number of authors and readers of specialist text is limited when compared to the general language authors and writers; usually a 1 million word specialist corpora will suffice. The different text types are also smaller for a specialist language and contains mainly learned articles, highly formalized and structured documents like memoranda, research and marketing reports, and instructional texts including user manuals and best practice documentation – the corresponding choices in general language involve a whole raft of imaginative texts (novels, magazines etc).

Our domain of interest is breast cancer care and we have collected three kinds of texts – abstracts of journal articles, best practice documentation, and informative literature available on the American Cancer Society website and other websites dedicated to patients. Table 1 gives the details of our three sub-corpora in the breast-cancer domain:

<table>
<thead>
<tr>
<th>Corpus</th>
<th>No. of tokens</th>
<th>No.of texts</th>
<th>Text Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td>255,144</td>
<td>224</td>
<td>Journal abstracts and full text</td>
</tr>
<tr>
<td>Professional</td>
<td>431,856</td>
<td>638</td>
<td>Journal abstracts; Full text articles on best practice and clinical trials</td>
</tr>
<tr>
<td>Patient</td>
<td>497,625</td>
<td>420</td>
<td>Informative articles from cancer research charities - full text</td>
</tr>
<tr>
<td>Total</td>
<td>1,184,625</td>
<td>1282</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Distribution of key terms within the three corpora: A univariate analysis

A comparison of the 10 lexical single words most frequently used in all three corpora shows key differences amongst the distribution of single keywords but with the key signature terms of the domain – breast and cancer given equal preference (see Table 2).

Experts use new terms (Breast cancer gene 1 and 2 abbreviated as BRCA1, BRCA2) much more frequently than the professionals and the patient, the focus of the experts appears to have moved away from ‘surgery’ but remains that of patients’ texts.

The rank correlation of frequently used words in the Expert and Professional corpus is 68% and between Professional and Patient corpus the rank correlation is 57%. There is a weak correlation between the ranks of the Patient and Expert frequent single words (0.28%)

A comparison of the distribution of compound terms reveals a similar picture. We have chosen 10 highest frequency compound terms (with a mutual information greater than or equal to 1): there is only one obvious term that has the same rank breast cancer but the other 9 are rather differently distributed (see Table 2b)
Table 2a. Sharing or otherwise of frequent single terms ranked according to frequency of all tokens in the three sub-corpora. In all three sub-corpora two key terms are shared (cancer, breast). The highlighted cells in the Table show the predominant use of the key terms in that particular sub-corpus.

<table>
<thead>
<tr>
<th>RANK</th>
<th>Single Words</th>
<th>Expert</th>
<th>Professional</th>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>cancer</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>breast</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>BRCA1</td>
<td>9</td>
<td>42</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>BRCA2</td>
<td>13</td>
<td>82</td>
<td>240</td>
<td></td>
</tr>
<tr>
<td>tamoxifen</td>
<td>221</td>
<td>31</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>chemotherapy</td>
<td>94</td>
<td>35</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>therapy</td>
<td>163</td>
<td>25</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>adjuvant</td>
<td>185</td>
<td>49</td>
<td>242</td>
<td></td>
</tr>
<tr>
<td>surgery</td>
<td>244</td>
<td>38</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>lymph</td>
<td>230</td>
<td>107</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>

Table 2b. Only one compound term has the same rank in all three corpora breast cancer, ovarian cancer is shared between two corpora at the same rank, otherwise compound terms are used with different preferences in the three corpora. The term or term components in bold is those that were preferentially used as single words – indicating the lexical productivity in all the three corpora.

<table>
<thead>
<tr>
<th>Compound Terms</th>
<th>Expert</th>
<th>Professional</th>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>breast cancer(s)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ovarian cancer(s)</td>
<td>2</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>mutation carriers</td>
<td>3</td>
<td>7</td>
<td>65</td>
</tr>
<tr>
<td>BRCA2 mutation(s)</td>
<td>4</td>
<td>26</td>
<td>58</td>
</tr>
<tr>
<td>BRCA1 mutation(s)</td>
<td>6</td>
<td>9</td>
<td>55</td>
</tr>
<tr>
<td>estrogen receptor(s)</td>
<td>13</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>endocrine therapy</td>
<td>50</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>metastatic breast cancer</td>
<td>51</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>lymph node(s)</td>
<td>42</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>radiation therapy</td>
<td>47</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

The rank correlation coefficient between the Expert and Professional corpus is positive (26%), but there is a stronger correlation between Expert and Patient (41%) and weaker between Professional and Patient (10%).

The above observations are based on a pre-knowledge of the language (English) and a working knowledge of the domain by the authors of the paper. Also, the use of the statistics is strictly based on a term-by-term basis. We have benefited from computation to the extent that over 1 million words of text were analyzed and both single- and compound terms were detected automatically.

4.3 Distribution of compound terms: A multivariate analysis

Table’s 2a and 2b show that we have to deal with a large number of compound words. These terms when looked up by somebody who is a competent native speaker of English, and knows something about breast cancer, can tell us that these terms are interrelated lexically and semantically with each other. Furthermore, the knowledgeable person can tell us that these terms suggests a common theme throughout the three corpora (e.g. breast cancer, ovarian cancer) or that some of the terms are characteristic of each corpus (e.g. BRCA1 mutations, BRCA2 gene for experts; endocrine therapy and estrogen receptors for professionals; lymph nodes, and breast reconstruction for the patients). The commonalities, distinctions and the apparent relationships between the terms within and across corpora may indicate that these terms are different manifestations of one or more concepts. What is required is the ability to identify terms, categorise the terms, and make statistically well-grounded judgments about the individual and collective distributions of the terms.

Factor analysis provides a quantitative and statistically well-founded method for reducing the number of original variables to a smaller set of derived variables or factors (see, for example, Biber, 1988 for an application of factor analysis to the study of variation in spoken and written language); note that we prefer to use the term dimension. Each dimension is a linear combination of the individual terms derived from a
correlation matrix of all the terms; if a correlation matrix element is unity then factor analysis method tells us that the two correlating terms will always be found together; if the element is zero, then it is not possible for terms to co-occur.

Consider the correlation matrix of 10 compound terms that are most frequently used when we look at our three corpora collectively (Table 3). We have used the SPSS statistical package to compute the matrix and the rest of the calculations. One can see some terms correlate well with a few other terms whilst others either little or weakly negative correlation. But these judgments, like some made with univariate analysis, can be only made after a visual inspection of the results. Factor analysis helps us to make the statement with the help of multivariate statistics.

Table 3. Correlation matrix for the 10 most frequently used compound terms in our corpus. The term breast cancer does not appear to correlate with any of the other nine terms, indeed, it mildly anti-correlates with all others. But ovarian cancer correlates positively with BRCA1 and BRCA2 mutation, and mutation carriers (BRCA stands for BRBreast Cancer gene/mutation and so on); estrogen receptor only correlates with endocrine therapy.

<table>
<thead>
<tr>
<th></th>
<th>breast cancer(s)</th>
<th>ovarian cancer(s)</th>
<th>Mutation carriers</th>
<th>BRCA2 mutations</th>
<th>metastatic breast cancer</th>
<th>estrogen receptor(s)</th>
<th>endocrine therapy</th>
<th>BRCA1 mutation</th>
<th>lymph node(s)</th>
<th>radiation therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>breast cancer(s)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ovarian cancer(s)</td>
<td>-0.12</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mutation carriers</td>
<td>-0.02</td>
<td>0.34</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRCA2 mutation(s)</td>
<td>0.03</td>
<td>0.35</td>
<td>0.49</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metastatic breast cancer</td>
<td>-0.05</td>
<td>-0.10</td>
<td>-0.04</td>
<td>-0.08</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>estrogen receptor(s)</td>
<td>-0.02</td>
<td>-0.06</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.12</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>endocrine therapy</td>
<td>0.03</td>
<td>-0.09</td>
<td>-0.06</td>
<td>-0.07</td>
<td>0.18</td>
<td>0.35</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRCA1 mutation</td>
<td>-0.03</td>
<td>0.43</td>
<td>0.38</td>
<td>0.45</td>
<td>-0.07</td>
<td>-0.01</td>
<td>-0.06</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lymph node(s)</td>
<td>-0.08</td>
<td>-0.16</td>
<td>-0.09</td>
<td>-0.09</td>
<td>0.01</td>
<td>0.10</td>
<td>0.01</td>
<td>-0.09</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>radiation therapy</td>
<td>-0.08</td>
<td>-0.06</td>
<td>-0.01</td>
<td>0.01</td>
<td>0.00</td>
<td>0.07</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.36</td>
<td>1</td>
</tr>
</tbody>
</table>

We have created a correlation matrix of all the compound terms whose mutual information is greater than one; mutual information is given by Manning and Schutze (1999) as:

\[
\text{Mutual Information} = \log_2 \left( \frac{f(a,b)}{f(a) \times f(b)} \right)
\]

Where \( f(a) \), \( f(b) \), is the frequency of occurrence of the words \( a \), \( b \), and \( f(a,b) \) the frequency of occurrence of the compound word \( ab \).

In Table 4, we can see a part of the factor matrix were 21 terms are shown as well as the final factor matrix including 7 factors or dimensions that were extracted. Each compound term makes its own contribution to the texts. In factor analysis, the loading of a variable, e.g. a compound term on a factor reflects how the variation in the frequency of that compound term correlates with the overall variation of dimension. Indeed, it is considered as a good indicator of how strong or weak is the co-occurrence relationship between a given compound word term and the dimension as a whole; therefore, loadings less than 0.30 are generally considered not interesting for the interpretation of the dimensions. The important and salient loadings (loadings above the threshold) the should be interpreted as part of each dimension; whether negative or positive, which indicates that the sign does not really affect the importance of loading (See Biber, 1988). The most frequent compound words that contribute significantly to one of the dimensions are: BRCA1 mutation(s), ovarian cancer(s), BRCA1 gene(s), these terms form the first dimension or (Factor 1), as they have loadings larger than 0.30 on this dimension. Note that BRCA2 mutation(s) and mutation carriers load also significantly on Dimension 4. However, they have their highest loadings on Dimension 4. While DNA repair, BRCA1 protein have loadings less than 0.30, so they don’t show any significant relationship with Dimension 1, and so on for each of the factors. However, these loadings are not equal; hence, they are not representatives of the dimension. So, in the interpretation of each factor, the focus is on the variables with greatest loadings, regardless of its sign.

The positive and negative loadings show the groups of words that co-occur in the same texts systematically which indicates a specific subject that has been discussed in the text. Note that the compound words: germline mutations and mutation carriers load significantly on both Dimension Factor 1 and Factor 4, however, their greatest loadings are on Dimension 4: we consider their relationships with Factor 4 as more significant for interpretation with Factor 4. It should be noted however, that they load also on
Factor 1, and perhaps, these two compound words co-occur together with high frequency in texts and in a systematic way and they have a special relationship to each other. For example, when radiation therapy, lymph node(s), and hormone therapy co-occur in texts, it is more likely to show the absence of metastatic breast cancer where its loading on Factor 4 is negative and that should be taken into consideration.

We may conclude that, the results of the principal components of a total of 30 compound terms show the clear emergence of 7 dimensions. (Table 4).

Table 4. Part of the factor matrix of the analyzed terms, loadings in bold indicate significant relationship between dimension and term.

<table>
<thead>
<tr>
<th>Term/Dimension</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRCA1 mutation(s)</td>
<td>0.77</td>
<td>0.03</td>
<td>0.2</td>
<td>0.03</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ovarian cancer(s)</td>
<td>0.72</td>
<td>0.01</td>
<td>-0.06</td>
<td>0.1</td>
<td>-0.05</td>
<td>-0.09</td>
<td>-0.09</td>
</tr>
<tr>
<td>BRCA1 gene(s)</td>
<td>0.56</td>
<td>0.04</td>
<td>0.07</td>
<td>-0.03</td>
<td>0.01</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>DNA damage</td>
<td>0</td>
<td>0.76</td>
<td>-0.03</td>
<td>-0.05</td>
<td>-0.03</td>
<td>0</td>
<td>-0.04</td>
</tr>
<tr>
<td>DNA repair</td>
<td>-0.04</td>
<td>0.72</td>
<td>-0.03</td>
<td>0.11</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.06</td>
</tr>
<tr>
<td>BRCA1 protein</td>
<td>0.09</td>
<td>0.66</td>
<td>-0.01</td>
<td>-0.06</td>
<td>0.02</td>
<td>-0.02</td>
<td>-0.01</td>
</tr>
<tr>
<td>endocrine therapy</td>
<td>-0.08</td>
<td>-0.04</td>
<td>0.73</td>
<td>-0.03</td>
<td>-0.07</td>
<td>-0.15</td>
<td>0.28</td>
</tr>
<tr>
<td>estrogen receptor(s)</td>
<td>-0.05</td>
<td>-0.02</td>
<td>0.68</td>
<td>-0.03</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>progesterone receptor(s)</td>
<td>-0.03</td>
<td>-0.01</td>
<td>0.59</td>
<td>-0.02</td>
<td>0.21</td>
<td>0.09</td>
<td>0.02</td>
</tr>
<tr>
<td>brc2 gene(s)</td>
<td>0.13</td>
<td>0.06</td>
<td>-0.07</td>
<td>0.78</td>
<td>0.01</td>
<td>-0.1</td>
<td>0.06</td>
</tr>
<tr>
<td>germeline mutations</td>
<td>0.13</td>
<td>-0.06</td>
<td>-0.02</td>
<td>0.65</td>
<td>-0.03</td>
<td>-0.03</td>
<td>-0.01</td>
</tr>
<tr>
<td>brc2 mutation(s)</td>
<td>0.42</td>
<td>-0.05</td>
<td>-0.07</td>
<td>0.48</td>
<td>0.04</td>
<td>-0.11</td>
<td>-0.06</td>
</tr>
<tr>
<td>mutation carriers</td>
<td>0.36</td>
<td>0.05</td>
<td>0.41</td>
<td>-0.06</td>
<td>0.01</td>
<td>0</td>
<td>-0.01</td>
</tr>
<tr>
<td>lobular carcinoma</td>
<td>-0.04</td>
<td>-0.02</td>
<td>0.04</td>
<td>-0.02</td>
<td>0.84</td>
<td>0.04</td>
<td>-0.06</td>
</tr>
<tr>
<td>ductal carcinoma</td>
<td>-0.03</td>
<td>0</td>
<td>0.03</td>
<td>0.81</td>
<td>0.07</td>
<td>0</td>
<td>0.08</td>
</tr>
<tr>
<td>radiation therapy</td>
<td>-0.04</td>
<td>0</td>
<td>0.03</td>
<td>0.04</td>
<td>0.06</td>
<td>0.06</td>
<td>0.1</td>
</tr>
<tr>
<td>lymph node(s)</td>
<td>-0.1</td>
<td>-0.06</td>
<td>-0.02</td>
<td>-0.07</td>
<td>0.1</td>
<td>0.53</td>
<td>-0.14</td>
</tr>
<tr>
<td>hormone therapy</td>
<td>-0.05</td>
<td>-0.03</td>
<td>0.04</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.51</td>
<td>(0.45)</td>
</tr>
<tr>
<td>adjuvant tamoxifen</td>
<td>-0.04</td>
<td>-0.02</td>
<td>0.06</td>
<td>-0.03</td>
<td>0.04</td>
<td>-0.05</td>
<td>0.62</td>
</tr>
<tr>
<td>adjuvant therapy</td>
<td>-0.04</td>
<td>-0.03</td>
<td>0.07</td>
<td>-0.01</td>
<td>-0.02</td>
<td>0.26</td>
<td>0.58</td>
</tr>
<tr>
<td>aromatase inhibitors</td>
<td>-0.06</td>
<td>0.04</td>
<td>(0.51)</td>
<td>-0.04</td>
<td>-0.11</td>
<td>-0.17</td>
<td>0.53</td>
</tr>
</tbody>
</table>

In order to characterize the texts with respect to each dimension, we computed the dimension value by summing, for each text, the number of occurrences of the compound terms that load saliently on that dimension. For ensuring the experimental independence of dimension values, each compound term was included in the computation only once, thus, each compound term is included in the dimension value of the one on which it has the highest loading.

In more concrete terms, the first dimension that accounts for 6.2% of the shared variance in the data consists of 30 compound terms that were included in the analysis. Just the three terms that have salient loadings (ovarian cancer, BRCA1 mutations and BRCA1 gene(s)), alone account for 4.7% of the total 6.2%, so if we did not include the loadings of these three compound terms in the computation of the total shared variance account for this dimension, then the account for the shared variance will be dramatically reduced to 1.4%.

From here, we can see the importance of these three compound terms with respect to this dimension as they represent for 76% of the total shared variance that is accounted for in this dimension. The same applies for Dimension 2 which accounts for 5.4% of the shared variance in the data; the compound terms which have the salient loadings on this dimension are: DNA Damage, DNA repair, BRCA1 protein(s) which account for 5.1% of the shared variance while all the other compound terms account for the rest of 0.03% of the total shared variance for this dimension, and so on.

The result of this constraint is that certain terms above the threshold (0.30) will not be included and they have been marked by the parentheses surrounded the value (in Table 4). For example, consider Dimension 1, we sum the frequency of occurrence of BRCA1 mutation(s), ovarian cancers, BRCA1 gene(s), for each text, then for each of the three corpora. The dimensions can be
expressed as linear combinations of these compound terms that were included for the computation of dimension values. (Table 5.)

Table 5. The dimensions expressed as linear combinations of the key compound terms

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
<th>Term 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>BRCA1 mutation(s)</td>
<td>ovarian cancers</td>
<td>BRCA1 gene(s)</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>DNA damage</td>
<td>DNA repair</td>
<td>BRCA1 protein</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>endocrine therapy</td>
<td>estrogen receptor(s)</td>
<td>progesterone receptor(s)</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>BRCA2 gene(s)</td>
<td>germline mutations</td>
<td>BRCA2 mutation(s)</td>
<td>mutation carriers</td>
</tr>
<tr>
<td>D5</td>
<td>lobular carcinoma</td>
<td>ductal carcinoma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>radiation therapy</td>
<td>lymph node(s)</td>
<td>hormone therapy</td>
<td></td>
</tr>
<tr>
<td>D7</td>
<td>adjuvant tamoxifen</td>
<td>adjuvant therapy</td>
<td>aromatase inhibitors</td>
<td></td>
</tr>
</tbody>
</table>

When we compute the principal components for each of the three corpora, we get a sense of how these un-correlated variables will help us in distinguishing the use of the terms used in the three corpora (Table 6).

Table 6. The values of each of the dimensions for our three corpora.

<table>
<thead>
<tr>
<th>Corpora</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>D7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td>1.65</td>
<td>1.24</td>
<td>-0.38</td>
<td>1.34</td>
<td>-0.28</td>
<td>-0.77</td>
<td>-0.32</td>
</tr>
<tr>
<td>Professional</td>
<td>0.05</td>
<td>0.00</td>
<td>0.28</td>
<td>-0.09</td>
<td>-0.10</td>
<td>-0.36</td>
<td>0.86</td>
</tr>
<tr>
<td>Patient</td>
<td>-0.54</td>
<td>-0.31</td>
<td>-0.29</td>
<td>-0.38</td>
<td>0.13</td>
<td>0.60</td>
<td>-0.08</td>
</tr>
<tr>
<td>Identifies</td>
<td>Experts</td>
<td>Professionals</td>
<td>Patients</td>
<td>Experts</td>
<td>Professionals</td>
<td>Patients</td>
<td></td>
</tr>
</tbody>
</table>

From table 6. We can see the Expert corpus have high positive scores on D1, D2, D4 and negative on D6, where the Patient corpus accounts high on D5 and D6 and negative on D1, similarly for the Professional Corpus as we see in the following:

<table>
<thead>
<tr>
<th>Corpora</th>
<th>D1 (1.65)</th>
<th>D2 (1.24)</th>
<th>D4 (1.34)</th>
<th>D6 (-0.77)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experts</td>
<td>D3 (0.28)</td>
<td>D7 (0.86)</td>
<td>D6 (-0.36)</td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>D5 (0.13)</td>
<td>D6 (0.60)</td>
<td>D1 (-0.54)</td>
<td></td>
</tr>
</tbody>
</table>

### 4.4 An initial evaluation

The three dimensions of variation of the expert texts, that is, the terms that explain much of the variance amongst these texts focus on the novel concept of *breast cancer genes* and their mutations, and ovarian cancer (dimensions D1, D2 & D4)– the acronym BRCA is used frequently as an adjective to emphasize the novelty of the concept; the professionals focus on *therapies* of different types and *receptors* for *estrogen* and *progesterone* (D3 & D7); the variance in the texts produced for patients is explained by two different types of *carcinomas* and the *therapies* include *radiation* and *hormone*, and *lymph nodes* (D4 & D5). The dimensions score show strong differences between experts’ texts and that written for the patients, with milder differences between professionals and patients.

The experts are focusing on novelty, the professionals are maintaining a balance between novelty and current knowledge, and patients’ texts are oriented towards well established practices (*radiation* and *hormone therapy*) and well known after-effects of breast cancer on *lymph nodes*.

### 5. Conclusions and future work

A method for extracting key terms used in a specialist community of practice was described and factor analysis was used to compute the importance of some of the terms. This method is based on well-established methods in corpus linguistics, terminology, and multivariate analysis. The results show two interesting findings: First, the variance in the Expert corpus is accounted for by 10 compound terms, where the number that accounts for the variance in Professional corpus is 6 and in Patient corpus is 5 (see Table 4). Second, the dimension values show that one can discriminate between the dimensions of variations in Expert corpus where (D1, D2, D4) account for the highest sum, while in Professional corpus (D3, D7) account for the highest sum. Additionally, it was noted that the dimensions that have high positive values for Patient corpus have negative values for Expert corpus.

Our results support how the different parts of the community share some key terms and almost exclusively use others. We have used a more objective criterion for determining which of the terms the different parts of the community prefer.
The similarities and differences indicate the extent of knowledge sharing on the one hand and identify the emergence of new ideas on the other.

We are currently conducting a diachronic study where texts published at different times will be examined. The dimensions of variation across time perhaps will indicate the rate at which ‘knowledge’ is diffusing. Another strand of our work is to verify the results obtained in the breast cancer study in another domain. Initial work in the domain of tunneling diodes – a sub-branch of semiconductor devices and materials- shows we can similarly distinguish between research papers (written by experts) and patent applications (written by legal experts with a working knowledge of the domain).

References
Knowledge Sharing Practices: Analysis of a Global Scandinavian Consulting Company

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Abstract: In a knowledge economy landscape, successful global consulting firms are the ones putting focus on effectively and efficiently organising and managing the highly distributed diversified knowledge in the organisation. In order to sustain their competitive advantage, knowledge-companies need to harness knowledge and to analyse knowledge sharing mechanisms and learning in the whole organisation. Knowledge sharing in global firms is a not only a cross-department process but it should also take place within the same department. It is well recognised that the knowledge sharing mechanism is a highly complex process to put in place and to promote in the organisation. The primary goal of our research is to empirically investigate knowledge sharing and learning mechanisms within a global consulting company. The phenomenology discipline has guided our research methodology because it is the most appropriate approach for coping with the social complexity of management and business. Our research approach intends to make social sense from the knowledge sharing practices and observations conducted in order to understand how and what is shared.

Keywords: Knowledge sharing, learning organisation, phenomenology, information communication technology, culture, empirical knowledge sharing investigation

1. Introduction

Due to a changing business environment today, organisations are facing challenges of global competitiveness. Furthermore, organisations are confronted more and more with issues such fast technological changes, product lifecycle shortened, downsizing, high market volatility. In order to cope with these challenges, organisations need to be able to manage highly distributed diversified knowledge. Challenges rely on the identification of crucial knowledge that improves the business process. Knowledge is central but even more so is the understanding of the knowing process, and the learning and knowledge transfer/sharing process (Küpers, 2005, Apostolou, 1999). Companies understanding the need to harness knowledge are aware about the crucial issue of creating a work environment that fosters knowledge sharing mechanisms and learning capabilities within and across organisations. It is well recognized that knowledge-sharing mechanisms are highly complex processes to promote in the organisation (Allix, 2003). Indeed knowledge-sharing hostility is perceived rather as a phenomenon that widely dominates organizational reality (Husted, 2002, Gupta, 2004).

Despite the large amount of literature about knowledge management practices from researchers and practitioners, knowledge sharing mechanisms still require to be understood (Hansen, 1999, De Long, 2000). Indeed, there is still a need to undertake further empirical study in analysing the role of knowledge sharing process as a vital key for a successful knowledge management in organisations. Investigation of diversified cases studies is required in order to get an in-depth account of knowledge sharing processes, organisational culture, trust and technological components and how they can possibly interact with each other (Dixon, 2002b).

The primary goal of our research is to empirically investigate knowledge sharing and learning mechanisms in a global Scandinavian consulting company. Our original study is based on the phenomenology approach, which examines various structures of experiences ranging from perception, social and linguistic activity involving meanings, communication, understanding, mood, etc. (Banning, 1995).

Phenomenology is particularly well suited to social complexity of business and management by providing observable indicators. Phenomenology as a discipline is related to other key disciplines in philosophy, such as ontology, epistemology, logic, and ethics (Smith, 2003). Therefore this multidimensional approach is used to develop a complex account of awareness of everyday activities performed in the life-organisation and with focus on understanding the knowledge sharing mechanisms. Our study intends to classify, describe, interpret and analyse structures of people’s experiences in order to specify a generic knowledge-sharing framework taking into account organizational and social dimensions. The present paper focuses on identifying organisational factors impacting on the knowledge sharing process in a global consulting company.
sharing process within and across-departments in a global Scandinavian consulting company.

The next section of this paper presents a literature review on knowledge management and the related topics of knowledge sharing concepts and learning organisations. Section three outlines the organisational context of study and the adopted research methods. In section four, data analysis is discussed.

2. Knowledge and knowledge managements concepts

2.1 Background

It is well recognised today that knowledge is one of the most competitive resource for the dynamic global business environment (Sharif, 2005). Indeed, in recent years companies have strongly focused on organising creating, transferring, searching, sharing Knowledge under the roof so-called Knowledge Management (Hildreth, 2002). On the other side, the multidisciplinary academic world such as philosophy, sociology, computer science have generated a large amount of publications on various perspectives and dimensions of knowledge management (Davenport, 1996, Davis, 2002).

It is usually agreed that there is no common definition of knowledge but let’s recall some of the popular definitions. “Knowledge is justified true belief that increases an individual’s capacity to take action” (Ayer, 1956). Davenport (2000) defines knowledge as “a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information”. According to (Brooking, 1999) knowledge is defined “as information in context with understanding to applying that knowledge”. The wide-based knowledge definitions highlight there are several forms of knowledge; tacit, explicit, implicit and systemic knowledge at the individual, group and organisational levels (Davenport, 2000, Dixon, 2002a, Polanyi, 1958, Nonaka, 1995, Inkpen, 1996).

Explicit knowledge has a tangible dimension that can be easily captured, codified and communicated. It and can be shared through discussion or by writing it down and stored into repositories, documents, notes, etc. Examples might include a telephone directory, an instruction manual, or a report of research findings. In contrast, tacit knowledge is linked to personal perspectives, intuition, emotions, beliefs, how, experiences and values. It is intangible and not easy to articulate, so it tends to be shared between people through discussion, stories and personal interactions. The management of explicit or tacit knowledge consists of performing one or several of the knowledge processes such as transferring, creating, integrating, combining and using knowledge. It is acknowledged that knowledge sharing is a nebulous concept very important for harnessing knowledge (Petersen, 2002, Little, 2002) and thus requires a holistic approach. Studies have focused either on knowledge sharing inter-organisations (Husman, 2001) or inter-units in a firm (Davis, 2002).

Knowledge sharing is not well defined in the literature partially because the research area have not been very active. Knowledge sharing has been defined as providing one’s knowledge to others as well as receiving knowledge from others(Dixon, 2002b, Davenport, 2000, Bircham-Connolly, 2005). A more pragmatic description of knowledge sharing is “the process through which one unit is affected by the experience of another” (Argote, 2003). We adopt the following definition of (Willem, 2002), “Knowledge sharing process is defined as exchange of knowledge between at least two parties in a reciprocal process allowing reshaping and sense-making of the knowledge in the new context”.

Today, many organisations are concerned about how organizational members share their knowledge and accordingly have set up some incentives to motivate them to make their knowledge available to the organisation or to retrieve knowledge stored in the corporate repositories when needed (Gupta, 2004).

The literature study shows us that there are several models for knowledge sharing (Petersen, 2002). The sharing knowledge forms with direct interaction between people or indirect interaction through the document creation. However, analysis of knowledge sharing practices shows that reluctance to share is dominating the organisational reality (Husted, 2002, Willem, 2003).

Factors affecting the behaviour of knowledge sharing have been quite heavily investigated (Wasko, 2000, Aridchvili, 2003). However, most of studies have focused either on social or technological dimensions. Few studies integrating the both dimensions have been conducted (Fu, 2005). Accordingly, our research project intends to analyse the sharing process integrating both dimensions based on the phenomenology approach described below.
2.2 Methodology of study

Knowledge sharing is a context-embedded process making its measurement difficult; there is so far no standard method to measure the sharing process. We have at first stage investigated the most appropriated research methodologies available. There are several qualitative research methodologies available such as ethnography, narrative inquiry, ethno-methodology, grounded theory, and phenomenology.

With the aim of understanding knowledge flow between people and being able to provide a correct interpretation of complex social structures within the study group, we have decided to perform qualitative observational research into the nature of group behaviours. Accordingly, we took an empirical approach based on observations of the behaviour of individuals or groups in their knowledge sharing and learning processes. We have opted for a dynamic approach updating accounts of observations on multiple levels of individual/group interactions.

The Phenomenology discipline has guided our research methodology because it is the most appropriate approach coping with the social complexity of business and management. This approach sets the research in a social context and with an idea to try to make social sense from observations. This should give us a more comprehensive understanding of knowledge sharing and learning mechanisms embodied in individual and group behaviour by being aware of what and why things are occurring.

Furthermore, the flexibility of this discipline facilitates the discovery of the reality of a situation or the reality behind a situation (Saunders, 2000). This is a major element to take in account in Knowledge management since the study context is highly dependant on several domains as stated by (Furlong, 2001) (i) personnel characteristics and experience of the knowledge worker, (ii) socio-technico and environmental facilitators or inhibitors to organisation development and in particularly with regard to knowledge sharing process, (iii) organisational culture.

Our research study is based on long-term observation (10 months) of a group with participation in that group. Observations of the working practices in context should foster the perception of elements that could have been omitted or simply not even considered if we have focused only on outcomes of the interviews. The underlying pragmatic research aims to conduct observations on what is being shared, why it is shared, how it is shared and who is sharing.

The empirical investigations seek to explore individual or group behaviours with the idea to grasp the organisational culture and see how people are interacting while working. For the first study, we have restraint our investigation to only two locations in the organisation. However, at a later stage, we aim to extend our study to the whole organisation.

Several focused and semi-structured interviews have been conducted with different managers and knowledge workers focusing especially on some specific Knowledge sharing mechanisms that help us to understand the sharing process beyond simple organisational anecdotes. We have performed various sessions of cyclic observations.

A set of indicators generated from the observation phase has been identified. The evolution of those indicators had been recorded in a grid. We are planning to complete our study with a survey of knowledge worker practices at a more organisational level.

In addition, we have collected and analysed a variety of corporate documents including reports, internal notes, knowledge repositories content, papers, minutes. It provided a more comprehensive picture of Knowledge sharing process.

By the end of our empirical investigation, we should be able to answer our fundamental global research question: “What are the indicators that facilitate or inhibit knowledge sharing mechanisms?”

Analysis and interpretation (Hermeneutics) of collected data are subject to the cognitive skill and current thinking of the researcher/observer (Agostini, 2000). Accordingly, the elaborated model does not definitely reflect all the aspects and dimensions of this highly complex of Knowledge sharing and learning mechanisms. Furthermore the selected indicators might enlighten only some perspectives of those mechanisms. Therefore, further research works should be conducted in order to confirm or refute the result of our study.

3. Organisational context: Global Scandinavian consulting firm

3.1 Organizational requirements specification and analysis

The research study is conducted within a global Scandinavian consulting firm supporting businesses in 60 countries. The company provides competitive and scalable services with
global coverage within the areas of desktop management file and print services, user administration, software distribution, license control, inventory, anti-virus, end-users support all in multiple languages. The organisation employs more than 600 people and when needed they supply with external consultants.

The company as an intensive knowledge firm is project-based and is distributed over geographical location. The diversified skilled consultants are highly mobile working at the client site. Consulting activities dominate their business activity. Therefore one main challenge for the top management is to keep tracks of the consultants activities, who are spread locally (customer sites), regionally or worldwide. Furthermore, the company is facing the problem of knowledgeable employees leaving the firm either through early retirement, better job offers, buy-outs or other reasons.

In order to deal with those issues, the company have instigated some Knowledge management initiatives. Undertaken initiatives encompass building huge corporate knowledge repositories, set up of collaborative tools, knowledge mapping, open office landscape configuration, coaching, training in order to foster the Knowledge sharing processes and learning.

However the preliminary analysis of the collected data shows that Knowledge management and learning processes are not managed at a formal organisational level but rather is a spontaneous activity embodied in a daily work

3.2 Findings

Although the study is still ongoing, preliminary analysis of typical working daily practices has already given us an understanding of the potential factors to consider such as type of the shared Knowledge, its quality/relevance, transfer speed, sender and receiver perspectives (absorptive capacity), culture, trust, motivation, working environment.

For the purpose of our study and in the context of the consulting company, we have identified and classified three types of corporate knowledge such explicit, tacit and implicit. It was important to make this distinction since the knowledge sharing processes might be supported differently (Ardichvili, 2003). According to the nature of knowledge, knowledge sharing concepts are based on general framework where tacit knowledge or skills of people is shared through formal and informal networks and explicit knowledge through systems, knowledge repositories, and documentation exploitations.

Based on the information and knowledge gathered through interviews and observations, we can deduct that there is a lack of inter-project exchange of knowledge and the knowledge workers based at the client site have very little opportunity to meet, socialize and informally discuss topics of interest. Although informal networks of people have emerged in order to share crucial knowledge or expertise necessary for carrying out working daily activities, those communities in place are rather seen as many close clusters within the organisation with specific tools or common informal business rules. It results in the organisation many small islands of expertise that is framed into the specific business areas. The observation described below confirms how much it is important to share experience.

**Obsv1:** “Newly employed backup wanted to install a new driver for the IBM Tivoli program as a solution to the Overlay problem with the WinDVD program, but one co-worker present and working on a daily base remember that someone had previously tried this manipulation and that it has engendered some problems. So he advised to not install the drive until he had talked to worker that had done it before. It turned out that after some discussions that the installation of the new driver will make the laptop unusable and will lead to the reinstalling of the whole operating system”.

Furthermore, this observation shows how much the informal network and the location of expertise are important to the efficiency of the business.

However due to the consulting nature of the business, the finding shows that if an experienced worker is not present locally, an employee tends to solve once again a problem that had occurred before, thus leading to the concept “reinventing the wheel” and consuming time on something that have been previously solved.

In order to overcome this known problem, the management has pushed knowledge repositories building. Still there is no obvious evidence that people will investigate if the knowledge is available in repositories or find what they are looking for or even contribute to update the repositories. This is due to several reasons; for example, we observed some situations where quite often, employee has been spending part of the day looking for information that has been misplaced. Furthermore, people based in a same location tend rather to ask each other instead of using the collaborative tools or the repositories.
Obs2: “One day, there was an urgent need for expertise on ADSL routers and the worked was not able to find it in the local environment, after some checking he learnt that the person having the expertise was in vacation. Since the client could not wait, he had to spend many hours solving it by trying and failing. The client’s problem was a new type of issues and there was too little information in the knowledge repository. However after solving it, the employee didn’t make input after the log either.”

Indeed, we have noticed that some users are still sceptical to make knowledge available for others. And for the one willing to contribute to the repositories building or repositories, publishing is seen as a strenuous activity and time consuming. Some employees perceive codification as a strong burden and the resistance to exploit optimally the repositories reflects it. A major claim from the employee is related to the lack of time, since there is a high pressure on the number of working hours with clients (7.5 hours per day).

It has been as well reported that the large variety of tools available in the company might actually slow down the transfer of the knowledge on top of increasing difficulties to maintain the overview of the used tools. When an employee uses a tool in a process, this tool alters the way the process is being performed and adds to the alignment with the company’s way of working. Some of the tools that are being used today for knowledge management are the CRM system (CPSS) and E-Support, which is linked into this by a database search function (Helping Hand). Historically this database was only used in Lotus Notes when this was considered the only collaborative tool. Interviewing the management in the Communication and Information department revealed that much of the effort of the department went to the use of intranet and IBM Lotus Domino Document Manager, which organizes documents and provides a lot of possibilities for collaborative work.

The organisation is promoting an open office with flexible workstations as a means to foster the tacit knowledge sharing amongst workers. The physical space and layout influence the way in which employees move around in the organization and thus whom they interact with during the day(Petersen, 2002). There is often more than one team located in one room. This enables cross-team communication on an informal level and can result in faster solutions to the question at hand. As stated by Davenport (2000), the best enabler for knowledge transfer is to hire smart people and let them talk to each. The following observation seems to confirm the decision.

Obs3: “The computer support team are working in an open space. A worker got a call from a client explaining that he spilled some cola on his keyboard. The employee did not know how to handle this request, so he asked his colleague from another team sitting next to him. He got the information that he should address this problem to ‘installation team’. By chance, a person from this team was sitting in the room., He decided to take over of the case, and registered it in the log-system (CPSS). He called back the client informing him that in this case, he had to order a new keyboard. The support worker didn’t understand why the client had to change the keyboard until he got the technical explanation from the installation team a bit later”.

In this specific case, the solution was quickly fixed and it was mainly thanks to the open space that let people communicate and cooperate easily and faster. In general, this type of open environment is well perceived by people working on customer supports where there is a strong need to know who to ask if, the worker do not know how to handle the request of the customer.

However during the interviews, it has been mentioned that working in an open office can be considered as an hindrance to perform their daily tasks quicker since they are many interruptions and people exchanges thoughts and reflections can slower the working pace and might been seen rather time consuming. In addition, there is the problem of noise and questions of inefficiency. People working at the customer support service unit receive several calls from the clients and in order to be able to concentrate on the description of the problem, the worker might take his phone and isolate himself in an empty room, however if he needs to check some data on the computer he might have to come back to his desk.

Furthermore, occasionally, some people stayed longer at the working place only to be able to accomplish their tasks in a quieter environment, they feel that it was only at that time they can concentrate on their work. Though when the managers are sharing the same open office with the knowledge workers, it has been observed, the communication and moves between employees are reduced drastically, creating a quieter environment however may be with less interaction between employees.

In addition to observations, analysis of gathered data led to identification of crucial behavioural indicators influencing the knowledge sharing process such trust, attitude of the sender and receiver, mood, opportunistic behaviour. Those
indicators are grouped as “social capital” of the organisation.

Other indicators that play important role in fostering knowledge sharing process are related to proper rewards and incentives. It has been mentioned several times during interviews that introducing such mechanisms will encourage employee’s attitude to be more positive toward knowledge sharing. Knowledge workers are more likely to participate in knowledge management activities if recognized or even rewarded financially.

The fundamental issues for the managers are to set up strategies that will facilitate knowledge sharing. Therefore, it is important to understand what are the indicators facilitating or inhibiting the sharing process.

4. Conclusion

Today task independency that workers have to perform requires a flow of information and a high level of knowledge sharing. This would imply appropriate approaches to transfer tacit knowledge such as communities of practice at a more organisational level or use of adequate technology to support the codification, storage, organisation, and retrieval of knowledge.

Our study has explored some of the mechanisms and issues related to knowledge sharing process in a global consulting firm. Even if the organisation has implemented some knowledge management strategies, our investigation shows that knowledge management practice is still not an obvious organisational reality. Therefore, management needs to understand better the factors that facilitate knowledge sharing activities.

Our research study indicates those socio-technical environmental indicators such as shared knowledge, its quality/relevance, transfer speed, sender and receiver perspectives (absorptive capacity), culture, trust, motivation, incentive; and environment play an important role in improving the knowledge sharing process.

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References


The Effect of Knowledge Management Context on Knowledge Management Practices: an Empirical Investigation

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Abstract: This paper presents recent research findings on the effects of organizational knowledge management (KM) context on KM practices. Data were collected at a large Canadian law firm via a Web-based survey instrument from over 400 participants comprising professional and support staff working in various office locations. The purpose of the study was to gain insight on the antecedents of knowledge management behaviors in organizations. A theoretical model explicating the impact of an organization’s KM environment on both organizational and individual KM behaviors was developed and tested using structural equation modeling techniques. The moderating effects of age, biological sex, job category, and years spent in the organization were also examined. Results indicate that an organization’s knowledge management environment impacts on both organizational as well as personal knowledge management behaviors. Furthermore, we show that organizational KM behavior also influences personal KM behavior, thus acting as a mediator between the overarching organizational knowledge management policies and practices and the employees’ individual practices. Based on this empirical evidence, recommendations are suggested for organizations wishing to institutionalize knowledge management initiatives in their firms.

Keywords: Knowledge management behaviour, knowledge management practices, knowledge management context, knowledge management environment, knowledge sharing, corporate strategy.

1. Introduction

This paper explores the relationship between knowledge management context and knowledge management practices in organizations—a broad research area indeed. Over the brief history of the knowledge management field, there have been many interpretations and descriptions of the theoretical constructs and variables that constitute organizational knowledge management context and practices. Surprisingly little empirical analysis on the effects of one on the other exists. This paper is an attempt to bridge that void.

For this paper, knowledge management is defined to be the systematic, effective management and utilization of an organization’s knowledge resources (i.e., ones that contain or embody knowledge) and encompasses the creation, storage, arrangement, retrieval, and distribution of an organization’s knowledge (Saffady, 1998). This includes the “methods and tools for capturing, storing, organizing, and making accessible knowledge and expertise within and across communities” (Mack, Ravin and Byrd, 2001, p. 925). It also includes the active management and support of human expertise (Blair, 2002). In this sense, knowledge management deals equally with the acquisition, handling, and use of explicit knowledge as well as the management of tacit knowledge in terms of improving people’s capacity to communicate and collaborate with one another (Al-Hawamdeh, 2002).

There are a variety of ways in which organizations go about doing this. For example, one field investigation of 12 private and public sector large-sized organizations identifies eight distinct methodologies corporations undertake to manage both explicit and tacit types of knowledge: 1) communities of practice; 2) question and answer forums; 3) knowledge mapping; 4) expert databases; 5) knowledge databases; 6) news information alerts; 7) training and education; and 8) virtual collaboration (Bouthillier and Shearer, 2002). Similarly, Bhatt (2002) points out four management strategies organizations use to promote KM within the firm: 1) the empowerment of employees; 2) the motivation and nurturing of individual expertise; 3) the fostering of self-organized teams and promotion of group collaboration; and 4) the development of tools and infrastructure to support KM activities.
social interaction; and 4) the storage and codification of rules and procedures in simple formats so that employees can easily access and understand these rules and processes.

By adopting such strategies, organizations are recognizing the need to facilitate and promote the creation, sharing, and use of information as part of their KM initiatives and offerings. In this sense, companies are attempting to create a context or environment that nurtures behaviors at both organizational and personal levels. The degree to which this context influences and shapes KM practices, and more importantly how the context does so, is unknown. Hence, the goal of this paper is to explore this relationship between organizational knowledge context and practices in more detail. Insight into this area may provide useful discourse, conceptually and practically speaking, in identifying the building blocks of new KM theories and supporting the development of KM initiatives in organizations.

2. Knowledge management context and practices

Theory from the information sciences and knowledge management literatures were used as background for the formation of this paper’s research model, namely Information Orientation and an interpretation of several theoretical models dealing with organizational information environments. This literature base was chosen since the writings deal holistically with organizational information contexts and describe how such environments can enable and foster strategic information use and knowledge work in corporations.

The following sub-sections briefly describe this background. This is followed by a description of the paper’s research model, which draws upon constructs identified in the afore-mentioned literature base and identifies specific hypotheses for investigation.

2.1 Information orientation

Originally coined by Donald Marchand, William Kettinger and John Rollins (Marchand et al., 2001a, 2001b), the term Information Orientation (IO) has been used to describe an organization’s preparedness to use information for competitive advantage by virtue of its beliefs and values, and its information management and technology practices. It measures the extent to which business managers perceive their organizations to possess the capabilities associated with effective information use to improve business performance.

In their research, Marchand et al. provide empirical evidence to show that an organization’s regard and appreciation of its information, and the ways information is used at personal and corporate levels, are critical to gaining and sustaining competitive advantage (Marchand et al., 2001a). They emphasize that information management is more than a matter of selecting and deploying various technologies and systems – it is a process which aims is to provide the individuals involved in critical business processes, the right information at the right time for effective decision making. Furthermore, the right information may be structured and factual, or unstructured and narrative, and to utilize information to positively affect business performance, an organization needs to have the right mix of i) information technology practices, ii) information management practices, and iii) information behaviors and values.

Information technology practices (ITP) refer to the capability of a company to effectively manage its technology infrastructure in support of operational decision-making and communication processes. Efffectual ITP oblige managers to link the overall corporate strategy to IT strategy in order to provide distinctive competencies that support innovation and management decision needs.

Information management practices (IMP) pertain to an organization’s capability to manage information effectively over its life cycle, including sensing, collecting, organizing, processing and maintaining information. In this regard, effective IMP allow business managers to explicitly set up processes, train employees, and take personal responsibility for the management of information in order to reduce information overload, improve the quality of information available to stakeholders, and enhance the decision-making capability of the organization. Information behaviours and values (IBV) symbolize an organization’s capability to instill and promote behaviors and values in its people for the effective use of information. For this, managers need to encourage integrity, formality, control, transparency, and sharing, while promoting proactive information use in their companies and removing barriers to information flow.

Together, the three components of ITP, IMP, and IBV provide an effective basis for information use within organizations. Marchand et al. expound the need for strong linkages between these three components by referring to the information management process as a recursive spiral. On the one hand, good information usage behaviors and values drive better information definition and management within the firm, and on the other, better information practices improve the
organization’s overall capability to use technology to support decision making and problem solving. The successful cycle in turn reinforces better information usage behaviors and values.

2.2 Organizational information environments


From this review, Detlor concludes that a firm’s information environment comprises several entities. The first is information culture, which refers to the degree to which information is readily shared, valued, and filtered across the company. The second are information systems development processes, which are the procedures in place in a firm, which dictate how information systems are developed and maintained. The third is information politics, which refers to the human struggle over the management of information. Moreover, Detlor points out how a firm’s information environment – in terms of its information culture, systems development processes and politics – constrain and shape the degree to which people in organizations can access, create, share, find, browse, create and use information. That is, an organization's information environment has a direct effect on both employee and organizational information behavior.

Detlor also describes how individual demographics (such as age and gender) and social roles (such as job position and years spent in the organization) can influence how people go about creating, finding, seeking, distributing and using information in the firm. These variables seem to mediate the effect of the information environment on information behavior.

2.3 The paper’s research model

Using the above literature base as a starting point, one can identify common themes or constructs. The first is the existence of a Knowledge Management Environment (KME), which symbolizes the culture and commitment within the organization to implement and institutionalize effective information and knowledge sharing processes, practices and technologies. KME is analogous to Marchand et al.’s ITP and IMP constructs, and the organizational information environment.

The second is the existence of information behaviors. The Information Orientation model clearly identifies an information behavior construct (IBV), which is separate and distinct from the contextual constructs of an organization’s technology and information management environments. Similarly, Detlor in his review of information environments in organisations posits the human action of information behavior outside and distinct from the organizational information environment in which knowledge work is performed. Both discuss, in varying ways, the interplay between context and behavior: Marchand et al. discuss how contextual constructs of ITP and IMP interact with IBV to facilitate effective information use in the company, while Detlor provides evidence of the strong effect of an organization’s information environment on employee information behavior, and illustrates how this relationship impacts the extent to which an organization can successfully go about creating, distributing, and using knowledge across the firm.

Interestingly, both Marchand et al. and Detlor in their writings describe, to varying extents, a distinction between organizational and personal information behaviors. Marchand et al. recognizes how information can be used in different ways at personal and corporate levels; Detlor describes how the organizational information environments can shape information behaviors on an individual or organization-wide basis. Based on this, organizational and personal information behaviors can be viewed as two separate constructs. Organizational information behaviors (OIB) would represent the information and knowledge sharing practices at the corporate level, while personal information behaviors (PIB) would concern an individual’s own actions in carrying out information and knowledge sharing practices. Based on this, one would posit that the KME influences both OIB and PIB:
**H1.** A firm’s knowledge management environment impacts organizational information management behaviours.

**H2.** A firm’s knowledge management environment impacts personal information management behaviours.

Furthermore, there is likely a relationship or close tie between organizational and personal information behaviors. For example, the theory of planned behavior (TPB) (Ajzen 1985; Ajzen 1991), an extension of the theory of reasoned action (TRA) (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975), suggests that subjective norms surrounding a behavior (such as an employee’s perceptions regarding the opinions of others in the firm who are important to him/her regarding performing a target behavior) influence an individual’s intent to perform that behavior. In this sense, one would posit that organizational information behaviors may influence the extent to which an individual goes about his or her own personal information behaviors:

**H3.** Organizational information behaviours impact personal information behaviours.

Based on this review, this paper presents a research model that shows the interplay between the three constructs of the firm’s knowledge management environment, organizational information behaviors, and personal information behaviors (see Figure 1 below).

![Figure 1: The study’s research model](image)

Furthermore, as Detlor suggests, there may be certain demographic variables about employees that impact the relationship between a firm’s KM environment and employee information behavior at both organizational and individual levels. As such, it would be interesting to ask whether certain employee demographics (such as age, biological sex, job category, and years spent in the company) affect the relationships between a firm’s knowledge management environment and organizational and personal information behaviors.

### 3. Methodology

#### 3.1 The case study site

To test the research model, a Web-based survey was administered to a large, Canadian law firm that employs over 2,000 people in offices spanning the nation. Participants comprised both professionals (e.g., lawyers) and non-professionals (e.g., support staff). In order to manage the knowledge of a diverse and geographically separated group of people, the organization recently introduced a firm-wide knowledge management strategy to allow people to better share their knowledge and experience. Central to this initiative is a knowledge portal specifically designed for law professionals to exchange knowledge and organizational learning. As such, this organization was open to participating in this research investigation as a means of getting a handle on how well their knowledge management initiatives were working out.

A service organization, such as a law firm, is a viable organization to study knowledge and information context and behaviors since these types of firms typically dwell upon the innovative and creative competences of their employees and are also subject to more rapid and radical changes in the business environment. For examples, several researchers have published case studies of KM practices in a variety of service-based organizations in the banking, insurance, legal and consulting sectors. According to Ulrich and Kerr (1995), such organizations today need to continuously assess their culture, capability and work processes in order to effectively respond to ever changing business conditions.
3.2 The survey instrument

The survey instrument was administered in the two official languages of Canada (English and French) and consisted of two parts. The first presented questions pertaining to the organization’s information management practices, information behavior and values, and information uses. These questions were adapted from the instrument used by Statistics Canada in its survey of Knowledge Management Practices in 2001, as well as the instrument developed by Marchand et al. (2001a, 2001b) to measure information orientation, behavior and values. The second solicited demographic information such as age, biological sex, and years spent in the organization, and job category. The survey was pre-tested both by members of the research team and participants in the case study site itself.

Table 1 below identifies the questions asked on the survey that pertained to the constructs outlined in the paper’s research model. Responses to these questions were on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A single negatively-worded reversed coded question was utilized to create a cognitive ‘speed bump’ (Podsakoff et al. 2003). This approach is commonly used in survey design (Hinkin 1995). The rationale is that this item requires respondents to engage in more controlled, rather than automatic, cognitive processing (Podsakoff et al. 2003). This allows partially mitigating the effect of uni-directional wording (Singh 2004) and potentially reduces common method bias in self-reports (Podsakoff et al. 1986).

4. Results

The survey instrument was administered to all employees in the organization. In the end, 405 usable responses were obtained. The English-based questionnaire was utilized by 92% of the respondents and the French-based questionnaire was used by the rest (i.e. 8%). Multivariate Analysis of Variance (MANOVA) (Pedhazur et al. 1991; Tacq 1997) revealed no significant differences between these groups (Pillai’s Trace of 0.049, p-value < 0.20). Thus, the remainder of the analysis is conducted on the merged dataset of 405 responses.

Table 1: Questionnaire Items pertaining to the research model’s constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>KME1</td>
<td>My organization has a culture intended to promote knowledge and information sharing.</td>
<td></td>
</tr>
<tr>
<td>KME2</td>
<td>Knowledge and information in my organization is available and organized to make it easy to find what I need.</td>
<td></td>
</tr>
<tr>
<td>KME3</td>
<td>Information about good work practices, lessons learned, and knowledgeable persons is easy to find in my organization.</td>
<td></td>
</tr>
<tr>
<td>KME4</td>
<td>My organization makes use of information technology to facilitate knowledge and information sharing.</td>
<td></td>
</tr>
<tr>
<td>OIB1</td>
<td>The people I work with regularly share information on errors or failures openly.</td>
<td></td>
</tr>
<tr>
<td>OIB2</td>
<td>The people I work with regularly use information on failures or errors to address problems constructively.</td>
<td></td>
</tr>
<tr>
<td>OIB3 (Reversed)</td>
<td>Among the people I work with regularly, it is normal for individuals to keep information to themselves.</td>
<td></td>
</tr>
<tr>
<td>PIB1</td>
<td>I often exchange information with the people with whom I work regularly.</td>
<td></td>
</tr>
<tr>
<td>PIB2</td>
<td>I often exchange information with people outside of my regular work unit but within my organization.</td>
<td></td>
</tr>
<tr>
<td>PIB3</td>
<td>I often exchange information with citizens, customers, or clients outside my organization.</td>
<td></td>
</tr>
<tr>
<td>PIB4</td>
<td>I often exchange information with partner organizations.</td>
<td></td>
</tr>
</tbody>
</table>

The analysis revealed several demographic characteristics. First, 77% and 23% of the subjects were female and male respectively. In other words, the majority of respondents were female. Second, the average age of the surveyed employees was 35-44 years old. Third, the
sample comprised 32% professionals and 68% administrative or support staff. And fourth, respondents were employed by the surveyed organization for periods ranging from 1 year to over 35 years, with a median employment time of 4 to 5 years. These demographic variables were included as moderators in the structural model.

4.1 The measurement model

The two-step approach suggested by Anderson and Gerbing (1988) was utilized for model assessment. Accordingly, an examination of the measurement model was conducted before embarking on testing the structural model. Both the measurement and structural models were estimated by using the structural equation modeling facilities of PLS-Graph Version 03.00 (Chin 1998; Chin 2001). The PLS approach was chosen since it fits small-sample exploratory research (Gefen et al. 2000), and it does not require meeting the multivariate normality assumptions posed by other structural equation modeling techniques (Thomas et al. 2005). As such, Table 2 offers statistics of the model’s set of measurement items. Please note that all constructs were operationalized with reflective indicators (Bollen 2002).

As one can see, almost all factor loadings exceeded the threshold value of 0.7. Only one item (PIB1) obtained loading slightly below this threshold. Nevertheless, this item was retained for two reasons. First, retaining the item maintains the content validity of the construct; and second, the deviation from the threshold is negligible. The psychometric robustness of the measurement items is further supported by an assessment of the item-to-total correlation values. These have exceeded the recommended cut-off point of 0.35 with relatively low residual variances. Overall, it is concluded that in general, items share more than 50% of the variance with the latent variable they pertain to, and that they have reasonably good psychometric properties.

In order to test for discriminate and convergent validities, a table of loadings and cross-loadings was constructed (see Table 3). A visual inspection of the table demonstrates that items load highly on their respective construct, and do not load on other constructs. Thus, there is strong confidence in the discriminate and convergent validity of the constructs.

Table 2: Measurement Items’ statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Factor Loading</th>
<th>Residual Variance</th>
<th>Item-total correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>KME1</td>
<td>4.1120</td>
<td>1.0290</td>
<td>0.7920</td>
<td>0.3747</td>
<td>0.6400</td>
</tr>
<tr>
<td>KME2</td>
<td>3.5396</td>
<td>1.1187</td>
<td>0.8310</td>
<td>0.3083</td>
<td>0.7210</td>
</tr>
<tr>
<td>KME3</td>
<td>3.3232</td>
<td>1.1436</td>
<td>0.8300</td>
<td>0.3095</td>
<td>0.6560</td>
</tr>
<tr>
<td>KME4</td>
<td>4.0025</td>
<td>1.0430</td>
<td>0.8030</td>
<td>0.3560</td>
<td>0.6690</td>
</tr>
<tr>
<td>OIB1</td>
<td>3.3032</td>
<td>1.2104</td>
<td>0.8590</td>
<td>0.2531</td>
<td>0.6880</td>
</tr>
<tr>
<td>OIB2</td>
<td>3.4986</td>
<td>1.1598</td>
<td>0.8610</td>
<td>0.2568</td>
<td>0.6770</td>
</tr>
<tr>
<td>OIB3</td>
<td>5.2941</td>
<td>1.3472</td>
<td>0.7510</td>
<td>0.4441</td>
<td>0.5010</td>
</tr>
<tr>
<td>PIB1</td>
<td>4.4883</td>
<td>0.8371</td>
<td>0.6790</td>
<td>0.5380</td>
<td>0.3930</td>
</tr>
<tr>
<td>PIB2</td>
<td>3.6084</td>
<td>1.2100</td>
<td>0.7210</td>
<td>0.4813</td>
<td>0.5230</td>
</tr>
<tr>
<td>PIB3</td>
<td>2.9633</td>
<td>1.3013</td>
<td>0.7790</td>
<td>0.3907</td>
<td>0.5520</td>
</tr>
<tr>
<td>PIB4</td>
<td>2.5921</td>
<td>1.2537</td>
<td>0.7430</td>
<td>0.4499</td>
<td>0.5940</td>
</tr>
<tr>
<td>Sex</td>
<td>0.2233</td>
<td>0.4172</td>
<td>1.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Job Category</td>
<td>0.3793</td>
<td>0.4860</td>
<td>1.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Sex*Job Category</td>
<td>0.1752</td>
<td>0.3807</td>
<td>1.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Age Group</td>
<td>2.9932</td>
<td>1.0785</td>
<td>1.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Years In Organization</td>
<td>3.1693</td>
<td>1.6681</td>
<td>1.0000</td>
<td>0.1581</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Further examination of discriminate validity was conducted by comparing the average variance extracted (AVE) from each constructs with its communal variances shared with other constructs.
These measures are reported below in Table 4. The inter-construct correlations are outlined underneath the diagonal and the square roots of the AVEs are given in the diagonal. A visual inspection of Table 4 demonstrates that the AVE for all constructs is higher than their shared variances. Thus, confidence in the discriminate validity of the model’s constructs is strengthened.

Next, construct statistics were calculated and examined. These measures are presented in Table 5. First, the constructs’ reliability was assessed using Cronbach’s alpha (Cronbach 1951). The results demonstrate acceptable levels of homogeneity as all Cronbach alpha values were above the commonly used threshold of 0.70 (Pedhazur et al. 1991). Second, Fornell and Larcker’s (1981) measures of internal consistency and convergent validity of all constructs were greater than 0.7 and 0.5 respectively.

Overall, the above-mentioned analyses demonstrate that there is some confidence in the psychometric appropriateness of the measurement items and latent variables. Thus, following the guidelines of Anderson and Gerbing (1988), the next sub-section outlines the examination of the structural model.

Table 3: Matrix of loadings and cross-loadings

<table>
<thead>
<tr>
<th></th>
<th>KME</th>
<th>PIB</th>
<th>OIB</th>
<th>Age</th>
<th>Sex</th>
<th>Job Category</th>
<th>Sex*Job Category</th>
<th>Years in Org.</th>
</tr>
</thead>
<tbody>
<tr>
<td>KME1</td>
<td>0.797</td>
<td>0.161</td>
<td>0.341</td>
<td>-0.052</td>
<td>-0.062</td>
<td>-0.103</td>
<td>-0.041</td>
<td>-0.045</td>
</tr>
<tr>
<td>KME2</td>
<td>0.832</td>
<td>0.151</td>
<td>0.267</td>
<td>0.000</td>
<td>-0.121</td>
<td>-0.089</td>
<td>-0.097</td>
<td>-0.080</td>
</tr>
<tr>
<td>KME3</td>
<td>0.838</td>
<td>0.175</td>
<td>0.398</td>
<td>0.008</td>
<td>-0.128</td>
<td>-0.121</td>
<td>-0.067</td>
<td>-0.075</td>
</tr>
<tr>
<td>KME4</td>
<td>0.806</td>
<td>0.209</td>
<td>0.297</td>
<td>-0.002</td>
<td>-0.070</td>
<td>-0.067</td>
<td>-0.047</td>
<td>-0.020</td>
</tr>
<tr>
<td>PIB1</td>
<td>0.259</td>
<td>0.680</td>
<td>0.342</td>
<td>0.020</td>
<td>0.027</td>
<td>0.096</td>
<td>0.058</td>
<td>-0.027</td>
</tr>
<tr>
<td>PIB2</td>
<td>0.089</td>
<td>0.720</td>
<td>0.116</td>
<td>0.194</td>
<td>0.085</td>
<td>0.139</td>
<td>0.082</td>
<td>0.152</td>
</tr>
<tr>
<td>PIB3</td>
<td>0.121</td>
<td>0.782</td>
<td>0.055</td>
<td>0.227</td>
<td>0.213</td>
<td>0.310</td>
<td>0.282</td>
<td>0.129</td>
</tr>
<tr>
<td>PIB4</td>
<td>0.142</td>
<td>0.758</td>
<td>0.132</td>
<td>0.163</td>
<td>0.082</td>
<td>0.129</td>
<td>0.079</td>
<td>0.176</td>
</tr>
<tr>
<td>OIB1</td>
<td>0.323</td>
<td>0.151</td>
<td>0.871</td>
<td>-0.018</td>
<td>-0.132</td>
<td>-0.125</td>
<td>-0.132</td>
<td>-0.166</td>
</tr>
<tr>
<td>OIB2</td>
<td>0.363</td>
<td>0.241</td>
<td>0.879</td>
<td>-0.050</td>
<td>-0.032</td>
<td>-0.074</td>
<td>-0.049</td>
<td>-0.118</td>
</tr>
<tr>
<td>OIB3</td>
<td>0.343</td>
<td>0.165</td>
<td>0.757</td>
<td>-0.087</td>
<td>-0.017</td>
<td>0.101</td>
<td>0.018</td>
<td>-0.057</td>
</tr>
<tr>
<td>Age</td>
<td>-0.014</td>
<td>0.209</td>
<td>-0.061</td>
<td>1.000</td>
<td>0.009</td>
<td>0.005</td>
<td>-0.002</td>
<td>0.534</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.119</td>
<td>0.150</td>
<td>-0.072</td>
<td>0.009</td>
<td>1.000</td>
<td>0.478</td>
<td>0.884</td>
<td>0.152</td>
</tr>
<tr>
<td>JobCat</td>
<td>-0.120</td>
<td>0.243</td>
<td>-0.041</td>
<td>0.005</td>
<td>0.478</td>
<td>1.000</td>
<td>0.602</td>
<td>0.235</td>
</tr>
<tr>
<td>SexJobCat</td>
<td>-0.077</td>
<td>0.187</td>
<td>-0.065</td>
<td>-0.002</td>
<td>0.884</td>
<td>0.602</td>
<td>1.000</td>
<td>0.202</td>
</tr>
<tr>
<td>YearsInOrg</td>
<td>-0.068</td>
<td>0.140</td>
<td>-0.135</td>
<td>0.533</td>
<td>0.152</td>
<td>0.235</td>
<td>0.202</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 4: Average variance extracted and inter-construct correlations

<table>
<thead>
<tr>
<th></th>
<th>KME</th>
<th>PIB</th>
<th>OIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>KME</td>
<td>0.814</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIB</td>
<td>0.212</td>
<td>0.826</td>
<td></td>
</tr>
<tr>
<td>OIB</td>
<td>0.406</td>
<td>0.220</td>
<td>0.731</td>
</tr>
</tbody>
</table>
Table 5: Construct statistics

<table>
<thead>
<tr>
<th></th>
<th>Arithmetic Mean</th>
<th>Cronbach Alpha</th>
<th>Internal Consistency</th>
<th>Convergent Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>KME</td>
<td>3.7431</td>
<td>0.8390</td>
<td>0.8872</td>
<td>0.6629</td>
</tr>
<tr>
<td>PIB</td>
<td>3.4300</td>
<td>0.7210</td>
<td>0.8211</td>
<td>0.5350</td>
</tr>
<tr>
<td>OIB</td>
<td>4.0174</td>
<td>0.7780</td>
<td>0.8649</td>
<td>0.6817</td>
</tr>
</tbody>
</table>

4.2 The structural model

Two hundred re-samples were used in a bootstrapping procedure (Cramer et al. 1988) to derive t-statistics for the structural paths. Chin recommends this number of re-samples for reasonable standard error estimates (Chin 2001). The structural model and the p-values are presented in Figure 2. Please note that while the model includes five control variables (sex, job category, the interaction of job category and sex, age, and years with the organization), for simplification, the figure portrays only the main relationships. The path coefficients, the t-statistics and the corresponding p-values for the control variables (in brackets) are presented in Table 6.

![Figure 2: The structural model](image)

Table 6: Effects of control variables and their levels of significance

<table>
<thead>
<tr>
<th>Control variables</th>
<th>Sex</th>
<th>Job Category</th>
<th>Sex * Job Category</th>
<th>Age</th>
<th>Years In Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIB</td>
<td>0.0270</td>
<td>(0.1952)</td>
<td>0.2290</td>
<td>(3.4725 ***)</td>
<td>0.0540</td>
</tr>
<tr>
<td>OIB</td>
<td>0.0320</td>
<td>(0.3422)</td>
<td>0.0660</td>
<td>(0.9552)</td>
<td>-0.0790</td>
</tr>
<tr>
<td>KME</td>
<td>-0.2730</td>
<td>(2.5716 **)</td>
<td>-0.1280</td>
<td>(1.6365)</td>
<td>0.2530</td>
</tr>
</tbody>
</table>

The main conclusion drawn from the reported structural model analysis as depicted in Figure 2 is that all three hypotheses (H1, H2, & H3) are supported with high degrees of confidence. Thus, the knowledge management environment influences indeed both organizational and personal knowledge management behaviors, and personal information behaviors are influenced by organization information behaviors. These results are consistent with the theoretical background used to inform the study’s research model, namely theory pertaining to Information Orientation and organizational information environments.
In order to approximate the predictive power of the two constructs that influence individual information behaviors, their effect sizes were calculated by formula (1). This formula was proposed by Chin (1998) as a means for predictive power estimations in PLS analysis. The formula includes the following variables: $f^2$ is the effect size of an independent construct; $R^2_{\text{included}}$ is the R-square value of a dependent construct when the tested independent construct is included in the model, and $R^2_{\text{excluded}}$ is the R-square value of a dependent construct when the tested independent construct is excluded from the model.

\[
f^2 = \frac{R^2_{\text{included}} - R^2_{\text{excluded}}}{1 - R^2_{\text{included}}} \tag{1}
\]

As such, R-square values of the PIB construct were documented after removing one independent construct at a time. A calculation of the predictive power values reveals that the predictive power of the KME and POB construct are 0.022 and 0.031 correspondingly. These values demonstrate low to medium effect sizes according to the guidelines given by Cohen (1988). This indicates that there is no single construct that contributes significantly to the predictive power of the model. Rather, it is the combination of the KME and OIB constructs that explain almost 20% of the variance in individual information behaviors. Thus, future research may include more variables in order to better explain information sharing behaviors.

With respect to the effect of the moderating variables, several findings were obtained. First, although the main effect of sex on KME is significant, it cannot be analyzed, as the interaction term of sex and job category is significant as well (Fox 1997, p.148). As such, only the latter is interpretable. Given the coding scheme used (i.e. male=1, professional=1) and the fact that this path coefficient is positive, it is concluded that professional males perceive the knowledge management environment to be stronger than what others perceive it to be.

Second, job category was found to have a significant positive effect on personal information behaviors. Thus, professionals in general (both males and females) tend to share more information with colleagues and customers, than support and administrative staff do.

Third, similar effect was obtained for age. As such, it is concluded that older personnel are more apt to share information with others than younger personnel do. Finally, a somewhat significant effect of years in the organization on perceived organizational information behaviors was observed. Given the negative corresponding path coefficient, it is concluded that the more time an employee spends with an organization, the lower his or her perception of information sharing behaviors of others.

5. Conclusion

In this paper, we have investigated and discussed the effects of organizational knowledge context on corporate as well as personal information and knowledge practices and behaviors. Towards that end, we have proposed and validated an analytical research model based on constructs derived from the information orientation and the organizational information environments models. The results of our survey illustrate that both organizational and personal information behaviors are influenced by the corporate wide knowledge management environment comprising the practices, policies and processes institutionalized and the technologies implemented for KM initiatives. Subsequently, personal information behaviors are also influenced by organizational information behaviors suggesting that an individual’s own behavior towards information and knowledge sharing is influenced by his/her perceptions of others commitments and tendencies towards knowledge sharing.

Furthermore, our research shows that specific career based demographic variables also impact the relationship between a firm’s KM environment and information behaviors at both organizational and individual levels. Specifically, males, older employees, and those with professional designations (as opposed to support roles) have a positive perception of and attitude towards the corporate KM context and organizational level KM practices.

The findings in this paper have both practical as well as theoretical implications. From a practical standpoint, the results of our survey compel businesses, especially those that regard themselves as “knowledge intensive” organizations to acknowledge, explore and positively influence the people-factors that are critical to task performance and organizational success through various material as well as relational means. Firstly, as an overarching approach, organizations need to promote knowledge sharing processes among employees through the establishment of formal policies and procedures and the implementation of requisite technology infrastructures. As shown in our research results, such formalized practices not
only lead to positive perceptions about the knowledge environment and organizational information behaviors but also enhance personal information behaviors. Additionally, the organizational information behaviors construct emphasizes the importance of pooled expertise, relationships, and alliances to the progress of KM initiatives, hence suggesting that in their efforts to further harness the knowledge based capabilities of their human capital, managers should undertake the development of various incentives for their employees to work collaboratively and share their knowledge with one another.

At a theoretical level, our study provides empirical evidence to support the relationship between the culture and context of knowledge management practices in the organization and the information and knowledge sharing behaviors of its employees. Hence the research model bears out important technological, psychological and sociological antecedents to the effectiveness and success of knowledge management initiatives within corporations. In addition to being excellent predictors, our model shows that these factors are also inexorably intertwined, and future research can help extend the findings of our model by considering other institutional settings and business-specific conditions in the organizational KM context.

References


Critical Knowledge Map as a Decision Tool for Knowledge Transfer Actions

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Abstract: Knowledge transfer is no longer reducible to classical solutions such as face-to-face training, technical education or tutoring. Knowledge to be transferred is professional knowledge (Business Knowledge). It involves the whole Knowledge Capital within an organization. Identifying the knowledge components that are worthwhile transferring is not an easy task. This is the problem addressed in this paper.

Keywords: knowledge transfer, knowledge management, knowledge mapping, and knowledge capitalization.

1. Introduction

1.1 Knowledge management for knowledge transfer

Knowledge Management has been defined as the setting up of a management system of cognitive flows, which allow all the components of an organization to use and enrich its corporate knowledge. Therefore, Knowledge Management allows knowledge in the firm to be located, formalized, shared, enriched and developed specifically knowledge with critical and strategic characteristics (Boughzala and Ermine 2004, Ermine 2002). The aim is to stimulate innovation and the creation through a better productivity of knowledge. A very serious problem is now growing in industrial countries: ageing of professional generations. This is a global problem but Knowledge Management focuses on some important aspects:

- How to identify critical knowledge that is worthwhile transferring to new professional generations
- How to capitalize and transfer professional knowledge from one generation to another.

In this paper we deal with the first question of identifying valuable knowledge in a company. We give a case study of knowledge capital analysis performed in the Hydro Québec Company, in order to have a clear plan of transferring knowledge between generations. Identifying valuable knowledge is the beginning of the solution, implementing devices for knowledge transfer is the next step, but that is another (long!) story.

1.2 Cartography of knowledge

Knowledge cartography (or knowledge mapping) allows the value of the firm’s critical knowledge to be enhanced (Pachulski & al 2000, Saad & al 2003). It is a step to be performed before any operation of knowledge management. Cartography is an identification of the corporate knowledge. We refer to the definition of knowledge cartography given by (Speel & al 1999): “knowledge mapping is defined as the process, methods and tools for analyzing knowledge areas in order to discover features or meaning and to visualize them in a comprehensive, transparent form such that the business-relevant features are clearly highlighted”. Companies wishing to manage their corporate knowledge must make a precise analysis in order to determine the knowledge they must preserve, develop, abandon etc. Thus, cartography becomes a decision support tool. To this end, there is a need to establish specific criteria in order to evaluate, in the cartography, the most critical knowledge for the company. This is the so-called “cartography of critical knowledge”. It is such an analysis tool that we describe here. The M3C methodology described here is the result of various experiences (we describe one of them in this paper) and issues developed in a working group of the Knowledge Management Club (www.club-gc.asso.fr) (Aubertin & al 2003).

1.3 Content of the paper

The paper begins by giving an overview of existing knowledge mapping methods and by underlining the contribution of the M3C methodology. Then, we present a case study performed in The Hydro Québec Company. Our goal is, using this case, to describe and to illustrate our “methodology of construction of the critical knowledge cartography” (cf. §4).
2. About knowledge mapping methods

Knowledge cartography helps to discover the location, value and use of organizational knowledge in the sense of (Tshuchiya 1993). It is a new research field in knowledge management and there are few academic papers. Knowledge mapping methods can be categorized into two approaches:

- A "Process" oriented approach
  This approach deals with knowledge cartography methods, which use modeling, description and analysis of business processes to determine critical knowledge.
- A "Domain" oriented approach
  In this approach, we try to make an analysis from a mass of information in order to organize it in logic different from the functional approach. In fact, the goal is to ignore the functional structure of the firm, grouping activities into knowledge domains. This task demands an important capacity of analysis because it's not a natural process.

2.1 GAMETH

GAMETH (Global Analysis METHodology) is an approach focusing on business processes that connects knowledge to action (Grundstein & al 2003).

GAMETH includes three main stages i.e. those presenting problems:

- Identifying the sensitive process;
- Identifying the determining problems;
- Identifying the crucial knowledge.

The first stage of the GAMETH approach consists in determining the sensitive processes. A sensitive process presents the stakes, which are collectively recognized by those involved. Independent of the company’s stakes, this process presents its own stakes and includes activities. The constraints and the dysfunction of these activities give rise to problems, which can weaken them and endanger the process they belong to. A risk assessment, carried out for the sensitive process, allows the critical activities to be determined. The problems connected to these activities are called “determining problems”. Identifying them constitute the second stage of the GAMETH approach. Some of them can be solved easily by eliminating some constraints. The other ones lead to the knowledge necessary to their resolution. According to the value of this knowledge with regard to its vulnerability (scarcity, accessibility, cost and delay of acquisition) and to its influence on the company’s life, markets and strategy, this knowledge can be identified as “crucial knowledge”. Identifying crucial knowledge constitutes the third and last stage of the GAMETH approach.

2.2 The method proposed by Tseng and Huang

Tseng and Huang (Tseng and Huang 2005) propose a cartography method to determine crucial knowledge necessary for the design of a knowledge management system. The authors define “crucial knowledge” as: "the necessary knowledge to solve problems dealing with a given objective, and that should be capitalized ". Their approach is "process" oriented and is guided by problems. It is based on a quantitative analysis of collected information while interviewing some experts. Different acquisition techniques are used (DELPHI, NGT, etc.) to collect and classify the needs in knowledge for the problem solving. Tseng and Huang propose an algorithmic procedure from the data collected to determine four sets characterizing the importance of knowledge:

- Set I (Vital knowledge): this type of knowledge is very important and should be located.
- Set II (The prompt acquisition knowledge set): this knowledge set is important for some problems.
- Set III (Seasonal knowledge): the seasonal knowledge set is not important for the majority of the problems.
- Set IV (Insignificant knowledge): this category of knowledge is not collected and no action is recommended unless there is a special need.

2.3 A method for the evaluation of tacit and/or explicit knowledge

Pomian and Roche propose evaluating the corporate knowledge by distinguishing between tacit and explicit knowledge (Pomian and Roche 2002).

Here, we present the criteria they use to analyze tacit and explicit knowledge:

- Criteria of analysis for tacit knowledge
- The principle of analysis consists in mixing the survey of the knowledge vulnerability with the criteria linked to their utility and their re-usability.
- Criteria of analysis for explicit knowledge

Pomian and Roche consider that most explicit knowledge is contained in available documents. The stake of the analysis consists in ensuring the quality of documentary communication. Thus, they propose four criteria for documents analysis: legibility, clarity, relevance and accessibility. However, the authors don’t propose a method to identify and collect knowledge. They consider that
the" operational manager" is able to draw up a list of the knowledge to be evaluated.

2.4 Knowledge trees

The goal of knowledge trees is to provide a cartographic representation of the knowledge considered as an element of the "human capital" for an organization (Authier and Lévy 1992). Knowledge trees are the expression and the consequence, evolving in real time, of training courses and experiences of all members of a given community. The underlying principles of their development are mathematical, philosophical and sociological. The creation of these knowledge trees can guide and sustain knowledge transfer.

2.5 Contribution of the M3C methodology

M3C is based on a «process" oriented approach. The cartography and the evaluation of knowledge domains are based on knowledge acquisition from experts. Thus, M3C is also a knowledge engineering method and it completes other methods used for the modeling of descriptive and operational knowledge of an expert (Tounkara & al 2002). M3C relies on robust models, which have been performed in industrial research centers and also in industrial operational units (GTIE group, Schindler, DGA, PSA Peugeot Citroën, etc.). A formal and a graphic model characterize the cartography model we propose.

2.5.1 The formal model of the cartography

The formal model described in a UML class diagram is a hierarchical representation that classifies the knowledge domains of the firm in several levels. A knowledge domain can be defined as a field of activity of a group of people from whom information and knowledge can be gathered. The central point of the cartography is the core activity or "core knowledge" which corresponds to the strategic knowledge capital, corresponding to its fundamental mission. Around this central point are the knowledge axes, which define the strategic domains of knowledge, often corresponding to the different detailed missions of the organization. The final knowledge domains in the classification are grouped according to a common finality on the same theme of knowledge, along the knowledge axes. According to the precision required, a domain can be divided into sub-domains and a theme into sub-themes.

2.5.2 The graphic model

The graphic representation of the knowledge cartography is based on the principle of visualization, which makes navigation easier and gives a global view of the knowledge domains in the firm. For example, the choice of an Ishikawa diagram allows the presentation of the hierarchy of different levels in the form of branches starting from the common trunk (Aubertin & al 2003). A tool of cartographic representation (Mind Manager, for example) can also be used. It can also be interesting to point out on the map the source of the knowledge that is the name of the owner of the knowledge as noted by Davenport in 1998 "knowledge maps typically point to people as well as to documents and databases. The employee with a good knowledge map has access to knowledge sources that would otherwise be difficult or impossible to find". (Davenport and Prusak 1998).

![Figure 1: The formal model of the cartography](image-url)
2.5.3 The criticality model

The criticality of a domain is an evaluation of risks/opportunities. It may, for example, be the risks of loss of knowledge that can have harmful consequences; the interest in developing a domain to obtain advantages for the firm (productivity gains, new market share, etc.). We now need to define what may be “objectively” the criticality of knowledge and to give a model of evaluation to identify the most critical knowledge domains in the cartography. The Knowledge Management Club has developed a grid of generic evaluation, called CKF (Critical Knowledge Factors) that is available to the members of the club. This grid has been used and validated in many French and foreign companies. The CKF grid contains 20 criteria around 4 thematic axes (cf. Figure 2). Each criterion is evaluated according to a scale composed of 4 levels, representing the degree of realization of the criterion. Each evaluation of a criterion is based on one question. Each level is expressed by a clear and synthetic sentence by avoiding the vague terms and which lead to confusion (“rating description”) (cf. Figure 3).

<table>
<thead>
<tr>
<th>Thematic axes</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rarity</td>
<td>Number and availability of experts</td>
</tr>
<tr>
<td></td>
<td>Externalization</td>
</tr>
<tr>
<td></td>
<td>Leadership</td>
</tr>
<tr>
<td></td>
<td>Originality</td>
</tr>
<tr>
<td></td>
<td>Confidentiality</td>
</tr>
<tr>
<td>Utility</td>
<td>Corresponding to strategic objectives</td>
</tr>
<tr>
<td></td>
<td>Value creation</td>
</tr>
<tr>
<td></td>
<td>Emergence</td>
</tr>
<tr>
<td></td>
<td>Adaptability</td>
</tr>
<tr>
<td></td>
<td>Use</td>
</tr>
<tr>
<td>Difficulty to capture knowledge</td>
<td>Identification of knowledge sources</td>
</tr>
<tr>
<td></td>
<td>Mobilization of networks</td>
</tr>
<tr>
<td></td>
<td>Tacit knowledge</td>
</tr>
<tr>
<td></td>
<td>Importance of tangible knowledge sources</td>
</tr>
<tr>
<td></td>
<td>Rapidity of obsolescence</td>
</tr>
<tr>
<td>Nature of knowledge</td>
<td>Depth</td>
</tr>
<tr>
<td></td>
<td>Complexity</td>
</tr>
<tr>
<td></td>
<td>Difficulty of appropriation</td>
</tr>
<tr>
<td></td>
<td>Importance of past experiences</td>
</tr>
<tr>
<td></td>
<td>Environment dependency</td>
</tr>
</tbody>
</table>

Figure 2: The critical knowledge factor grid

3. Hydro Quebec case study

Inter-Generation Knowledge Transfer is an emerging issue linked to massive retirements planned for the coming years. There is a great risk of knowledge loss. The massive retirements are principally due to the ageing of populations and also to the decrease in demographic growth. States such as Canada and Belgium have already taken into account the necessity of knowledge transfer between generations. In this context, Hydro Quebec is implementing knowledge management projects to facilitate knowledge transfer to new generations of its employees.

3.1 Hydro Quebec presentation

Hydro Quebec is one of the biggest electricity producer and distributor in North America. Hydro Quebec is a public company and its principal shareholder is the Quebec Government. Hydro Quebec has about 21000 employees and is facing difficulties linked to massive retirements and particularly the departures of the most experienced employees:

- 500 per year from 2003 to 2008
- 800 per year from 2008 to 2011

We can notice also that the « age curve » is very unbalanced (cf. Figure 4).
3.2 The study

The Hydro Quebec study is part of a bigger project « Expertise Management Plan » leaded by the Human Resources Department in collaboration with the CEFARIO. These were the objectives:

- Identifying strategic knowledge
- Making a diagnosis of the vulnerability of strategic knowledge
- Making recommendations about pertinent KM projects for capitalization, sharing, knowledge transfer, etc.

4. The M3C methodology

The construction of knowledge cartography and the analysis of criticality may be a difficult operation and can mobilize a great number of people, if it is carried out in order to enable a strategic decision. In addition to having concepts and tools, one needs a methodological and efficient process to build the cartography and the criticality analysis. To do this, we propose a new knowledge cartography method: M3C. We describe the M3C methodology as it was performed in Hydro Quebec.

4.1 Framing

The goal is to define the real strategic objectives of the cartography within the global knowledge management plan. This also enables the limits of the action field to be fixed inside the corporate knowledge. Framing consists also in replacing the cartography approach according to other
transversal approaches in the Organization. Knowledge Management is complementary to other domains such as Quality Management, Skills Management and Information System Management. In the four approaches, the processes and the roles performed by the actors are the articulation points. Quality defines procedures by determining the roles and the recorded information. The Skills Management organizes the necessary competencies to operate a role. Information System distributes computing resources according to the information needs of agents in order to help them accomplish their role. Finally, knowledge cartography detects and organizes the agents’ knowledge necessary to the implementation of their role in the Organization.

4.2 Location of knowledge domains
The location of knowledge domains consists, from documentation of reference and eventually interviews, in highlighting knowledge domains by the successive analysis of activities, projects, products, etc. This task demands a great capacity for analysis. Here, knowing the activities of the firm can be a brake. In fact, we try to ignore of the functional structure of the firm, grouping activities into knowledge domains. The reference documentation is composed of:
- The documents of the organization (status, organization chart, description of departments activities, etc.);
- The strategic documents (medium term plan, synthesis, etc.);
- The documents about the production (publications, studies, activities results, etc.);
- The quality documents.

4.3 Construction of the first version of the cartography
This point deals with the construction of the physical representation of the knowledge cartography. The first step concerns an in depth analysis of the activities of the firm. The analysis is put into form in order to make it accessible and more usable. The representation must be adapted to the operational vision of the people concerned. The construction of the map is an iterative process and the operational managers validate it. These managers are able to locate and describe knowledge domains in the organization and they know the functional needs.

We realize a constant feedback in 3 phases:
- Appropriation of the problem
- Co-construction of the representation
- Validation of the map

In this context, it is vital to have a solid and constant representation structure, which allows the ideas to be fixed and to make the interviews efficient. The cartography will be the basis for individual and collective interviews of the experts concerned with the knowledge domains located. During these interviews, the experts can modify the cartography. The map presented below is the first version we drew up for one of Hydro Quebec units: it evolved with the corrections and additions of experts.

Figure 5: Example of a knowledge map

4.4 Elaboration of the criticality criteria
Here, we refer to the Critical knowledge Factors grid established by the Knowledge Management Club. This grid must be adapted by taking into account the specificities of the organization, the expectations of the cartography project, the vocabulary used by the organization (e.g. Quebecois expressions in the Hydro Quebec case study).

The adaptation of the CKF grid can consist in:
- Adding new thematic axes,
- Adding new criticality criteria,
- Modifying the evaluation scale of a criterion,
- Modifying the definition of a criterion.
4.5 Sampling

The choice of experts to be interviewed, using the CKF grid, is important for the success of the cartography project. In this step, we constitute a representative sample of experts for each knowledge domain. Operational chiefs can help to make the right choices. The diversity of profiles is important for the pertinence of the analysis and the interpretation of the data collected. For each expert, we prepare a document to include information such as:

- Profile (diplomas, certificates, qualifications, etc.)
- Position, age, year of entry in the company
- Past experiences (before joining the company)
- Experience in the knowledge domain
- Role in the knowledge domain (contributor, user, etc.)
- Etc.

4.6 Collection of data

The evaluation of the criticality is tackled on the basis of the CKF evaluation grid. The choice of experts to be interviewed in order to fill in this grid and the modalities of data collection are tricky. The efficiency and the pertinence must be targeted, but we must avoid overloading the operational managers.

4.6.1 Preparation of interviews

The preparation of an interview plan is suggested to ensure the homogeneity of all interviews.

Table 1: Advantages and inconveniences of individual/collective interviews

<table>
<thead>
<tr>
<th></th>
<th>ADVANTAGES</th>
<th>INCONVENIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIVIDUAL INTERVIEWS (one expert)</td>
<td>Experts are more comfortable. More qualitative data are collected.</td>
<td>Many interviews to perform (more time). Additional step for the comparison of experts’ arguments.</td>
</tr>
<tr>
<td>COLLECTIVE INTERVIEWS (group of experts)</td>
<td>Exchanges and discussions between experts. We are sure to ask the same questions to all experts of the group. Knowledge domain analysis is faster.</td>
<td>Sometimes, one expert can take the leadership and then there is a great risk of having a poor argument. Difficult to manage interviews. A collective interview takes more time than an individual one.</td>
</tr>
</tbody>
</table>

4.7 Data analysis

The analysis of data recorded may represent a considerable volume: it depends on the number of knowledge domains to be evaluated and the number of experts to be interviewed. That’s why a tool is very useful for the processing and the representation of these data, particularly with radar diagrams (Kiviat diagrams for example) and graphs. The cartographic representation tool, with the visualization of different criticality factors, is important for the synthesis and the representation of the results.

4.7.1 Automatic analysis

After the data collection, we make an automatic analysis using an Excel tool we have developed. It’s an analysis tool that helps:

- To fill in all the experts’ scorings in one single table;
- To get automatically, the average of all experts’ scorings, for a knowledge domain (average sorted by criterion and by thematic axe).

- This tool also generates for each knowledge domain:
- Comparison curves (cf. Figure 6) which allow the visualization of gaps between experts while evaluating the same criterion; the goal is to locate criteria that need additional information before the interpretation step.
Figure 6: Example of comparison curves generated by the Excel tool

- The radar diagrams (by criterion and by thematic axis, (cf. Figure 7) which are the visualization of each expert’s evaluation
- A final radar diagram which is a visual synthesis of the collective perception (all experts) about the knowledge domain criticality

The criticality of a knowledge domain with regards to a criterion ($m_{\text{criterion}}$) is obtained by calculating the average of experts’ scorings.

$$m_{\text{criterion}} = \frac{1}{n_{\text{expert}}} \sum_{i} m_{\text{exp}}$$

$k_{i}$ is the coefficient corresponding to the criterion “$i$” used for the average calculation. This coefficient is a weight given to the criterion according to its importance in the analysis.

Advantages and inconveniences of an automatic analysis are listed in the table below (cf. Table 2):

4.7.2 “Levelling out” step

“Levelling out” consists in making an interpretation of existing divergences between experts. In this step, analysts must:
- Take into account the position, the role, the expertise level of the people interviewed;
- Listen again to the recorded interviews.

At the end of the “polishing” step, we obtain the final scorings and averages. A synthesis is written for each knowledge domain.

Figure 7: Diagrams for the automatic analysis
Table 2: Advantages and inconveniences of the automatic analysis

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Inconveniences</th>
</tr>
</thead>
<tbody>
<tr>
<td>First global vision</td>
<td>Does not take into account divergences due, for example, to:</td>
</tr>
<tr>
<td>Less effort: « economical »</td>
<td>An interpretation of criteria different from one expert to another</td>
</tr>
<tr>
<td>A good basis for debate</td>
<td>The level of expertise of people interviewed</td>
</tr>
<tr>
<td></td>
<td>The position and the role of experts (Short/Long term vision, Technician/manager, etc.)</td>
</tr>
</tbody>
</table>

4.8 Mixed" analysis

The "Mixed" analysis is a strategic analysis of knowledge domains from combinations of groups of criteria. These combinations are defined with regards to the evaluation objectives. The goal is to highlight specificities concerning, for example:
- Domains with great expertise
- Domains to be valued
- Very vulnerable domains

The methodology used to perform the crossed analysis is described in the following model:

4.8.1 Choice and definition of groups of criteria

The first step consists in choosing the groups of criteria to mix. Each group of criteria must be defined with regards to its evaluation objective. These are two examples of groups taken from the Hydro Quebec case study:

Table 3: Examples of groups of criteria

<table>
<thead>
<tr>
<th>Groups of criteria</th>
<th>Evaluation objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 3: nature of knowledge</td>
<td>This group of criteria gives an idea of the complexity level of knowledge:</td>
</tr>
<tr>
<td></td>
<td>Depth</td>
</tr>
<tr>
<td></td>
<td>Complexity</td>
</tr>
<tr>
<td></td>
<td>Difficulty of appropriation</td>
</tr>
<tr>
<td></td>
<td>Tacit knowledge</td>
</tr>
<tr>
<td>Group 4: Access</td>
<td>This group evaluates the difficulty of access to knowledge from tangible and intangible sources:</td>
</tr>
<tr>
<td></td>
<td>Difficulty identifying sources</td>
</tr>
<tr>
<td></td>
<td>Importance of tangible sources</td>
</tr>
<tr>
<td></td>
<td>Mobilization of networks</td>
</tr>
<tr>
<td>Combinations</td>
<td>Specificities</td>
</tr>
<tr>
<td>Combination: Nature (versus) Access</td>
<td>The goal is to identify knowledge domains that need to improve means for training courses and/or knowledge transfer.</td>
</tr>
</tbody>
</table>
4.8.3 Results synthesis and recommendations

We list in a table, using the graphs of crossed analysis, knowledge domains concerned by specificities we want to highlight. This table is the basis for a more refined analysis and for recommendations.

Table 4: Example of results

<table>
<thead>
<tr>
<th>Knowledge domains</th>
<th>Domains with great expertise</th>
<th>Domains to be valued</th>
<th>Very vulnerable domains</th>
<th>Domains that need to improve/adapt methods for training courses, knowledge transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Domain B</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Domain C</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

5. Conclusion

Knowledge cartography is a new issue. Its importance is increasing with the needs in Knowledge Management, especially in Knowledge Transfer between professional generations. There are few academic papers and experiments in this domain. The M3C methodology and the tools, which have been described here, have shown their interest and their credibility. The Hydro Quebec case study has allowed them to be validated. The basis is now ready for new developments in the cartography domain and in criticality studies. The cartographic tool reveals itself to be interesting. More than the analysis of critical knowledge, it can be a basis for:
- Communities of Practice structuring
- Knowledge elicitation
- Environment scanning actions

The knowledge map can also be used as an access portal to the knowledge capital by indicating at the expert, the publications or the attached documents.

References


Knowledge Management Methodologies

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Abstract: Knowledge management (KM) research and practice embraces a wide range of activities and interests. The KM domain covers, on the one hand, technological interventions that aim to support knowledge dissemination and, on the other hand, to appreciation of social approaches that bring people together to share their experiences. The former represents an earlier bias in the field while the latter is more indicative of the current emphasis. Such a shift in emphasis has called for a shift in the way that the research and practice is undertaken; this paper focuses on research activities and asserts the appropriateness of a particular methodology for today/s knowledge management research.

This paper will firstly consider the range of research methodologies that have been employed in knowledge management research. It will move on to consider the use of one particular research methodology, ethnography, as a framework for understanding the more personal elements of knowledge. It is contended that use of ethnography, which emphasises observation within a compact cultural setting, offers a potentially ideal method of undertaking research in knowledge management because it concentrates on a community and in the provision of descriptions of how members of the community interact with each other. Utilisation of ethnography as a research method sits comfortably with theories of knowledge, which acknowledge the tacit element of knowledge and its experiential embeddedness; ethnography is therefore put forward as a meaningful methodology for contemporary knowledge management research.

Keywords: Ethnography, research methodologies, tacit knowledge

1. Introduction

There is a developing body of literature in knowledge management that aims to use models of managing knowledge more purposefully in real world situations. In developing research, a common approach has been to create a distinction between tacit and explicit knowledge. The tacit/explicit distinction has led to differing approaches in the conduct of empirical research. Of considerable importance in the adoption of a particular research method to investigate knowledge, tacit and explicit, is the utilisation of a research method suitable for illuminating the research domain as well as offering practical insight.

This paper will first consider how research approaches distinguish between tacit and explicit knowledge and the impact of this distinction upon the research methods used in the conduct of knowledge management research. Then the use of ethnography as a potentially suitable research method will be considered in relation to knowledge management research.

2. Tacit/Explicit knowledge distinction

One of the features of research in the knowledge management field has been the concern of researchers to identify the ambit of their research. Thus, researchers have tried to offer explanations, define meaning, characteristics or features of their understanding of knowledge and related terminology. The effect of these efforts has tended to result in myriad definitions of knowledge. Thus, Blackler (1995, p.1032) describes knowledge as “multifaceted and complex, being both situated and abstract, implicit and explicit, distributed and individual, physical and mental, developing and static, verbal and encoded”, an interpretation echoed in Davenport & Prusak”s (1998, p.5) description of a “fluid mix of framed experience, values, contextual information and insight”. Samiotis et al. (2003, p.176) implicitly reference knowledge”s multifacetedness as it “reflects the intentions of the humans who create it and interpret it”. This human element of knowledge management research is also acknowledged by Chatzkel (2002) and with Fowler & Pryke”s (2003, p.258) view that knowledge is “as much about the perception arising from information... refracted through the individual”s personal lens”. The various definitions offered, although not exhaustive, reflect a broad spectrum of views about what constitutes knowledge. More recent research has developed a greater emphasis on the human aspect of ‘transforming’ information ‘into’ knowledge.
Figure 1 reflects the tacit/explicit split as one way of highlighting the different aspects of knowledge, with tacit knowledge attempting to capture the 'personal' elements of knowledge and explicit knowledge representing its more tangible elements. The proposed method to better understand the research is to reflect on what features tacit knowledge is observed as having, or, what makes tacit knowledge distinct from explicit knowledge (or as it may be termed 'the informational content of knowledge') as identified in prior research.

In scientific theory generation, Polanyi (1966) posited that it was the application of tacit knowledge that led scientists to generate new theories, premised on the conception "we can know more than we can tell" (1966, p.18). This 'knowing more than could be told' has been regarded as the 'tacit' aspect of knowledge. This idea of a tacit element of knowledge has been adopted and interpreted in the knowledge management literature (Nonaka & Takeuchi 1995; Carayannis 1999; Hildreth et al. 1999; Alavi & Tiwana 2002). Thus, Hendriks & Vriens (1999, p.114) acknowledge Myers (1996), who states, “at its core, knowledge must be seen as tied to the personal or human element. Knowledge as we generally understand it, resides in peoples' heads”. Thus, tacit knowledge is perceived as being more personal and encompassing "factors [such] as personal belief, perspective and values embedded in individual experience" (Hendriks & Vriens 1999, p.114).

Evidence would suggest that, in understanding knowledge, and, in particular, tacit knowledge the research undertaken recognises distinctions between different aspects of knowledge and that this are reflected in the literature by distinguishing the elements of tacit knowledge from those of explicit knowledge. However, in making these distinctions and emphasising the importance of tacit knowledge, it can be seen, in the next section, that the research still tends to focus more closely on informational aspects of knowledge, perhaps due to the greater ease with which it is possible to manage that which can be easily articulated.

3. Research approaches - Tacit/Explicit knowledge

Although it has been stated in the preceding section that there is a developing clarity in the conceptualisation of individual aspects of knowledge with recognition of the importance of the human aspect in the development of knowledge, research, whilst acknowledging this, still tends to focus more readily upon the explicit aspects of knowledge. The tendency in knowledge management research is to reinforce the distinction between tacit and explicit knowledge. By drawing out the explicit aspects of tacit knowledge and focusing on these explicit qualities with greater emphasis there may be a tendency to pass over or exclude more detailed scrutiny of the tacit aspects of knowledge.

With regard to this distinction between the tacit and explicit knowledge and research in knowledge management, much of the literature, whilst acknowledging the importance of tacit elements of knowledge, tends to focus on its more manageable elements (Wiig 1997; Pan & Scarborough 1998; Bolisani & Scarso 1999;
Levett & Guenov 2000; Mentzas et al. 2001; Forcadell & Guadamillas 2002; Seng et al. 2002; Albers & Brewer 2003; Fowler & Pryke 2003). Thus, research tends to emphasise “from a theoretical standpoint, KMS refer to the information systems adopted and designed, which efficiently and effectively leverage the collective experience and knowledge of employees to support information processing needs, as well as enabler and facilitating sense-making activities of knowledge workers” (Wickramasinghe 2003, p.298). Here too, the research work accentuates the focus on information as a means of supporting employees engaged in ‘knowledge’ work. There is still a significant amount of literature emphasising the explicitness of knowledge, particularly through the use of technology in the research (Levett & Guenov 2000; Apostolou & Mentzas 2003; Gottschalk & Khandelwal 2003; Muscatello 2003).

However, what seems to be emerging is a growing awareness in the research community in knowledge management that there is a social element to this research area. The first ‘wave’ of knowledge management research appeared to be concerned with the need to “capture, codify and distribute organisational knowledge (usually in centrally managed computer systems)” (McElroy 2000, p.199). Over time there has been a movement towards focusing on people centred approaches in an organisation as a means of managing knowledge (Hildreth et al. 1999). With research developing awareness of the social elements of knowledge there is a concomitant recognition of the need to utilise research methods to better understand the tacitness of knowledge. In repositioning the focus more clearly on the tacit elements of knowledge, the aim of research may be to improve the management of knowledge itself. Practitioners appear to have recognised social elements of managing knowledge in such work as Sveiby (2001) and Sveiby & Simons (2002).

With research concentrating on the more ‘personal’ elements of knowledge, knowledge management systems research now encompasses the social or cultural elements of managing knowledge (McAdam & McCreedy 1999), activities in organisations that might be termed knowledge management (Janz & Prasarnphanich 2003) and organisational learning (Alavi & Tiwana 2002; Forcadell & Guadamillas 2002; Jones et al. 2003; Zárraga & García-Falcón 2003). Although there has been an acceptance that earlier knowledge management literature has omitted this ‘personal’ aspect of knowledge (Hildreth et al. 1999), it also serves to underscore the fact that this aspect of knowledge “largely, defies recording and explicating” (Hendriks & Vriens 1999, p.115). Since research has tended to focus more easily in the explicit knowledge domain, in turn this has influenced the research approaches utilised in knowledge management research.

3.1 Research design

One of the first issues which emerge from research in knowledge and knowledge management is the degree to which research still focuses on the domain of managing explicit knowledge despite the avowed recognition of the importance of tacit knowledge. A second issue emerges when consideration is given to the actual conduct of research that is undertaken. It would appear that researchers may explicitly or implicitly state their methodological stance but subsequently appear to have difficulty in implementing the methodology in their primary research. Secondly, the methodological stance is not always evident, which may result in criticism that the research position is ambiguous and, therefore, problematic for others in the research community to construct a possible stance by piecing together aspects of the data collection and analysis in an effort to ‘assemble’ a possible methodology.

Firstly, it may be argued that, foremost in the process of constructing a research design, the researcher may be faced with the need to “to confront his or her preconceptions (prejudices) that guided the original research design…As a minimum, the researcher should identify what type of interpretivism s/he prefers, identify its philosophical roots and relate the particular strengths and weaknesses of the preferred philosophical direction to the purpose of the work” (Klein & Myers 1999, p.76). The inference is threefold. First, the research process, practically implemented, embodies the inherent preconceptions of the researcher; second, the research process should attempt to make explicit the philosophical roots underpinning the research, and; third, that the research process, by virtue of the preceding points, may ultimately be interpretivist.

Each of these points requires further elaboration. From consideration of research generally, it would appear that there is often little evidence to support the view that researchers explicitly acknowledge their preconceptions. This does not imply that the researcher has failed to reflect upon these preconceptions, merely that they have failed to enunciate them. It may be argued that this is most evident in research that exhibits the traits of an essentially positivist tradition. The basis for this assertion rests on the contention that the philosophical roots of positivism emphasise two
aspects, namely; (1) the belief of the researcher that there is an objective reality which exists independently of them, and (2) that this objective reality is capable of measurement and analysis from which may be deduced general theories with potential universal applicability.

Through analysis of the various evolutions of scientific research it can be seen that the philosophical underpinning has tended to reduce the influence of inherent preconceptions of the researcher and emphasise the importance of that which is observed. Thus, the positivist research tradition appears to be premised upon the ontological assumption that the researcher is independent of the research undertaken and that the observable world in which the research is being conducted is a world that exists independently of the research with external, concrete structures. It is for this reason that positivism tends to favour the inductive method; that information or data is gathered by careful observation of a particular phenomenon, allowing a preliminary hypothesis or generalisation to be formulated and these are subsequently tested in later research. Kuhn (1970) identifies such periods of science to be consistent with periods of ‘puzzle solving’. However, it is against this backdrop that Kuhn (1970) argues that science exhibits periods when a researcher explicitly acts in defiance of the ontological assumptions which underpin their field; namely at periods when scientific revolutions occur. Whilst researchers do not explicitly negate their ontological belief in an external reality, they do, during periods of scientific revolution, reject assumptions held by the research community. This usually occurs because the methods used in ‘puzzle solving’ have simply failed to answer intractable puzzles.

Kuhn’s (1970) view of scientific research actually undermines the claim that scientific research is essentially positivist because to achieve a scientific revolution, the general deductive reasoning from observation is rejected and this requires the scientific community to reject the second plank of positivist thinking. This rejection underscores both (1) the failure of the positivist research tradition to acknowledge inherent assumptions internal to the researcher in the development of a research design and (2) the failure of the scientific community to acknowledge that in the actual conduct of research their ontological and epistemological assumptions underpinning this research are nothing more than paradigmatic congruence, i.e., an agreed world view or ‘Weltanschauung’.

Linking this to the study of knowledge, if knowledge is encapsulated as Polanyi’s (1966) ‘we know more than we can tell’; then explicit knowledge may simply reflect the informational content of knowledge. Assuming that knowledge has an innate quality framed in part by our experience (unlikely to be replicable), then our view of the world is so framed that even measuring the ‘concrete’ world (within a positivist tradition) must lead to constructing a view of the world from which flows the scientific revolutions that Kuhn (1970) discusses. Within the recent literature about knowledge management, the positivist tradition maintains reductionist views on something that is not necessarily capable of being so examined (Hildreth et al. 1999). This poses the question of how can the phenomenon of knowledge be made ‘meaning full’ by the researcher?

If the research process is always subject to the inherent preconceptions of the researcher (Klein & Myers 1999, p.76), within the natural sciences, this has been sublimated by the scientific method. Social sciences, with its recognition that the methods appropriate to natural science may not be suitable, have engaged in discussion about suitability of research methodologies more openly. Thus there has been greater recognition that “one of the great dramas…. is making the transition from philosophy to methodology to design and the selection of data collection methods” (Lawler 1998, p.109). Within social science, there has been an attempt to realise the philosophical assumptions made in the conduct of research. However, translating the theoretical ideal of research in to the practical is not a straightforward process. The path to achieving valuable research is problematic. Yet, acknowledging that there are difficulties is an important step in achieving research that is of value to the social scientific research of the community.

As a starting point, an idealised model of the conduct of research is contained in Figure 2, below.
Figure 2: Simple exposition of the research process (derived from Easterby-Smith et al. 2002)

Figure 2 is based on Easterby-Smith et al.'s (2002) exposition of research methods. The essence of divisions in the conduct of research can be represented in a simplified way by separating the underlying philosophical assumptions that underpin the work that the researcher conducts and, therefore, influence the design of research and its practical application through the use of differing methods of data collection. Thus, a positivist view of the world is likely to be premised on the belief that observations made in the natural world enable the derivation of predictions; the same premise being equally applicable to social order. From this philosophical assumption, the likelihood is that the research design will result in the creation of experiments and numerical methods of data collection and analysis; whereas a phenomenological stance will rest upon the view that the world is socially constructed and, therefore, interpretivist.

Figure 2 (supra) represents a simplified view of how research might evolve. The intention of this Figure is to highlight the contention that all research is underpinned and usually reflected by the philosophical standpoint of the researcher (albeit that this may not be consciously acknowledged by them), through to the design subsequently devised and finally to the way in which the researcher ultimately determines the most appropriate way to collect data in furtherance of their research objective. To reflect that there is, in practice, a greater degree of complexity in the research process, Figure 2 (supra) has been developed as represented in Figure 3 (below).

Figure 3: Second level exposition of the research process

It can be seen in Figure 3 that several areas (philosophical, research and analysis) have been developed to reflect the greater complexity that actually occurs in the research process. Using Figure 3 consideration can be given to actual research undertaken by those writers in...
knowledge and knowledge management, which will now be considered.

The first difficulty highlighted is that researchers might state their methodological stance but subsequently have difficulty in implementing the methodology in their primary research. Why is this important? It might be argued that research, which is rooted in a methodology and underpinned with a philosophy that is essentially phenomenological, may be likely to use data collection methods that are qualitative. Wilcox King and Zeithaml’s (2003, p.765) four step process for measuring organisational knowledge utilises quantitative data collection methods and quantitative data analysis techniques. The use of quantitative methods for selection in the research, whilst acceptable as a method to obtain focus and to support analysis of the data collected, does appear to be at odds with the authors’ perceived view of organisational knowledge; “enacted through the perspective of multiple knowers” (Wilcox King & Zeithaml 2003, p.764). Within social science, if it is accepted that the nature of reality is interpreted, then Wilcox King & Zeithaml (2003) appear to recognise this interpretivist approach; but, in the translation of the research design, employ positivist criteria. This would support the contention that there is a mixing of the methods used to conduct their research and the methodology itself.

Both Bolisani & Scarso (1999) & Apostolou & Mentzas (2003) adopt a ‘case study’ approach consistent with a phenomenological philosophy. Bolisani & Scarso’s (1999, p.213) research question is “to investigate the correlation between kinds of knowledge exchange and kinds of ICT applications”, whilst Apostolou & Mentzas (2003) are concerned with the implementation of their ‘Know-Net’ solution in four organisations. Two difficulties arise in relation to each authors’ work. Whilst both would appear to have implemented a methodology consistent with a phenomenological position, there is a lack of elucidation about the case studies conducted. This leads to the second difficulty that the use of a ‘case study’ could be construed as overly broad in its terms. The data collection methods utilised in a ‘case study’ do not fit neatly within Fig. 3 (supra). Similarly there appears to be a degree of confusion in the work of Lytras & Pouloudi (2003). In a section headed ‘Research Methodology’, the authors describe how their practical involvement came about. Action research is cited as the reason for involvement in this project, without subsequent clarification of its use for the analysis of their findings. Their failure to explicate their philosophical assumptions more clearly suggests that there is a difficulty in translating a theoretical design for research into its implementation.

Sometimes, rather than confusion about translating a theoretical research design into its practical implementation, it becomes too difficult for the researcher. Thus, Wickramasinghe’s (2003) research concerns describe “case findings from three consulting companies – approximately ten years after they...adopted a knowledge management system...The data were gathered using standard techniques for conducting qualitative multiple case study research” (2003, p.298). This could be described as a lucid exposition of the research design adopted together with the methods utilised to collect data. However, the utilisation of thematic coding raises the issue of its appropriateness within a qualitative framework as it might suggest a degree of quantification in analysis.

Similarly, Hendriks & Vriens (1999) research methodology appears to entail ‘empirical investigation’. This would suggest that they are concerned with developing an understanding of a given situation based on experience. However, it might be argued that, although empirical investigation is closely allied to the scientific method approach to research, the result of which is that, though many practice research in this way, little, if any, attempt is made to explicate it within an overall framework for the conduct of research (usually due to its longevity in terms of a method for conducting research). Unfortunately, the result of this is that there is a danger that the scientific method is adopted without any obvious consideration of its most appropriateness for undertaking research. Additionally, it has been suggested that capturing tacit knowledge is something that “largely, defies recording and explicating” (Hendriks & Vriens 1999, p.115) and this may highlight the need to think carefully before employing any research methodology. Similarly, Gottschalk & Khandelwal’s (2003) ‘empirical study’ of the factors that determine knowledge management technology projects in law firms, entails a survey from which the results are subject to numerical analysis. An empirical study tends to be an examination of the research phenomena based on observation with subsequent analysis using quantitative measures and data analysis techniques. In what way does this differ from ‘thematic coding’ in a piece of qualitative research?

As has been discussed earlier, many pieces of practical research clearly enunciate the way in which the researcher intends to conduct the research whilst rarely making explicit their understanding of the research process. Sviokla’s work (1996) attempts to deal with this by acknowledging that within his research domain
previous studies have developed theoretical models which have rarely been tested in fieldwork. In order to develop a predictive model, Sviokla (1996) breaks down the research process in to two phases; the first to develop the variables for later testing in phase two. Thus at one level, he (Sviokla 1996) attempts to address the process of research design. However, the main difficulty, and a major feature of research in a non-traditional or social science area is the mixing of data collection methods. This appears to be a frequent feature of case studies. The overall impression is that the researchers seek validity and reliability for the subjective aspect of their work by inclusion of facts and figures. It must be asked if this is appropriate. Should a case study be concerned with facts and figures? Sviokla (1996, p.25) states at the outset that his work is concerned with “not about new organizations or those transcending a deep crisis; rather, it concerns the push and pull of managers attempting to implement a new technology”. This statement would appear to suggest a concern for the social implications of implementation and it might therefore be argued that the data collection methods should concentrate on the very aspect Sviokla (1996, p.39) dismisses on the grounds of validity and reliability.

It is suggested that one of the major underlying weaknesses of developing a research methodology, particularly in social scientific research centres on this tension – that social research is sacrificed at the expense of a desire to be seen to be ‘scientific’.

4. Ethnography – A suitable research method

Having considered the problematic aspects of research in the field of knowledge and knowledge management, two main issues arise. Firstly, it would seem that that the scope of knowledge and its management has tended to focus on those aspects, which are readily explicated, to the possible exclusion of knowledge’s tacit elements. Secondly, in the conduct of research there would appear to be a degree of confusion between the development of a research design to its implementation. This second issue may impact upon the beneficial aspects to be drawn from the research.

One way to address these issues may be to adopt an existing methodological approach, that of ethnography. This form of research has been described as “a research process in which the anthropologist closely observes, records, and engages in the daily life of another culture – an experience labelled as field work – and then writes accounts of this culture, emphasizing descriptive detail” (Marcus & Fischer 1986, p.18).

The roots of ethnography are to be found in anthropology. Traditionally, travellers wrote commentaries about ‘other peoples’, with the emphasis intended to bring out the difference of these other people. Therefore, the goal of ethnographic research was to “lay bare, from within, the logic that informs and organizes the collectivity’s life and way of thinking” (Alasuutari 1998, p.61).

Historically, ethnographic writing (Hammersley & Atkinson 1983; Thomas 1993; Van Maanen 1995; Wolcott 1999) has acknowledged the importance of Malinowski’s (1922) “Argonauts of the Western Pacific” in the formalisation of rules for undertaking ethnographic research; developed to facilitate the use of a rigorous approach to the application of ethnographic methods used in field work, in the same way as occurred in scientific research. In order to meet the rigour of scientific research, Malinowski (1922) believed that it was necessary for the researcher to explain how the material had been collected and the results presented. In essence, this required the presentation of an account of the research process in addition to the presentation of the data obtained. Additionally, it was important that the theories and interpretations of the researcher were kept separate from the raw data, i.e., the observations and what people said. Another feature highlighted by Malinowski (1922) was the importance of participant observation. The rationale for this was the perceived need to remain in the background to eliminate the effect that the researcher’s presence had on the object of study (at least in theory).

However, it may be argued that this is simply not possible given the type of research being conducted or given one’s attitude about the interaction between the researcher and that which is being observed. In more recent research, e.g., in the area of ethnomethodology, the idea is to uncover the hidden assumptions of people’s lives by challenging them, or as Alasuutari (1998, p.67) states, the aim is “to explore and make visible the taken-for-granted rules of interpretation that people use in their everyday life as well as the collectively shared assumptions on the basis of which we make sense of different interaction situations”. The purpose of this is that it would allow the reader to determine how reliable the researcher’s work was and thus the ‘validity’ of the researcher’s conclusions based on the material obtained.

There are parallels with understanding tacit knowledge. Drawing on Polanyi’s (1966)
contention that "we know more than we can tell", ethnography may offer a methodological research approach to uncover the tacit elements of knowledge more fully. This is because it is an area that researchers find the most intractable due to the difficulty in explaining that part of knowledge, which is experiential or cultural for humans.

Ethnography, as a method of conducting research, appears to exhibit certain characteristics. Firstly, it seems rooted in observation of 'others' as evidenced by its development from travellers' tales. Secondly, the research undertaking is based on the researcher dwelling with this other culture and observing and participating in the lives of the 'others'. Finally, in the presentation of the research, it is deemed necessary to explain not only the data obtained, but also the means used to collect data. Based on these requirements, it is useful to look in more detail at the ethnographic research methodology, in particular, in light of the transposition of its use in other research areas and within the overall context of research methodologies.

Ethnography is not a perfect method for the implementation of a research design. Arguments still persist about its adequacy and validity. These arguments have tended to focus on two aspects. Firstly it is argued that ethnography lacks scientific sufficiency. Secondly, it is argued that ethnography has failed to separate itself sufficiently from qualitative research (Hammersley & Atkinson 1983, p.6). In order to consider these criticisms; it would be beneficial to reflect upon Fig. 3 ( aforementioned at p.8). Having contended that it is a necessary part of the research design to construct a model thereof, reflecting the philosophical underpinning; Figure 4, below, represents a refinement of Fig. 3 as it relates to ethnographic research.

From Figure 4, it is evident that ethnography, although subject to criticism, appears to offer some continuity between theoretical and practical application of a research design. However, focusing more closely on the arguments, referred to supra, the main thrust in countering a lack of scientific rigour appears to have centred on ethnography's unique empirical phase. Ethnography has responded to these criticisms in a number of ways. Firstly, it has been stated that ethnography is a method of social science research better suited to understand human behaviour than other methods because of its "processual and meaning-laden character" (Hammersley & Atkinson 1983, p.7). Secondly, social science has tended to try to mimic natural science, but ethnography is distinct. Ethnography is concerned with a different kind of science from that of natural science. Unlike natural science, ethnography focuses on both the general and unique. Rather than simply describing human behaviour, it is concerned with 'understanding' and interpreting human behaviour. Thus as Evans-Pritchard's (1962) argues, human behaviour, as a manifestation of culture, always requires interpretation. Underpinning this is the assumption that human society can be better understood through the use of interpretation, than

![Ethnographic research method](https://example.com/ethnographic-research-method.png)
reliance upon quantitative methods? The basis for this is that quantitative methods do not manage to capture human social behaviour because of their reliance on that which can be reduced to observation, within an artificially created experiment. Ethnography in contrast entails observation and living within a social collective.

Thus, ethnography makes certain assumptions (akin to ontological and epistemological underpinning of research). These can be summarised as the beliefs in naturalism, understanding and discovery. Naturalism is based on a particular view of social research, which states that the only way to capture human behaviour is to do so in a natural setting rather than in 'unnatural settings' that might be created for the purposes of experimentation. The corollary of this is that within the 'natural' setting, the researcher tries to lessen their own impact to heighten the neutrality of the research undertaking. The third aspect of naturalism is the contention that to explain social phenomena, it must be done within the context within which it occurs.

At the heart of the second premise (understanding) is the view that the way people behave differs from behaviour in the physical world. In the physical world, it is believed that observation will produce a series of fixed responses dependent upon stimuli. However this does not necessarily apply to the social world. Instead it is contended that in the social world, stimuli are interpreted and responses (plural) are constructed. Taken to its natural conclusion, this would result in a rejection of the concept of causality in the social world. However, ethnographers do not wholly reject the principle of causality – rather there may be causal relations in the social world but these are not conceived in the same way as those found in the physical world. As part of the process of interpretation, it is argued that it is necessary to understand the culture of the group in order to produce the interpretations for the behaviour of the group members. Therefore, participant observation provides a method that produces a more 'in-depth' understanding of culture and human behaviour. In relation to discovery, ethnography takes a fundamentally different stance from traditional scientific research. Scientific research appears to be premised upon the basis of hypothesis testing. Ethnographers favour an approach, which requires a rejection of this limitation; rather it tries to "examine a type of social phenomena and/or consider some theoretical issue or practical problem" (Hammersley & Atkinson 1983, p.15). The argument for this is that hypothesis testing narrows the focus of the research issue to the extent that it may result in missing the true nature of the phenomena.

Does ethnography fall between two stools? It has been argued that ethnography lacks scientific sufficiency. Ethnographic writing may tend to use terms such as 'frequently' and 'often', lacking in precision. Thus, it fails to adequately quantify phenomena as words like 'frequently' and 'often' are used in an imprecise way and it has been accused of being “impressionistic” (Hammersley & Atkinson 1983, p.10). Ethnographers reject this on a number of levels. Quantification, per se, has not been rejected and some ethnographic accounts include their use. However, it is not necessary, because if a difference is large, then figures do not require to be stated precisely with any loss of meaning. The danger is that in being too precise, the claims made cannot be justified and quantification can just as easily distort in the same way as a lack of precision, based on the measurement techniques utilised.

By the very nature of the ethnographic research process there is an inbuilt bias because of the lack of structure to interviewing, i.e., no formal/structured interviews, and this undermines the ability of other researchers to replicate findings. As has been stated earlier, ethnographers acknowledge the role of the researcher in the research process. Secondly, all knowledge is in some sense social and cultural and cannot be isolated out of the research process and is, therefore, inherently bias laden. Finally, by accepting that the research process is not neutral, it may be argued that science is subjective. We all react to the structure we impose upon our research and thereby predetermine its subjectivity, e.g., I ask the same question at the same point in an interview as you did; it is still subject to interpretation, either yours or mine. Thus, ethnography accepts that it is interpretive and not merely neutrally observational. This is in contrast to much of the natural sciences where the belief is that you observe and neutrally describe what you observe.

Ethnography as a method of research to better understand tacit knowledge also potentially aids knowledge management in practical terms. It offers both an in depth approach to better illuminate the contextual nature of tacit knowledge and is underpinned by a theoretical basis for the appropriate conduct of research.

5. Conclusion
The fundamental premise of ethnographic research posited here rests on the belief that, as a research methodology, it is unproblematic if it is
accepted that ethnographic research represents a different kind of science from that of the natural science. In essence, if it is accepted that ethnography is a research design based upon different ontological and epistemological foundations, then why should it require to adhere to those suited to the natural sciences? This leads to the fundamental question at the heart of the utilisation of the ethnographic method as a way of developing research in knowledge and knowledge management.

Part of the discontinuity in knowledge management research may be due to the fact that, whilst acknowledging tacit knowledge’s importance, research has tended to focus on explicit knowledge as it offers a more easily encapsulated view of knowledge and is easier to manage than people’s insights, values, culture or experience. It may be because there has been a lack of an agreed view about what constitutes an appropriate research methodology, which would enable a greater discussion of how to manage tacit knowledge. The answers to these propositions are not presented here. Rather, a suggestion is made – whatever the facets of tacit knowledge may be: they are, in some sense, inextricably bound to Polanyi’s (1966, p.18) view that ‘we know more than we can tell’. It is suggested that Polanyi identified self knowledge, i.e., that which is within us, and alluded to the knowledge that is part of a group, socially and culturally bound. It is contended that ethnography presents a research methodology to illuminate these aspects of ‘knowing more than we can tell’.

References


Effects of Knowledge Representation on Knowledge Acquisition and Problem Solving

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Abstract: The way knowledge is represented influences the effectiveness with which that knowledge can be shared and reconstructed. Of particular interest to this study is the hypertext knowledge representation. Based on the schema theory, we propose a model explaining the effect of the hypertext knowledge representation on the user’s problem solving performance. The sophistication of the knowledge structure that the user can construct from the hypertext knowledge representation is proposed as an intervening variable mediating the effect of hypertext on the problem solving performance. According to our model, the hypertext representation of the ‘collective schemata’ of a group of experts allows the user to acquire a more complex and better integrated knowledge structure that is more similar to the experts’ than does a linear representation. The model further hypothesizes that the complexity, integration and degree of similarity of an individual’s schemata to that of domain experts in turn improves significantly the individual’s problem solving performance. Compared to the linear representation, the hypertext representation of expert knowledge is expected to improve the quality of problem solving in the organization through the facilitation of the acquisition of more sophisticated knowledge structures by the users. A field experiment was used to verify the hypotheses of our model. This research demonstrates the important role of hypertext knowledge representation in supporting knowledge construction and problem solving.

Keywords: Hypertext, knowledge representation, knowledge elicitation, knowledge construction, problem solving

1. Introduction

The way knowledge is represented influences the effectiveness with which that knowledge can be shared and reconstructed. Traditionally, knowledge is presented in a linear way, following a hierarchical structure. Learners have no control over the sequence of learning materials and the association among concepts is not explicit. With hypertext, on the other hand, knowledge can be represented as a network of linked nodes. The nodes can include a variety of knowledge representations such as free text, structured data, mathematical and other types of models as well as multimedia representations. The links can portray semantically significant relationships varying from cause-effects to logical and mathematical associations. Hypertext, as a knowledge representation scheme and also as a user interface modality, has been indicated to support mental model building and mental model maintenance by enabling scanning and focused search (Vandenbosch and Higgins 1996). Another important feature of hypertext is that it allows for different levels of prior knowledge (Stanton and Stammers, 1990). With linear text, the learner may have to go through already known material sequentially before reaching new information. This could have negative effects on the learner’s motivation. With hypertext, on the other hand, the learners are more active in selecting the material to explore and have more browsing flexibility. Also important to mention is the ability of hypertext to provide contextualized access to domain knowledge. This hypertext feature has been shown to enhance understanding, to reduce the motivational ‘cost’ of learning and to be highly effective for resolving comprehension difficulties (Mao and Benbasat, 1998).

In this study, we compare the hypertext representation of expert knowledge to the traditional linear text representation in terms of the effects on the transfer and reconstruction of complex knowledge structures. Based on the schema theory, we propose a model explaining the effect of the hypertext knowledge representation on the user’s problem solving performance. The sophistication of the knowledge structure that the user can construct from the hypertext knowledge representation is proposed as an intervening variable mediating the effect of hypertext on problem solving performance. According to our model, the hypertext representation of the “collective schemata” of a group of experts allows the user to acquire a more complex and better integrated knowledge structure that is more similar to the experts’ than does a linear representation. The model further stipulates that the complexity, integration and degree of similarity of an individual’s schemata to that of domain experts in turn improves significantly the individual’s problem solving performance. Compared to the linear representation, the hypertext representation of expert knowledge is expected to improve the quality of problem solving in the organization through the facilitation of the acquisition of more sophisticated knowledge structures.
The paper is structured as follows. We first describe the research model and justify its hypotheses. This is followed by a description of the empirical study and a discussion of the results. In conclusion, we summarize the study, discuss the theoretical and practical implications and make suggestions for future research.

2. Research model

Our model (see Figure 1) stipulates that knowledge representation determines knowledge acquisition, which in turn affects problem solving performance. As far as knowledge acquisition is concerned, an important advantage of hypertext is its non-linearity and more particularly its capability of representing associative relationships. According to the schema theory (Rumelhart, 1984), knowledge is stored in long-term memory as a network of information packets: schemata. These schemata are abstract, structured and dynamic. They are viewed as semantic networks or meaningfully related concepts (Jonassen and Reeves 1996). These networks are dynamic in the sense that they are continuously reconstructed through knowledge acquisition. The schema theory defines knowledge acquisition as the process of interpretation of new information and its assimilation and accommodation into schemata (Anderson and Pearson, 1984). Assimilation is the incorporation of new information into an already existing schema and accommodation refers to the modification of an existing schema to fit in new information. After several reorganizations of his/her knowledge structure, the novice forms a schema that resembles that of an expert (Shavelson 1974).

Hypothesis 1: The hypertext representation of expert knowledge will enable the user to acquire a significantly more sophisticated knowledge structure than with the linear representation of the same knowledge.

The sophistication of a knowledge structure is defined in terms of its complexity, its level of integration (interconnectedness) and its structural closeness to the experts’ knowledge. Complexity and integration are the main characteristics that differentiate the knowledge structure of the expert from that of the novice. More able individuals have richer, more interconnected knowledge structures than do less able individuals (Derry 1990). As expertise is attained through learning, the elements of knowledge become increasingly interconnected (Ruiz-Primo and Shavelson 1996). In addition to growing more complex and better integrated, the semantic networks of novices also become more structurally similar to those of an expert with learning (Royer et al. 1993). It is not just the number of elements of knowledge (complexity) and the number of connections between these elements (integration) that matter, but also which particular connections are made (structure).

Hypothesis 2: The level of sophistication of an individual's domain knowledge structure affects positively the individual's problem solving performance in that domain.

Knowledge structure represents an important dimension of the acquisition of cognitive skills (Mandin et al. 1997). A number of studies established a significant relationship between the knowledge structure and problem solving performance (e.g., Robertson 1990; Markham et al. 1994). The similarity of an individual’s domain-specific knowledge structure to that of an expert correlates significantly with measures of achievement (Markham et al. 1994). In our model, problem-solving performance is measured in terms of performance time, the appropriateness of the solution (as judged by domain experts) and the individual’s rationale or justification of the solution (also as evaluated by domain experts). As our model explains the effect of hypertext on the acquisition of explicit knowledge as opposed to tacit knowledge, the ability of the user to justify the solution is an important aspect of the user’s performance.

3. Empirical study

To verify the hypotheses of our model, we conducted a between-subjects field experiment involving eighty business professionals enrolled as part-time MBA students. Participation was voluntary and remunerated. The subjects were randomly assigned to two groups: a control group and an experimental group. The control group used a computer-based linear representation. The experimental group, on the other hand, had access to a hypertext representation of the same material. The two groups were compared in terms of knowledge acquisition (i.e., sophistication of
knowledge structure) and knowledge application (i.e., problem-solving performance).

3.1 Experimental procedure

We conducted a knowledge elicitation process with a group of bank loan officers (domain experts) regarding the evaluation of personal loan applications. The process resulted in a collective concept map describing the loan applications evaluation that all participants agreed upon. We then used the resulting experts’ concept map to design the navigational structure of a hypertext system, where each node was presented with a separate screen describing the associated concept(s) and links (cross-links). Such associated information was highlighted with hyperlinks, allowing for the access to the neighborhood (related concepts) of the node. We also developed a linear computer system including the same screens as the hypertext system, but without the hyperlinks. The two systems had the same look and feel. The only difference was in the navigational structure.

The experiment involved three stages performed on three different days. In the first stage, the subjects received a briefing on the experimental procedure and then attended a tutorial on concept mapping. A test revealed no group difference in terms of map complexity and integration. In the second stage of the experiment, the subjects participated in a knowledge acquisition session followed by a concept mapping session. The experimental group used the hypertext system while the control group used the linear system to learn about the evaluation of loan applications. The knowledge acquisition session lasted 45 minutes. After a recess of 15 minutes, the subjects were given 30 minutes to draw a concept map describing the loan application evaluation process. The duration of both sessions was determined by a pilot experiment. To motivate the subjects to perform at the best of their ability, they were informed since the first stage of the experiment that the best concept map would be selected for a monetary prize ($200).

In the third stage of the experiment, the subjects were given three loan applications to evaluate. No time limit was imposed, but the subjects were told to perform the evaluation as fast as possible and that the fastest correct evaluation would receive a monetary prize (another $200). The first loan application was a straightforward case, satisfying both objective criteria (eligibility ratios) and subjective factors (risk and character). The second application satisfied the objective criteria but failed some important subjective criteria. More specifically, the loan officers judged the application risky because of lack of residency stability and insufficient assets. The third application did not satisfy the objective criteria because of the lack of the credit bureau rating, as the applicant did not have any credit history. It was, however, accepted by the loan officers because it scored high on the subjective criteria. The risk and character factors were judged as good and the applicant had sufficient assets to cover the loan. After the subjects evaluated all three cases, they were interviewed individually and asked to justify their evaluations. The interviews were audio-taped and later analyzed by loan officers.

3.2 Measurement

Knowledge structure acquired by the subjects in a specific domain was assessed with concept mapping (second stage of experiment). The sophistication of a subject’s knowledge structure was determined by the complexity and integration of the subject’s concept map and the closeness of the map to the referent knowledge structure (the experts’ concept map). The total number of valid direct links measured complexity, while the total number of valid cross-links measured integration. Three loan officers that were not involved in the knowledge elicitation phase determined the validity of the nodes, links and cross-links. The three loan officers performed the validity judgment separately. In case of disagreement about the validity of a node or a proposition, they were asked to reevaluate the entire map without being informed of each other’s evaluation. If after the second round the disagreement was not resolved, the opinion of the majority (two out of three) was selected. The closeness of a subject’s map to the experts’ map was measured with the C metric (Goldsmith and Davenport 1990). The C metric measures the degree of similarity of the neighborhood of a given node, in the subject’s map, to the neighborhood of the same node in the referent map. The C metric is determined for every node in the subject’s map. Cs for individual nodes were then averaged across all nodes in the map to produce a single C value that indicates the overall similarity of the subject’s map to the experts’ map.

Three different measures of problem solving performance were considered: 1) total time spent on the evaluation of the three loan applications in phase 3 of the experiment, 2) the appropriateness of the solution (evaluation) and 3) the justification of the solution. Solution appropriateness refers to the ratio of agreement of the subject’s evaluations with the loan officers’ evaluations of the three cases (1/3 for one match, 2/3 for 2 matches and 1 for complete agreement). Solution justification was rated by the three loan officers who validated the subjects’ concept maps, based on the audiotaped interviews. The rating was done according to the Structure of the Observed Learning Outcome (SOLO) taxonomy (Biggs and Collis 1982). Higher levels in the SOLO taxonomy correspond to higher
levels of understanding of the problem domain. The SOLO scores given by the three loan officers were averaged to produce a unique score for each subject, after verification of inter-rater reliability.

4. Results and Discussion

As indicated in Table 1, the experimental group achieved significantly higher scores for knowledge structure complexity, integration and closeness.

<table>
<thead>
<tr>
<th>Structural Knowledge Sophistication</th>
<th>Means for Control group</th>
<th>Means for exp. group</th>
<th>Sig. (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity (number of direct links)</td>
<td>15.12</td>
<td>19.75</td>
<td>.000</td>
</tr>
<tr>
<td>- Integration (number of cross-links)</td>
<td>2.00</td>
<td>4.65</td>
<td>.000</td>
</tr>
<tr>
<td>- Closeness to referent structure (C metric)</td>
<td>0.32</td>
<td>0.53</td>
<td>.000</td>
</tr>
<tr>
<td>Problem Solving Performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Performance time (in minutes)</td>
<td>43.52</td>
<td>33.37</td>
<td>.000</td>
</tr>
<tr>
<td>- Solution appropriateness (agreement ratio)</td>
<td>0.40</td>
<td>0.75</td>
<td>.000</td>
</tr>
<tr>
<td>- Solution justification (SOLO score)</td>
<td>2.90</td>
<td>4.17</td>
<td>.000</td>
</tr>
</tbody>
</table>

The measurement of knowledge structure sophistication and problem solving performance was examined with factor analysis, resulting two factors as indicated in Table 2. All indicators had high and significant loadings with respective constructs, demonstrating the construct validity and the discriminant validity. The reliability and convergent validity of the measurement model of this construct were confirmed by the composite reliability of the scale and the average variance extracted (Fornell and Larcker 1981), which all exceeded the recommended value of 0.8 (Nunnally 1978).

To test the mediation effect, we computed the factor scores for both knowledge structure sophistication and problem solving performance. The regression analysis (OLS) was conducted and the results support the hypothesized mediating role of knowledge structure sophistication, as illustrated in Table 3: 1) knowledge representation significantly affects the mediator \(0.853^*\); (2) knowledge representation significantly affects problem solving performance in the absence of the mediator \(0.726^*\), (3) the mediator has a significant unique effect on problem solving performance \(0.64^*\), and (4) the effect of knowledge representation on problem solving performance shrinks upon the addition of the mediator to the model \(0.726^* \rightarrow 0.181\). We also performed a formal test (Sobel-Test) as recommended by Baron and Kenny (1986) and a significant z-value of 4.63 \((p<0.01)\) was observed. These results provide a strong indication that a significant part of the relationship between knowledge representation and problem solving performance can be explained by the effect of knowledge representation on the sophistication of the knowledge structure acquired by the user. In this particular case, the hypertext knowledge representation seems to lead to a faster, more appropriate and better justified problem solving mainly because it supports the construction of a more complex, better integrated and more expert-like knowledge structure than the linear representation. Although other hypertext features may still affect problem solving positively, it is the capability of hypertext to mimic the associative nature of human memory that seems to be the most important. This particular feature is the basis for the hypothesized effect of hypertext knowledge representation on knowledge structure sophistication, which is shown to be mediating a
significant part of the effect of hypertext on problem solving. 

Table 3: Regression Results for Mediation Test

<table>
<thead>
<tr>
<th>Reduced Model: $R^2=0.527$</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Presentation → Problem Solving Performance</td>
<td>0.726**</td>
</tr>
<tr>
<td>Full Model: $R^2=0.639$ $R^2=0.727$ (KSS)</td>
<td></td>
</tr>
<tr>
<td>Knowledge Presentation → Problem Solving Performance</td>
<td>0.181</td>
</tr>
<tr>
<td>Knowledge Presentation → Knowledge Structural Sophistication (KSS)</td>
<td>0.853**</td>
</tr>
<tr>
<td>Knowledge Structural Sophistication → Problem Solving Performance</td>
<td>0.64**</td>
</tr>
</tbody>
</table>

5. Conclusion

This research demonstrates the important role that hypertext knowledge representation can play in supporting knowledge acquisition and problem solving. The hypertext representation of expert knowledge is shown to help the users to reconstruct and apply that knowledge. More importantly, a model explaining the superiority of hypertext over linear knowledge representation is developed and empirically tested. According to this model, the hypertext knowledge representation assists the user in the acquisition of a more sophisticated knowledge structure that enhances the user’s application of the acquired knowledge to problem solving. The level of sophistication of the knowledge structure constructed by the user is shown to mediate the effects of hypertext on problem solving. The results of this study have several implications. Firstly, the explicit representation of a referent knowledge structure in the hypertext navigational structure is an effective method for facilitating the acquisition of a similar knowledge structure by the user. Designed in this way, hypertext can play an important role in constructivist learning environments, where the learners are encouraged to actively create knowledge through free exploration of learning material. Hypertext can then be used to help the learner acquire an initial knowledge structure that serves as a framework for the interpretation of new information. This initial knowledge structure can be developed further through other learning methods such as collaborative learning. Secondly, when the referent knowledge structure embedded in the hypertext navigational structure is that of an expert or a group of experts, hypertext-based systems, e.g., corporate Intranets, help other employees to acquire this knowledge and apply it effectively to problem solving. In such a case, hypertext can be considered as a valuable tool for supporting organizational memory. Thirdly, the usage of concept mapping for the elicitation of expert knowledge and for the design of the hypertext navigational structure is proven to be effective. Concept maps have been used for a long time in educational psychology research to measure change in the learner’s knowledge structure. They can also be applied to the design of effective hypertext. Now that hypertext is becoming widely used with the proliferation of Internet and Intranet applications, the development of more effective methodologies and tools for the design of such systems is more needed than ever. In the knowledge elicitation stage of our empirical study, we used a collaborative concept mapping approach to derive the collective knowledge structure of a group of expert. Such an approach enabled us to develop an explicit representation of what used to be mainly informal knowledge. The associative structure of concept maps, make them also suitable for mapping the elicited knowledge directly onto the hypertext navigational structure. The potential of concept mapping as a hypertext design tool should be investigated further in future research.

Also in future research, the integration of hypertext with collaborative technologies should be investigated. While the hypertext knowledge representation can play an important role in the explicit representation of a referent expert knowledge structure, collaborative technologies can assist in the communication and further development of this structure. Lim et al. (1997) have shown that a co-discovery approach to learning leads to the acquisition of a mental model with higher inference potential than a self-discovery approach. Furthermore, with collaborative hypertext, knowledge representation and knowledge sharing can be integrated. Starting with a referent expert concept map, the users can discuss the embedded knowledge structure and build upon it. Such an approach has the potential of improving the effectiveness/efficiency of the knowledge construction process and leaves more room for creativity (i.e., developing novel knowledge structures) than using hypertext alone.

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The New Business Models in the Knowledge Economy: the Strategic Way to Value Creation

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Abstract: Over the last decade we have seen the emergence of an economy in which the digital component has become a constant presence in all areas of knowledge. In the digital world, characterised and dominated by a complex connectivity, value assumes a complex meaning, which is strongly distinct from that used in the traditional economy. There are new business concepts, new strategies based on innovation, new mechanisms to create value, and a new need – to build methodologies and metrics that can measure and reflect it.

Keywords: Digital economy, knowledge economy, intellectual capital, business models, and value networks

1. Introduction

In the present day, information represents a new raw material. Determining extensive alterations in the behaviour of individuals and organisations, it seeks to reach sustainable standards of development. The emergence of a new economic order has resulted from the management of this new raw material, in which intangible assets, while supporting the main source of value creation, have assumed a preponderant role. In accountancy it is known as intangibles, in economic theory as knowledge assets and in management literature, as intellectual capital. Its essence represents an asset without physical existence, providing potential future returns. Those assets are generally very expensive. They are extremely difficult to manage and, even today, their associated property rights are confused. This assertion raises the need to rethink accounting and financial principles and, also, protection and management models, with a view toward creating a more appropriate match between accounting and market values.

2. Aims and objectives

Intangible assets are the main source of value creation and evidence has already been obtained that the impact of knowledge capital investment (KCI) on gross domestic product (GDP) surpassed, for the period 1991-2000, that of fixed capital investment (FCI) (Lopes et al., 2004). This has provoked the need to make those assets explicit and questions the rules that support them at an accounting level. Independently of the approach followed - using models centred on knowledge classifications, those based on intellectual capital or socially constructed models (McAdam and McCreedy, 1999) - our intrinsic objectives are primarily concerned with their classification. Broadly speaking, consistent and workable accounting rules are required in order to fairly and truly reflect the economic and financial reality. This linkage certainly supports organisations in their decision-making and helps them to implement strategies in volatile and complex environments that are gradually being dominated by new business models (electronically constructed) and are strongly supported by dynamic innovation processes.

3. Intangible asset: the concept

The search for a broadly acceptable definition of an “intangible asset” is not an easy task, since any approach lacks certification and precision. Baruch Lev (2001:5) affirms: “An intangible asset is a claim to future benefits that does not have a physical or financial (a stock or a bond) embodiment”. Hence, any assets that can provide costs economies can, essentially, also constitute, an intangible asset.

Broadly, Brockington (1996:5) refers to the expected returns when he affirms that:

".... The value of intangible assets is created and maintained almost entirely by expectations about the future and the value that this places on a current situation. It is the business of management to maximize those aspects of a business situation which are invariably given expression by the existence of intangibles".

From an economic theory perspective, Reilly and Schweihis (1998:5), enumerate a set of characteristics as the basic requirements in the classification of asset. Intangible assets should be subject to specific identification, have a recognizable description, have legal existence and legal protection and be subject to private...
property rights. Their private rights should be promptly and legally transferable, they should be required to bear some tangible manifestation of their existence, they should have been created or come into existence at an identifiable time or as the result of an intangible event and, finally, they should be subject to destruction or to termination of their existence at an identifiable time or as a result of an identifiable phenomenon. The intrinsic pragmatism of those approaches contrasts is of a generalist and subjective nature. It creates increased difficulties for a measurement and analysis approach. Broadly speaking, economic phenomena do not qualify as intangible assets, which rely on the importance and use of financial reports at a secondary level.

International Accounting Standard (IAS) 38 establishes that an intangible is an asset without a monetary nature; it is identifiable, controllable and without physical substance and it can generate a future economic benefit. It is retained in the organisation for use in the production or distribution of goods and services, to be rented or for administrative purposes. Phillips and Phillips (2002:4) mention that those assets are the key to competitive advantage in the knowledge economy environment. They are characterized by their invisibility, by the difficulty in quantifying, acquiring or imitating them, by the permeability of the accounting rules and procedures involved and, by their indefinite lifetime. According to Brockington (1996), their value can fluctuate unexpectedly. Immediate evidence of their existence can sometimes be impossible to obtain. This is only given expression when definitive advantages coming from the development and result of certain businesses are surveyed.

4. Categories of intangible assets

There are several approaches to the classification of intangible assets. They depend upon the accounting boundaries and the economic theory. Hence, we present the main intangible asset categories, as expressed in literature as a whole, focussing to a very great degree on the microeconomic level.

![Intangible asset categories](image1)

Figure 1: Intangible asset categories I (adapted from Reilly and Schweih, 1998)

This economically constructed classification whose boundaries are difficult to identify, allows the inclusion of a specific asset in a certain category, as the result of the criteria used in its measurement or in accordance with the analyst’s sensitivity. From a management point of view, in contrast to tangible assets and financial capital, intellectual capital (Edvinsson et al., 1997) emerges as an alternative in intangible asset analysis. Strongly focused on and oriented towards the management of a firm – in particular knowledge management - this approach has recently received, great credit and wide application. We note in particular the developments at the Swedish company Skandia. In Figure 2, we show four categories of capital and the scope of intellectual capital scope, as an important source of value creation.
As in the previous classification, the panoply of elements enclosed in intellectual capital offers extensive latitude and shaky objectivity. This must express itself in increased subjectivity in the methods and criteria required to translate the information into financial statements. Human capital, which is essentially linked to implicit or tacit knowledge (Nonaka and Takeushi, 1995), is the one that is most difficult to manage, capture and develop. It represents, from our point of view, the most difficult structural block to be reflected in and incorporated into the financial statements. In fact, the four structural blocks shown in the diagram, representing capital, cannot be dealt with nor analysed in isolation. Regenerative capital basically appears to be associated with capacity to innovate, reflected in the intensity and quality of patents registrations in particular. Research and development investment becomes the operational source for the technology, product or process patenting activity. Structural capital is in its essence, related to the internal processes and explicit knowledge. Finally, the company’s relational reflects its influence at an external level, translating what, in classic Balanced Scorecard terminology (Kaplan and Norton, 1996), is assigned as the market or customer perspective.

Figure 3: Intangible assets: examples as per IAS 38

The categories presented in this section allow us to better understand specific types of intangibles (with or without a physical element) and the consequent ambiguities in their measurement and analysis. Nevertheless, those assets should be aggregated or disaggregated as necessary to provide relevant information to users of the financial statements as a whole.

5. The accounting approach

To translate, into financial terms, the costs occurring in the knowledge capturing process, is not an easy task or a transparent one from an ethical point of view. But their recognition as costs in a specific accounting period does not match their potential return. This means that traditional
accounting methods (cost based methods) are not properly adjusted to suitably reflect the transformation in the business processes. New principles and methods are required (using economic criteria, market valuation or hybrid methods) that recognise intangibles assets as a powerful source of value when they reflect an existing use, a market value and a liquidation valuation. Financial reporting, a merger or acquisition, fund raising, taxation, brand management and license agreements are the main reasons supporting the intangible assets valuation (Brockington, 1996:176).

Primarily, those assets should be initially recognised according to their cost, depending, however, on two basic conditions: the probability that future economic benefits will flow to the enterprise and the fact that the cost can be measured reliably. After initial recognition, the assets should be entered either according to their historical cost minus any accumulated amortisation and impairment (the amount by which the carrying amount of an asset exceeds its recoverable amount) losses (based on a benchmark approach and annually tested as per IAS 36) or by means of a revalued amount minus any subsequent amortisation and impairment losses (based on fair value viewed as the amount for which an asset could be exchanged between knowledgeable, willing parties in an arm’s length transaction). This alternative treatment of impairment is allowed throughout for all the bottom up and top down tests on goodwill. Broadly speaking, “an intangible asset should be derecognised (eliminated from the balance sheet) on disposal or when no future economic benefits are expected from its use and subsequent disposal” (IAS38). Gains or losses should be determined as the difference between the net disposal proceeds and the carrying amount of the asset. They should be recognised as income or expense in the income statement.

Let us remember what is expressed in IAS 38. Marks, headings, publication headings, lists of customers and other elements that, in substance, are generated internally, do not have recognized as an intangible asset. This norm follows the point of view that these assets cannot be distinguished from the costs required to develop the company as a whole. Therefore, such items cannot be recognized as intangible assets since they were not internally generated (e.g. expenditure on internally generated brands). Generally, brands are, in fact, an important example of intangible assets: thought without any physical element, many are very valuable for the companies according to the impact on their businesses. In fact, as stated by Brockington (1996:134), a brand is not a single identifiable asset but a complex combination of names, market positions and other skills that allow companies to retain or obtain a greater competitive advantage than could otherwise be generated. As shown in Schwartz (1999:32), “a brand is a set of differentiating promises that link a product or a service to its customers”. Since brands have the same nature as internally generated goodwill and they are not bought or sold, they should not be recognised in the financial statements if self-generated (IAS 38). In the particular case of their acquisition, they should be deemed to have a useful life and then amortised over the established period. The same applies for structural and renewal capital, in particular mastheads, publishing titles, customer lists, corporate reputation and other similar items. In this paper, we stress the fact that Research activities (original and planned investigation undertaken with the prospect of gaining new scientific or technological knowledge and understanding) and development activities (application of research findings or other knowledge to a plan or design for the production of new or improved sustainable materials, devices, etc, prior to the commencement of commercial production or use) are the source of important intangible assets and support the new business models that explored in detail in the following section.

6. The new business models: an integrated approach

A business system is defined as the way a company defines and differentiates its offers, defines the activities that properly match its strategy, selects its processes, configures and allocates its resources, enters the market, creates utility for its actual and potential customers and obtains a positive return from those activities (Slywotzky, 1996).

Traditionally, as business systems evolved they observed an innovation phase strongly focused on vertical integration. They evolved processes of innovation in their structures and processes. New activities emerged as the result of disaggregation and reaggregation processes in the traditional value chains. In general, these activities are developed by means of electronics contexts, in which networks drive the interlinked phenomena of increasing returns and network effects. In the new economy Kelly, 1998), web economy (Schwartz, 1999) or network economy (Shapiro and Varian, 1999), Tapscott et al. (2000) identify a new system of doing business (the business web), which, on the economic plane, has brought new proposals for value, new competition rules and
procedures, new resources, capabilities and competences, new strategies and new, more sophisticated market approaches. These strongly internetworked business systems represent a new source of value for customers and wealth for shareholders. The core competences of each participant become the key factor of success in this business approach. As stated by Tapscott et al. (2000:17), a b-web can be defined as:

“A distinct system of suppliers, distributors, commerce service providers, infrastructure providers, and customers that use the Internet for their primary business communications and transactions”.

Innovation offers a new proposition that renders the old way of doing business obsolete: the electronic infrastructure now represents the principal way of sharing data, information and knowledge. Innovation management can capture broad application ideas and optimise the licensing value of the patented invention (Willigan, 2001:27). Firms become increasingly virtual and volatile on account of the innovation processes. The differences between various organisations’ competitive agreements (multinational, global, international or transnational) and their consequent value networks (Shapiro and Varian, 1999) remind us that the research and development process (as a process that allows the creation of new intellectual property, potentially protected by patent registration) should be kept as an internal activity - the source par excellence of true and sustainable competitive advantage.

As mentioned above, in b-web structures a new proposal for value emerges: the Internet becomes a primary structure. Value is created and managed, sometimes, through complex innovation chains. These models, with their intrinsic forces, apply and require multiple participation: the competitive advantages in terms of costs, capacities, innovation, competence and future returns are dependent on the core capabilities of the various companies who integrate the business system.

The performance of these business systems is not exactly linear. Its complexity results from the multiplicity of agents (contributing to global value of the system) that, on the basis of a synergistic interdependence, should provide and guarantee a solid and dynamic competitive advantage. This interlinked manner of doing business requires a new breed of pioneers, strongly supported by information and communication technologies, to drive the companies. New cost categories arise such as those for search, contracting and coordination costs. Tapscott et al. (2000) classified the participants in five distinct categories, as illustrated in Figure 4, below.

From our point of view, the most innovative and revolutionary dimension relates to how participants should do business. We are in a still fluid process, in uncharted territory, where customers are gaining more power than ever before. Coopetition has arisen as a phenomenon in the b-web process. All participants simultaneously compete and cooperate among themselves on the b-web, emerging as a universal platform for creating value and wealth. A b-web is, in truth, highly focused on the end customer. Its members try to satisfy the customers’ requirements and needs on an ongoing basis.

Figure 4: Participants in a b-web (adapted from Tapscott et al., 2000:20)

We are, in fact, in an unsettled and highly volatile field: its functional desegregation is moving towards a new form of intermediation (Szabó, 1999; Tapscott et al., 2000). The elimination and substitution of the physical space (where traditional intermediate agents developed their businesses) have gradually led to a new form of intermediation. Multiple participants, requiring new coordination rules and procedures of engagement, apply, also for a new structural capital approach (Shapiro and Varian, 1999). Thus, these new business models are built, in the entire value system, on the basis of two structural dimensions: their control (hierarchical or self-organized) and their value integration. According to the authors, the success of this type of
business depends on its intrinsic innovation strategies, in particular its policies of intense research and development.

Figure 5: B-web typology (Tapscott et al., 2000:28)

In the digital economy, whose boundaries are highly flexible, the success of the business platforms depends on the participants’ capacity and intelligence. The structural combination of physical and intangible assets results in an important competitive advantage (what Tapscott et al., 2000 called the marketface). Some of them represent authentic free and neutral markets where an ample assortment of products and information is offered to purchasers through personal negotiation (the agoras).

In particular, in the alliances, whose nature is not hierarchical, participation is in accordance with established rules and standards, based on a philosophy of creative contributions. As we have repeatedly affirmed, the customer assumes a preponderant role value creation. Alliances normally display increasing returns and strong network effects (driven by demand side economies of scale), as they link individuals and organisations in their own self-interest.

The aggregator model is led by companies that act as intermediaries. They focus their activity on the selection and organisation of goods; prices setting and customer help in finding goods and services that on a fulfillment basis match their needs. Although, capturing specific markets and segments is their basic aim, they do not add value to the goods. Nonetheless, they improve and increase value through the exchange process.

The market integrator approach has a distinct aim: its responsibility is the restructuring and management of the value chain. It provides an alternative that more successfully responds to a specific segment, with an integrated and specifically oriented customer approach. Based on high technology and focused on value-added design and relationship management, this model is strongly linked to the innovation process.

In contrast to traditional business models, the b-web requires a reduced investment in fixed capital, low fixed costs and offers higher operational edges. It is therefore to be expected that this type of business bring high returns. On the other hand, customers have acquired more power in contributing information and knowledge to the system. They normally raise their expectations, acquire flexibility and, thus, gain in terms of cost and quality. Intangible elements (information, control, relationships and knowledge) are enhanced. As mentioned by Kelly (1998:2) “This new economy has three distinguishing characteristics: It is global. It favours intangible things – ideas, information, and relationships. And it is intensely interlinked. These three attributes produce a new type of marketplace and society, one that is rooted in ubiquitous electronic networks”. New metrics are required that, on a fair and true basis, can capture and measure the competitive advantages that emerge from those new business models. As already mentioned, "The b-web is to emerge as a generic and universal platform of creation of value and wealth" (Tapscott et al., 2000:25).

7. Innovation as the core activity for business webs

Intellectual property (patents, trademarks and copyrights, among others), have been seen by some economic agents as mere legal instruments and by others as basic tools for business. Many companies have explored this type of asset, regarding it as a potential competitive weapon and
source of unexpected returns (Shapiro and Varian, 1999; Rivette and Kline, 2000). Intellectual property management has been reflected in many cases, in the way added value has been created. We refer to registered intellectual property, codified or un-codified organisational and human capital (Contractor, 2001).

To identify some of the competitive advantages emerging from intellectual property, it is necessary to identify certain key drivers (presented in Figure 6). They allow companies to gain a competitive advantage in market and financial terms.

Intellectual property constitutes an important driver with which to gain competitive advantage from a financial or market point of view. This assertion, which is now irrefutable is gradually being assumed as a generic strategic principle, draws our attention to innovation activities and processes. Measuring it, however, is neither an easy task nor on which the scientific and academic communities are united. The expected returns remain the most important corollary, enabling companies to enter those assets in their financial statements, unless, as sometimes, they are used, for internal purposes.

We shall now describe, by means of a simplistic and possibly incipient and twisted approach, an alternative that can be used in the valuation of a financial patents portfolio. In the first place, all patents should be audited and segregated into "not essential patents" and "essential patents" for the business (in accordance with business growth and the intensity of patent use in the business). In the second phase, companies should identify their real commercial contribution for business. This contribution should be monetarily quantified for those patents, percentage of net value added. Finally, "not essential patents" should be assigned a residual value, unless the company obtains high returns from their application by third parties.

At a macroeconomic level, the intensity of research and development investment also represents an important driver that genera competitive advantages between nations or regions. In the last nine years, in Europe, moderate increases have been seen, particularly in the business enterprise sector (Graph 1). However, among those states above the European average, the Nordic countries (namely, Finland and Sweden) have been the leaders with regard to the intensity of R&D both in the business enterprise and higher education sectors. As regards, the poor levels observed in the other countries, in particular the ones that recently joined the European Union, new macroeconomics politics are required, that, in the medium and long run, can support the new business models development and generate increased competitive advantage.

Figure 6: Translating intellectual property into competitive advantage (adapted from Rivette and Kline, 2000:58-60)
Graph 1: Research and development in Europe (Eurostat, 2003)

Patent registration is, probably, the most obvious indicator of innovation management. According to Willigan (2001:35):

"Companies wishing to exploit their intellectual assets may wish to establish an incentive program for scientists and engineers to direct and motivate their invention activity. The objectives of such an incentive program are to channel invention activity into areas where the current patent portfolio needs improvement, and to identify areas of future technology that companies need to “play in” in order to be successful in the “knowledge-based” world of the future."

The data available from the EPO (European Patent Office) relates to the annual requests received. In contrast, the data available from the USPTO (United States Patent and Trademark Office) relates to the registrations actually granted are. Given the problems of comparability between the data available, we have considered that of USPTO. In spite of the assertions and potential restrictions derived from the registration process, our evidence and conclusions should be carefully analysed.

Graph 2: Patent registrations in the USPTO (Eurostat, 2003)

Patents registrations are allocated to the country of the inventor except in the case where more than one country is involved. A fractional method of counting is used in this particular case. The United States of America (USA) and Japan (JP) lead the patent registrations in the USPTO, as shown in Graph 2. Sweden and Finland led the European scenario as they submitted, per million inhabitants, approximately 187 and 158 requests, respectively, in 2002). We note the same trend if we refer to the requests submitted to the EPO by country.
On the basis of the European average for two structural drivers – R&D investment intensity and patent registration in the USPTO - the countries identified in Graph 3 are those whose position lies above that average. The supremacy of the USA, the Nordic countries (FIN and S) and Japan becomes clear and evident. Other European countries, in particular the ones that recently joined the European Union, present weaknesses that require technological innovation policies and procedures if they are to achieve a fair and sustainable alignment in comparison with the rest. Without these developments, we shall continue to face the difficulties arising from a Europe developing at different speeds. Moreover, potential competitive advantage may be gradually and permanently lost in the digital and global economy.

8. Conclusions

The intangible asset concept is associated with expected future returns. It is viewed as an identifiable non-monetary asset without physical substance, controlled and is the source of future returns for the enterprise. In this respect, one of the most visible sources of intangible assets is patent registration, supported by the intensity of research and development. This evidence is consolidated at a later date by the number of patents actually registered and granted by the international agencies. Innovation management is, therefore, a source of competitive advantage for national economies in general and the business sector in particular. However, especially in Europe, we have a lack of innovative ideas that will lead to broad application-based patents that can maximize a company’s investment in research and development. The European evidence in those domains clearly indicates a need for urgent reflection and action.

Graph 3: R&D intensity and patent registrations in the USPTO (Eurostat, 2003)

Based on sophisticated innovation processes, new business models have emerged, that have transformed the traditional value propositions. Innovation capacity seems to be the key to achieve competitive advantage in a more virtual and complex way of doing business.

The capitalisation of intangible assets and their consequent amortisation over an estimated and proven period of useful life positively affect the usefulness of financial information in the eyes of investors. However, if internally generated, they cannot be recognised as intangible assets because in many cases they are a mixture of several items such as names, competitive positions, customer lists and other similar items. The recognition of intangibles as immediate costs has the inverse effect in disclosing the incapacity of present accounting systems to reflect the reality of a national economy, which is more volatile and less supported by physicals assets than a decade ago.
References


Introducing a Toolbox for IC Measurement in the Iran Insurance Industry

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Abstract: This paper reports on an empirical study, which investigates the Intellectual capital measurement and management in the Iran Insurance Industry. According to the current situation of the firms in this industry, we develop a toolbox for managers to help them to identify and evaluate ICs in this industry. In this regard we investigate intellectual capital stocks, intellectual capital processes and performance in this industry through three phases including: Identifying, Measuring, and Analyzing. Based on this toolbox, the priority of Iran Insurance industry was uncovered and the road map was discussed.

Keywords: Intellectual capital measurement, insurance Industry

1. Introduction

In the 1990s, the nature of competition changed radically because of increased global connectivity, distributed expertise, and shorter product development cycles (Turban, 2002a) and day after day, deploying knowledge management (KM) as a response to these changes, increase.

Based on a recent survey of senior executives in 158 companies Boudreau (2002, pp: 3) found that 80% of companies had KM efforts, 60% expected to use KM enterprise-wide within five years, 25% had a chief knowledge officer, and 21% had a KM strategy.

The importance of intellectual capital is becoming more widely recognized, and demand for the application of intellectual capital is increasing.

According to the current situation of the firms in this industry, we develop a toolbox for managers to help them to identify and evaluate ICs in this industry. In this regard we investigate intellectual capital stocks, intellectual capital processes and performance in this industry through three phases:

- Developing the IC Process impact Portfolio: which IC processes are important in Iran Insurance Industry, regarding to the current and future impact?
- Measuring key, basic and promising IC activity: for all 3 sections of IC activities, what are the current situation and the potential that can be achieved by each firm?
- Conclusion: at the end, we investigate the tree main part of the Intellectual Capital measurement toolbox in each company and in the whole Insurance Industry and introduce some roadmaps for improvement.

2. Research objectives

This paper tries to introduce new approach for measuring Intellectual Capitals regarding to a holistic perspective of Intellectual capital and knowledge management. This new approach was deployed in Iranian Insurance industries. The main objectives pursued in this research are replying to these questions:

1. What are the main IC stocks and IC Processes in Iran insurance industry?
2. What is the current situation of these ICs in Iran insurance industry?
3. How much gap exists regarding to the current situation and the potential of these ICs in Iran insurance industry?
4. What is the priority of companies for cultivating and deploying ICs in Iran insurance industry?

In the rest of the paper, after reviewing the Theoretical background in briefly, we propose a toolbox for measuring intellectual capital. Then the
Research Methodology and Results are discussed.

3. Theoretical background

In the 1980s, with emergence of SIS era (i.e. strategic information system) after data processing and MIS era (i.e. management information system), much attention was given to means by which IT might be harnessed to enable and sustain competitive advantage. (Senn, 1992, Porter and Millar, 1985, Galliers, 1999, pp: 230)

After great investment in IT, some economists such as Strassmann and Solow, concluded that there is no relationship between computer expenditures and company performance (e.g. Malhotra, 2000, pp: 5, Turban, 2002b, pp: 568). A wave of disenchantment with the ROI of IT (1980s) was faced with some responses, and the main response concluded that IT is implemented incorrectly and it relates to organizational processes, structure, and design, which were not “work friendly”! (El Sawy 2002, pp: 4) and because of some other pressures, e.g. 3Cs by Hammer and Champy, the BPR was introduced by Hammer, Davenport, and champy. (El Sawy 2002, pp: 6)

Unfortunately, there’s no universal definition of KM, just as there’s no agreement as to what constitutes knowledge in the first place. For this reason, it’s best to think of KM in the broadest context. Succinctly put, KM is the process through which organizations generate value from their intellectual capital and knowledge-based assets.

After the high failure rate in BPR projects (Turban, 2002b, pp3703,) and raising the organizational attention to intellectual capital (Heather, 2003, pp: 4) as hidden assets (Skyrme, 2000, pp: 62) and vital role of human in e-business model innovation and distinguishing knowledge from information and data and understanding the important role of knowledge instead of information, in reaching sustainable competitive advantages in the continues changing environment (Malhotra, 2000, pp: 6.), also improved collaborative technologies and growing number of cases where better understanding and management of knowledge has brought demonstrable bottom lines benefits.(Skyrme, 2000, pp: 62) worldwide spending on knowledge management (KM) services is grow up, as Dyer in 2000 expected.(Turban, 2002a, pp347). Fig1 illustrate the history of KM emergence on the basis of literature review. (Moslehi, 2004)

Also, some use the concepts interchangeably (For e.g. see Van burn, 1999). But we assume ICM as a strategic notion and introduce the proposed toolbox as a part of the ICM activity.

In general, taxonomies of intellectual capital contain three primary types of capital: human capital, structural capital, and customer capital. Despite their differences, intellectual capital conceptualizations have in common a focus on the intangible assets of an organization. As intangible, these assets are distinct from the tangible assets that make up the forms of capital, physical and financial, upon which organizations have traditionally competed. As assets, they are viewed not as costs to an organization, but as sources of future economic value.

4. Proposing a toolbox for measuring intellectual capital

At present, measuring a company’s intellectual capital (IC) is quite common. According to a Nordic survey, two thirds of Finnish companies measure their intellectual capital regularly.

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**Figure 1:** Illustrates the history of knowledge management emergence.

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**2.1 Knowledge management and intellectual capital management**

Another term that used in this field is intellectual capital management. Some authors argued that there is a clear difference between intellectual capital management and KM knowledge management. ICM refer to strategic level while KM is tactical issue. (For e.g. Wiig1997, and Edvinsson, 1997)

Also, some use the concepts interchangeably (For e.g. see Van burn, 1999). But we assume ICM as a strategic notion and introduce the proposed toolbox as a part of the ICM activity.

In general, taxonomies of intellectual capital contain three primary types of capital: human...
Although different measurement systems for measuring intellectual capital have been developed, none of them has been accepted for common use.

In our point of view, for measuring the intellectual capital, first we should ask 3 key questions, include why, what and how's of measuring:

2.2 Why companies try to measure their intellectual capital, up to now? And why should they measure their intellectual capital?

In order to analyze the motives and methods of influential authors, a literature review was undertaken. During this research process, the existing motives for IC measurement are recognized. (Skyrme, 1998, Marr, et al. 2003, Gopika Kannan, 2004 and Andersson, 2004.

It seem that we can define the motives for all partners view such as managers, personnel, suppliers, customers, investors, government agency and all of the parties which can relate to the companies. At the end based on the Andersson, (2004) we can classify all of them into 4 categories:
1. Improving internal management
2. Improving external reporting,
3. Statutory and transactional motives
4. Accuracy and reliability of national accounts

For the purpose of this research we just focus on the first two motives.

2.3 What is measured up to now and what should be measured?

It is generally agreed on by academics that intellectual capital consists of at least three separate forms of organizational assets (Stewart, 1997):

- Human capital – the skills, tacit knowledge, talents and capabilities of the individuals associated with an organization.
- Structural capital – the processes and packages that allow human capital to be used effectively to create value. This includes the information systems and the management competencies, which leverage human capital.
- Customer capital – the value of an organization’s relationships with the people with whom it does business. Some people broaden this concept to include all of the firms with which a company does business and call it relationship capital (Vanburen, 1999)

Based on the some research such as Danish project (2001), Meritum Project (2001), we define a framework for measuring 3 things. These are IC Stocks, IC Process and IC Performance. (See fig2)

Figure 2: Illustrates the 3 main aspects in measuring intellectual capita

2.4 How companies measure their intellectual capital, up to now? And how should they measure their intellectual capital?

According to Sveiby (2001), the approaches for measuring intellectual capital fall into four categories: Scorecard methods in particular have been developed as a tool for management and therefore the proposed toolbox that presented in this paper is based on some of these methods. Some question such as when, with whom, also can be considerable, that companies should define them in practice.

The conceptual framework for intellectual capital measurement in our toolbox was illustrated in Figure 3.
5. Methodology

Since the level of intellectual capital of knowledge intensive industries may higher than others or the importance of intellectual capital in these industries may be higher (Read, et al. 2001), this research selected relatively representative Insurance firms in Iran. In the end we had a total of 139 complete questionnaires in 6 main insurance firms replies covering almost 99% of Iran insurance market. Four Companies are public companies and they are leading firms in different products or market segmentations. And other two companies are the greatest private companies in Iran.

To construct a measurement toolbox and explore the intellectual capital profile of Iran Insurance industry, this study has conducted a tree-stage survey. The first stage is a general survey on intellectual capital indicators. The questionnaire was designed to tap into the IC constructs in Iran Insurance industry.

We first selected 264 indicators through a thorough literature review of intellectual capital measurement indexes. Question items were revised according to the feedback of the pilot-test on 15 participants. A questionnaire of these 264 indicators with a 5-point scale from “very low important” to “very important” was distributed to the Iranian insurance experts such as insurance management university masters, people graduated in insurance management discipline and researches and expert which work in R&D department in Central Insurance of Iran. For the purpose of regulating, expanding and guiding Insurance Industry in Iran, central Insurance of Iran (Bimeh Markazi Iran) was established in 1971 by the Act of Parliament. Bimeh Markazi Iran plays an active role in the Industry by promoting, regulating and supervising insurance activities within the market and also by providing national and international reinsurance services.

Based on the first stage survey, we select and revised 110 indicators in tree aspects of our toolbox include 55 indicators for measuring IC-Stock, 38 indicators for measuring IC-Process and 17 indicators for measuring the Performance of companies. These indicators are used in the next stages for further analyses. (See table 1)

Table 1: Introduces the indicators in tree intellectual aspects that used in the proposed toolbox in this research

<table>
<thead>
<tr>
<th>Intellectual Aspect</th>
<th>IC-Stock</th>
<th>IC-Process</th>
<th>IC-Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators</td>
<td>55 indicators include: Human, Customer and Structure capital</td>
<td>38 indicators include: 10 main intellectual capital processes</td>
<td>17 indicators in tree aspect of performance include: Stability, Productivity and Growth of 3 main ICs (i.e. Human, Customer and Structural capital)</td>
</tr>
</tbody>
</table>

In the second stage, the toolbox used for 3 purposes:

1. KPIs: what are the key performance indicators in each company?
2. Developing the IC Stocks impact Portfolio: which IC stocks are important in Iran
Insurance Industry, regarding to the current and future impact?

3. Developing the IC Process impact Portfolio: which IC processes are important in Iran Insurance Industry, regarding to the current and future impact?

In this regards a questionnaire of these 3 aspects-mentioned before in table 1, designed to evaluate which IC stocks are important in Iran Insurance Industry, according to the current and future impact, with a 5-point scale from “very low important” to “very important”. Regarding to support of Central Insurance of Iran this questionnaire was distributed to 60 Iranian insurance top managers were selected not randomly but based on their experience and ability to answer the questions. At the end 37 managers filled our questionnaire through structured interview.

Then, after introducing the main IC Stocks and processes, which are the basic, Promising and key IC stocks and Processes, based on the knowledge strategy process (Van der spek, et al. 2002), in the last stages, the toolbox used for measuring these ICs. In this stage we have two aims:

- Measuring key, basic and promising IC stocks: for all 3 sections of IC stocks.
- Measuring key, basic and promising IC process: for all 10 sections of IC process

Nevertheless in each question, tree things are evaluated:
1. The importance of each measure in his or her company.
2. The current situation and
3. The potential that can be achieved by each firm.

For the third questionnaire, we have been able to ask 150 Iranian insurance middle managers and supervisors to respond to our questionnaire. In this stage, they were still selected not randomly but based on their experience and ability to answer the questions. At the end, 102 managers filled our questionnaire through structured interview.

Cronbach’s Alfa is used for examining the reliability of the instruments. The reliabilities for all constructs calculated and presented in table 2. As it is shown, all reliabilities were adequate since the Cronbach Alfa values for each were significantly greater than the prescribed 0.7 thresholds. The values varied from 0.7379 (Customer to Customer, intellectual capital process) to 0.9476 (intellectual capital process) showing that our instruments are sufficiently reliable.

<table>
<thead>
<tr>
<th>Measure</th>
<th>No of Items</th>
<th>Mean</th>
<th>S.D.</th>
<th>Reliability-Cronbach Alfa coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Capital</td>
<td>4</td>
<td>3.153846</td>
<td>0.307692</td>
<td>0.93</td>
</tr>
<tr>
<td>Attitude</td>
<td>8</td>
<td>3.307692</td>
<td>0.397436</td>
<td>0.86</td>
</tr>
<tr>
<td>Competency</td>
<td>7</td>
<td>2.923077</td>
<td>1.076923</td>
<td>0.80</td>
</tr>
<tr>
<td>Communication-Skill</td>
<td>4</td>
<td>2.846154</td>
<td>1.141026</td>
<td>0.76</td>
</tr>
<tr>
<td>Creativity</td>
<td>3</td>
<td>2.923077</td>
<td>0.74359</td>
<td>0.71</td>
</tr>
<tr>
<td>Customer Capital</td>
<td>4</td>
<td>3.846154</td>
<td>0.474359</td>
<td>0.89</td>
</tr>
<tr>
<td>Customer support</td>
<td>3</td>
<td>3.846154</td>
<td>0.474359</td>
<td>0.71</td>
</tr>
<tr>
<td>Collaboration</td>
<td>2</td>
<td>2.461538</td>
<td>0.769231</td>
<td>0.72</td>
</tr>
<tr>
<td>Networking</td>
<td>2</td>
<td>2.076923</td>
<td>1.910256</td>
<td>0.78</td>
</tr>
<tr>
<td>Customer relationships</td>
<td>8</td>
<td>3.230769</td>
<td>0.192308</td>
<td>0.84</td>
</tr>
<tr>
<td>Structure Capital</td>
<td>5</td>
<td>2.230769</td>
<td>0.192308</td>
<td>0.90</td>
</tr>
<tr>
<td>IT application</td>
<td>5</td>
<td>2.307692</td>
<td>0.230769</td>
<td>0.75</td>
</tr>
<tr>
<td>Core Process</td>
<td>4</td>
<td>2.538462</td>
<td>0.769231</td>
<td>0.89</td>
</tr>
<tr>
<td>Intellectual Property</td>
<td>2</td>
<td>2.307692</td>
<td>0.730769</td>
<td>0.90</td>
</tr>
<tr>
<td>Innovation</td>
<td>2</td>
<td>2.615385</td>
<td>0.75641</td>
<td>0.72</td>
</tr>
<tr>
<td>Culture</td>
<td>5</td>
<td>2.384615</td>
<td>0.423077</td>
<td>0.77</td>
</tr>
<tr>
<td>IC Process</td>
<td>10</td>
<td>2.394487</td>
<td>0.301799</td>
<td>0.95</td>
</tr>
<tr>
<td>H2H</td>
<td>5</td>
<td>2.523077</td>
<td>0.72359</td>
<td>0.83</td>
</tr>
<tr>
<td>H2S</td>
<td>4</td>
<td>2.211538</td>
<td>1.206731</td>
<td>0.86</td>
</tr>
<tr>
<td>S2H</td>
<td>2</td>
<td>2.076923</td>
<td>0.410256</td>
<td>0.79</td>
</tr>
<tr>
<td>H2C</td>
<td>3</td>
<td>2.282051</td>
<td>0.904558</td>
<td>0.72</td>
</tr>
<tr>
<td>C2H</td>
<td>3</td>
<td>2.128205</td>
<td>0.139601</td>
<td>0.78</td>
</tr>
<tr>
<td>C2C</td>
<td>4</td>
<td>3.115385</td>
<td>0.620994</td>
<td>0.74</td>
</tr>
<tr>
<td>C2S</td>
<td>2</td>
<td>2.384615</td>
<td>0.839744</td>
<td>0.74</td>
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<tr>
<td>S2C</td>
<td>2</td>
<td>2.576923</td>
<td>0.535256</td>
<td>0.74</td>
</tr>
<tr>
<td>S2S</td>
<td>3</td>
<td>2.538462</td>
<td>0.139601</td>
<td>0.75</td>
</tr>
</tbody>
</table>
6. Results

6.1 Identifying

Based on the conceptual framework of proposed toolbox, we have 3 aspects for measuring and exploring the intellectual capital profile, include, IC Stocks, IC Processes and Performance. Fig4, 5 and 6 show the final IC Stocks, IC Processes and performance, based on the first stage survey. As fig 3 shows, the IC Stocks include 3 elements: Human stocks, Customer stocks and Structural stocks. And Human stocks for example include 4 objects, include: Competency, Attitude, Communication-Skill and Creativity on experts work for insurance company. The number shows in front of each IC, is the number of measure that finally used for measurement.

![IC Stocks Diagram](image)

**Figure 4:** Illustrates the conceptual framework for intellectual capital stock

And as showed in fig 4, we design 10 typical IC Processes, which introduced by Sveiby et al, (2002), and we use also some indicators from Rajan et al. (1999).

![IC Processes Diagram](image)

**Figure 5:** Illustrates the conceptual framework for intellectual capital process.

![IC Performance Diagram](image)

**Figure 6:** Illustrates the conceptual framework for intellectual capital performance

2.4.1 IC stock and IC process portfolio

According to knowledge strategy process (Van der spek, et al. 2002), this portfolio can be defined based on the impact of each ICs on companies at present and in future. If each IC has not considerable impact on insurance companies, like IC number 5 in Fig7, it maps on the “not-Relevant” position.
If at present, each IC has considerable impact on insurance companies but it lose the impact in the future, like IC number 3 and 7 in Fig7, then it maps on the “Basic” position and so on.

The figs 8 and 9 show the result of survey among the top management of Iranian insurance industry. As you can see in the fig 8, none of the IC stocks are mapped in “not-relevant” and “Basic” position the same as IC Process, which is illustrated in fig9

As it is showed in fig 8, based on the opinion of Iranian insurance top managers in the 2nd stage survey, competency, attitude of companies’ expert and customer relationships and customer support are the key IC stocks and other IC stocks such as creativity of expert and IT infrastructure are the promising ICs. It means that these ICs may have a considerable impact on insurance industry in the next 5 years.

And as it is showed in fig 9, based on the opinion of Iranian insurance top managers, all the IC Process are the promising ICs. It means that these ICs may have a considerable impact on insurance industry in the next 5 years. These figures show that in spite of the knowledge economy emergence, there is no considerable and programmed attention for cultivating and deploying ICs in Iranian Insurance industry, but these top managers are going to pay much attention to these ICs in the next 5 years. In this regards, these IC portfolio can help them to
communicate more effective with each other, based on the classification of ICs, to identify them. It is the first step for helping companies to develop and deploy them in regarding to the companies top goals and strategies.

6.2 Measuring
As described before, we select and revised 110 indicators in tree aspects of our toolbox include 55 indicators for measuring IC-Stock, 38 indicators for measuring IC-Process and 17 indicators for measuring the Performance of companies by 3rd questionnaire.

2.4.2 KPI
What are the key performance indicators in each company and in the whole industry? This is the main question that can help managers to broadly assess all the key aspects of their companies. In this regard understanding the need for new performance indicator is viable. Nevertheless the characteristics of new performance system such as intangibility, difficulty to trade & assess, are the considerable challenge for these managers. For the purpose of this research we introduce the following framework to Insurance managers see fig 5. According to the Intangible Asset Monitor developed by Sveiby, our conceptual framework for intellectual capital Performance is shown in fig6. Fig 10 shows some reports on performance of intellectual capital in whole insurance industry, which calculated by 17 proposed indicators answered by top managers include financial managers. In this figure part 1 shows the current situation of IC performance vs. part 2 that shows the potential of the IC Performance in each aspects include: Human capital, Structural capital, and Customer capital performance.

2.4.3 IC stock
After identifying the key ICs, the next step for managers is understanding the current and also potential situation of them. The potential situation is pointing at the desirable and also achievable situation so our toolbox tries to help them in this regard by providing valid indicators for measuring each IC.

Figure 10: Illustrates a report on performance of intellectual capital in insurance industry

Figure 11: Illustrates the Structural capital current state vs. the potential in all 5 aspects of Iran insurance industry

Based on these 55 indicators we measure IC stock capital including, human, structural and customer capitals, and also IC Process in each company and then calculated the current stat of industry. For example fig 11 shows the structural capital current state vs. the potential in all 5
aspects in Iran insurance industry and fig12 illustrate the current state vs. the potential of all IC stock aspects in Iran insurance industry.

Figure 12: Illustrates the current state vs. the potential of all IC stock aspects in the Iran insurance industry.

2.4.4 IC process

The next step is measuring the IC processes. Based on the 38 indicators we measure 10 typical processes in each company and then calculated the current state of industry. Based on the Figure 12 the current vs. the potential state of all IC processes are too weak in Iran insurance industry.

Figure 13: Illustrates the current state vs. the potential of all IC process aspects in the Iran insurance industry.

6.3 Analysing

2.4.5 IC stock

At the top level, managers need to prioritize their decisions; in this regard two things seem important:

- Type of ICs (i.e. Key, Promising and Basic intellectual capitals), which reported in section 6.1. It is reasonable that the priority of key ICs should be higher than Promising and Basic intellectual capitals and the priority of Promising ICs should be higher than the Basic intellectual capitals. For the purpose of this research, we consider the current and future importance of each intellectual capital.

- The gap between the potential and the current situation of each IC. It is reasonable that the more the gap between the potential and the current situation of each IC the more priority it should be has.

So as it is presented at table 3, the priority score calculated by multiplying the “CI” column, that is the current importance, into “FI” column that is the future importance into “gap” column. We also prioritize the indicators of each IC Stock for clearing the detail method of improvement.
Table 3: Prioritising of IC stocks regarding to their gap and their type.

<table>
<thead>
<tr>
<th>Rank</th>
<th>IC Stocks</th>
<th>Gap</th>
<th>CI</th>
<th>FI</th>
<th>Priority Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Competency</td>
<td>1.98</td>
<td>0.64</td>
<td>0.98</td>
<td>1.26</td>
</tr>
<tr>
<td>2</td>
<td>Attitude</td>
<td>1.97</td>
<td>0.66</td>
<td>0.94</td>
<td>1.22</td>
</tr>
<tr>
<td>3</td>
<td>Creativity</td>
<td>2.18</td>
<td>0.58</td>
<td>0.94</td>
<td>1.20</td>
</tr>
<tr>
<td>4</td>
<td>Customer relationships</td>
<td>1.80</td>
<td>0.66</td>
<td>0.98</td>
<td>1.17</td>
</tr>
<tr>
<td>5</td>
<td>Customer support</td>
<td>1.66</td>
<td>0.77</td>
<td>0.86</td>
<td>1.10</td>
</tr>
<tr>
<td>6</td>
<td>Innovation</td>
<td>2.10</td>
<td>0.52</td>
<td>0.97</td>
<td>1.06</td>
</tr>
<tr>
<td>7</td>
<td>IT Application</td>
<td>2.34</td>
<td>0.46</td>
<td>0.97</td>
<td>1.05</td>
</tr>
<tr>
<td>8</td>
<td>Culture</td>
<td>2.08</td>
<td>0.48</td>
<td>0.94</td>
<td>0.93</td>
</tr>
<tr>
<td>9</td>
<td>Core Process</td>
<td>1.90</td>
<td>0.51</td>
<td>0.94</td>
<td>0.91</td>
</tr>
<tr>
<td>10</td>
<td>Collaboration</td>
<td>2.29</td>
<td>0.49</td>
<td>0.75</td>
<td>0.85</td>
</tr>
<tr>
<td>11</td>
<td>Networking</td>
<td>2.08</td>
<td>0.42</td>
<td>0.92</td>
<td>0.80</td>
</tr>
<tr>
<td>12</td>
<td>Intellectual Property</td>
<td>2.11</td>
<td>0.46</td>
<td>0.78</td>
<td>0.77</td>
</tr>
<tr>
<td>13</td>
<td>Communication-Skill</td>
<td>1.04</td>
<td>0.57</td>
<td>0.85</td>
<td>0.50</td>
</tr>
</tbody>
</table>

2.4.5 IC process

For improving this situation to the potential state, first managers should prioritize the IC process, like the actions done for prioritize the IC Stocks, which described before. Table 4 shows the detail data. We also prioritize the indicators of each IC Process for clearing the detail method of improvement.

Table 4: Prioritising of IC process regarding to their gap and their type

<table>
<thead>
<tr>
<th>Rank</th>
<th>IC Process</th>
<th>Gap</th>
<th>CI</th>
<th>FI</th>
<th>Priority Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S2C</td>
<td>2.81</td>
<td>0.52</td>
<td>0.92</td>
<td>1.34</td>
</tr>
<tr>
<td>2</td>
<td>S2S</td>
<td>2.80</td>
<td>0.51</td>
<td>0.90</td>
<td>1.28</td>
</tr>
<tr>
<td>3</td>
<td>S2H</td>
<td>2.86</td>
<td>0.42</td>
<td>0.93</td>
<td>1.11</td>
</tr>
<tr>
<td>4</td>
<td>H2S</td>
<td>2.72</td>
<td>0.44</td>
<td>0.90</td>
<td>1.08</td>
</tr>
<tr>
<td>5</td>
<td>H2H</td>
<td>2.33</td>
<td>0.50</td>
<td>0.84</td>
<td>0.99</td>
</tr>
<tr>
<td>6</td>
<td>C2S</td>
<td>2.38</td>
<td>0.48</td>
<td>0.81</td>
<td>0.92</td>
</tr>
<tr>
<td>7</td>
<td>General</td>
<td>2.54</td>
<td>0.42</td>
<td>0.85</td>
<td>0.91</td>
</tr>
<tr>
<td>8</td>
<td>H2C</td>
<td>2.40</td>
<td>0.46</td>
<td>0.80</td>
<td>0.88</td>
</tr>
<tr>
<td>9</td>
<td>C2C</td>
<td>2.38</td>
<td>0.42</td>
<td>0.80</td>
<td>0.81</td>
</tr>
<tr>
<td>10</td>
<td>C2H</td>
<td>2.33</td>
<td>0.43</td>
<td>0.70</td>
<td>0.70</td>
</tr>
</tbody>
</table>

At the end based on the top management survey, we ask them to define their opinion about this proposed toolbox, in two sections include: the role if this toolbox for helping managers to improve the internal management in insurance companies and second for helping managers to improve the external reporting. Table 5 illustrated the extent of top management agreement with these two general benefits in some detail.

Table 5: Iranian top insurance managers’ opinion about the proposing toolbox

<table>
<thead>
<tr>
<th>Helping managers to improve Internal management</th>
<th>Agreement. Avg from 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis</td>
<td>87</td>
</tr>
<tr>
<td>Resource Allocation</td>
<td>80</td>
</tr>
<tr>
<td>Holistic View</td>
<td>81</td>
</tr>
<tr>
<td>Measurement Standard</td>
<td>86</td>
</tr>
<tr>
<td>Common Language</td>
<td>74</td>
</tr>
<tr>
<td>Future Focus</td>
<td>83</td>
</tr>
<tr>
<td><strong>Extent to agree that, this toolbox can improve Internal management?</strong></td>
<td>87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Helping managers to improve the reporting to external partners</th>
<th>Agreement. Avg from 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transparency</td>
<td>86</td>
</tr>
<tr>
<td>International Reporting Standard</td>
<td>82</td>
</tr>
<tr>
<td>Benchmarking</td>
<td>86</td>
</tr>
<tr>
<td><strong>Extent to agree that, this toolbox can improve the reporting to external partners?</strong></td>
<td>81</td>
</tr>
</tbody>
</table>
7. Conclusion

As the business environment continues to shift into more knowledge-based services, companies who are recognizing the true importance of intellectual capital are going to be more successful. It is the intellectual capital that is becoming the primary source of competitive advantage within many industries, particularly in knowledge intensive industries such as Insurance industry.

So for the first time in Iran, based on the context of Iran insurance industry we select 110 indicators for measuring ICs in Iran insurance companies.

Based on the literature review, we can conclude that the IC toolbox does not disclose the value of the firm's intellectual resources rather, they disclose 3 aspects of the firm's, including IC stocks, knowledge-management Processes or IC Processes and IC performances. In this regard we develop a toolbox, hopefully could help managers in 5 steps methodology to:

- Introducing the main ICs (i.e. the key, potential and basic intellectual capitals) in his or her company and in whole Iran insurance industry. (Identifying phase)
- Measuring the current position. (Measuring phase)
- Realizing the existing gap between potential and current position and prioritizing the next step for cultivating and deploying ICs in Iran insurance industry. (Analyzing phase)

Nevertheless based on the top management survey, we conclude that the proposed toolbox can help managers to improve the internal management in insurance companies (87% agreement) and also can help managers to improve the external reporting (81% agreement) see table 5.

Based on the result of this toolbox, it can be learned that the potential of intellectual capital is so considerable but up to now, in spite of the importance of these capitals, the insurance industry ignores them. This may cause by the monopoly of the public companies. At the end this toolbox tries to give organizations the opportunity to better understand the intangible aspect and casual relations within the organization. In this regards the longitudinal research seems to be necessary.

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The Effects on Knowledge Creation and Transfer in Production Process Verification due to Virtual Prototypes

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Abstract: The purpose of this article is to analyze how knowledge creation within production process verification units within companies and knowledge transfer between product development and production units are affected by the use of virtual prototypes. The analysis shows that the use of virtual prototypes has a negative effect on knowledge creation and transfer. However, increased degrees of acceptance regarding the new method combined with improved technical level are anticipated to reduce these negative effects.

Keywords: Final verification, virtual prototype, knowledge transfer, automotive industry.

1. Introduction

When companies develop new products they want to do this as inexpensively and quickly as possible, taking into account that their customers still want a high quality product. In any manufacturing industry, where the competition between manufacturers over the customers is fierce and the profit window is decreasing (Bullinger et al, 1995), this will be particularly true. The automotive industry is a good example of this situation. During the last two decades, there has been a lot of attention aimed at decreasing time-to-market (TTM) both within industry and the scientific community (Almgren, 1999).

One way of decreasing TTM is to perform the subprocesses within the product development process concurrently. To be able to do so, knowledge has to be transferred between different departments within the company. One way of doing this is to involve manufacturing representatives in the development work in order to use their knowledge to create a better product (Almgren, 1999).

The main phases during product development (in accordance with Hayes, Wheelwright and Clark (1988) in Wheelwright and Clark (1992, p. 33)) are presented in Figure 1.

![Figure 1: The main product development phases. Source: Hayes, Wheelwright and Clark (1988) in Wheelwright and Clark (1992, p. 33).](https://example.com/figure1.png)

A lot of studies have been performed within the first three phases (D’Adderio, 2001) and there has been some attention to the last two phases (Almgren, 1999), but there has been little attention focused towards the Prototype Building phase (PB-phase). Thus, the processes included in the PB-phase have a clear improvement potential within the automotive industry since the costs for physical prototypes are high (Thomke, 1998).

One clearly visible trend in society in general and in product realization in particular is the increased use of computer-based tools (Poolton and Barclay, 1998; Rangaswamy and Lilien, 1997). In regards to this area, one apparent area of interest from some of the major actors in the industry (Thomke and Fujimoto, 2000; Östman, 1998; Gomes de Sà and Zachmann, 1999) is to use virtual prototypes (a virtual prototype should be understood as a computer-generated visualization of parts of (or entire) products) instead of physical prototypes to verify the new product. The use of such prototypes is believed to have a positive impact regarding the outcome of the PB-phase. The studies performed to confirm this belief are scarce (Thomke and Fujimoto (2000); Nobelius (2001); Gomes de Sà and Zachmann, 1999) but the focus in these studies has neither been on the PB-phase, nor on knowledge issues.

Knowledge issues in product development have been studied to great extent (for example West and Burns, 2000 and Lindkvist, 2001), but the focus on knowledge issues in the PB-phase is...
scarce. Some studies have been performed where the knowledge perspective has been applied (Thomke, 1998) but not in such detail. Other studies have been performed that deals with knowledge transfer issues due to virtual prototypes, but they only treat knowledge transfer within the early phases (D’Adderio, 2001).

This indicates a clear need to study the knowledge issues connected to the Prototype Building phase.

2. Purpose

The purpose of this article is to analyze how knowledge creation within production process verification units within the companies and knowledge transfer between product development and production units are affected by the use of virtual prototypes.

3. Theoretical framework

In this paper, a theoretical framework based on the five-phase model of organizational knowledge creation presented by Nonaka and Takeuchi (1995) is used. Some modifications will be done to better suit the problems identified. The basic reason for choosing Nonaka and Takeuchi is that it is a process including both explicit and tacit knowledge as well as both individual and organizational knowledge issues important in the studied cases.

The Nonaka and Takeuchi (1995) model includes five phases, which shows how the process of organizational knowledge creation spirals through the organization. This model is developed for product development and shows how the process moves cyclically and across levels. While the first four phases move horizontally, the fifth one moves vertically in the organization. In the fifth phase activities are created at different levels of the organization. The model is an ideal example, and it includes the following phases: sharing tacit knowledge, creating concepts, justifying concepts, building an archetype, and cross-levelling knowledge. The first phase is a socialization mode and the second is an externalization mode. In the second phase a concept is created, which then must be justified in the third phase. The organization decides whether or not to proceed with the concept. If the concept is accepted it will be converted into an archetype in the fourth phase. An archetype can be either a physical object such as a prototype, or an operating mechanism such as a new organizational structure. In the fifth phase the knowledge created in the previous phases is spread to other parts of the organization or even to parts outside, e.g. customers, suppliers, and partners. In this paper, the phases will differ some from the original model as seen in Figure 2.

The following sections include descriptions of the different activities included in the theoretical model. Further on in this paper, this model will be referred to as KTVP (Knowledge Transfer in Verification Processes). In this model, there is no distinction made between different kinds of knowledge so the reader should interpret knowledge as including both explicit and tacit knowledge when not articulated explicitly.

There are four main factors that influence the difficulty of knowledge transfer: The characteristics of the knowledge transferred, the source(s), the recipient(s) and the context in which the transfer takes place (Szulanski, 1996). These four are combined in the initial knowledge flow. Szulanski (1996) discusses variables influencing these four factors. In this paper, only the variables specifically interesting for each phase are considered.

![Figure 2: The developed version of the Nonaka and Takeuchi model; the Model of Knowledge Transfer in Verification Processes (KTVP), used in this paper as the theoretical framework](image-url)

3.1 Incoming knowledge transfer and sharing knowledge.

Incoming knowledge transfer and sharing knowledge are discussed in the same section since these activities are closely related as well as prerequisites for being able to perform verification activities in the first place. Variables of particular interest when changing from physical to virtual verification are:
- Unprovenness, which is connected to the characteristics of the knowledge (the tacit knowledge of skilled workers needed for verification complicates the knowledge transfer).
- Lack of motivation with the participants is connected to both the source and the recipients.
- The incoming knowledge is not perceived as reliable. When new technology is used, people have a tendency to perceive the information provided from that source as less reliable.
- Lack of retentive capacity. If the recipients are not able to retain the knowledge transferred, the transfer is unsuccessful.
- Barren organizational context. If there are formal structures and coordination mechanisms that support knowledge transfer, the transfer process is facilitated.
- An arduous relationship between the participating individuals can be a negative influence on the knowledge transfer. For example, if the participants have not met before or if they have different cultural background this can put a damper on the openness and acceptance between the individuals.

Another important area discussed here is the positive influence from the use of routines to improve the ability to adopt the incoming knowledge (Szulanski, 1996; Hellriegel and Slocum, 1974). In short, the more routine there is in a knowledge transfer, the easier it is for the recipient to adapt that knowledge.

The sharing knowledge phase includes, what Nonaka and Takeuchi (1995) calls the socialization mode of knowledge creation. When individuals share their experiences shared tacit knowledge, so called sympathized knowledge, is created out of the individual tacit knowledge. The process of sharing tacit knowledge can take place either through dialogue or through observation, imitation, and practice. To enable this mode, teams must be created where the socialization can take place.

3.2 Creating concepts

Within the verification process studied, the creating concepts phase can be exemplified with the discussions held to decide whether the planned manufacturing sequence is appropriate and the outcome from these discussions. The variables that are particularly interesting in this phase are:
1. Causal ambiguity. If there is ambiguity within the verification organization regarding the source of knowledge used for particular decisions, the knowledge transfer process is obstructed.
2. Not perceived as reliable. If the novelty in the virtual environment affects the individuals in a negative way due to low personal experience, there is a risk that the knowledge and information provided from the computers are perceived as being unreliable.
3. Barren organizational context. The cross-functional integration in the verification team creates a sound base for the amount of knowledge organizationally enabled in the verification teams.

A fourth variable not treated by Szulanski (1996) that should be included here is the concept of ba (ba means place). In this setting it is of interest to study the environment where the verification takes place. Do the participants previously know the environment? Do the participants have the possibility to communicate face-to-face? Nonaka and Konno (1998) emphasise face-to-face experiences as a key to conversion and transfer of tacit knowledge.

3.3 Justifying concepts

When justifying concepts, the main activities do not include knowledge transfer, so here different justification modes are presented.

To verify any product or process it is necessary for the participants in the verification process to be able to justify and by that, to accept that the results from the process are valid. There are several ways of justifying results and processes. The following discussion regarding justification is based on Tell (2001). He describes two different dimensions of justification modes where the endpoints (of a continuum) are described.

The four different kinds of justification are:
1. External justification
2. Internal justification
3. Justification by procedure
4. Justification by performance

External justification can be exemplified with the positivistic way of performing scientific studies. This kind of justification means that the individual accepts a proposition based on beliefs that originate ex somate. The foundation is that there are some things that are given and that from these things, truth originates.

Internal justification can be regarded as the opposite to external justification. In other words, the individual can only accept proposed solutions if they coincide with internal beliefs. These kinds of beliefs can be created within a social system,
which lead individuals included in this social system accepts rules that might seem strange for people outside of the system. Justification by procedure is the kind of justification used to convince the reader that the conclusions are correct by describing the theoretical framework, presenting the method used to gather information and analyzing the information in a conventional way. If the appropriate approach to research is used, then the conclusions are justified.

Finally, when trying to justify by performance, the method is regarded as an obstruction to real progress. It is only when there is disorder and irrational behaviour is used that knowledge can be created. The results are the only thing that matters. They speak for themselves.

3.4 Outgoing knowledge transfer

This final phase is congruent with the mode of internalization, which is when explicit knowledge is turned into tacit knowledge (Nonaka and Takeuchi, 1995). The tacit knowledge created is called operational knowledge, i.e. tacit knowledge about such things as the feel for a correctly performed assembly sequence. Documents, manuals or oral stories are useful tools. To exemplify, the act of documenting helps individuals to internalize their experiences. Furthermore, documents can enable the transfer of explicit knowledge to others. In this mode the need for action is stressed. Training through activity instead of continuous reasoning is the key.

4. Method

This paper is based on studies performed within the automotive industry, since it is an industry where intra-organizational knowledge transfer combined with virtual verification is widespread today. In this paper, Volvo Cars and SAAB Automobile were utilized for the empirical material. Within these companies, the most labour-intensive part of the manufacturing process was chosen for the study. This was also the area where most radical changes were made in the verification process, since computer-based tools have been used for years regarding automated assembly lines (cf. robot simulations).

4.1 Selection of research methodology

Since the character of the main questions in this paper is “how” in combination with the exploratory nature of the study, this implies (Yin, 1994) the use of the case study approach. The use of case studies is strengthened by the fact that the author had little control over the events.

4.2 The case studies performed

This paper is based on several studies performed during a four-year period. The three main studies are presented briefly below:

1. Study 1 was performed during the production ramp-up phase of a product development process (PDP), where physical prototypes were used during the verification process. In this study, the outcome from that development process was collected and analyzed. To add supplementary details, a retrospective study was performed after the completion of the development process.

2. Study 2 was performed during the prototype-building phase of a PDP where virtual prototypes were used instead of physical. This study was aimed at describing the changes in outcome from PDP’s with a varying degree of virtual prototypes used. Here, historical data from two earlier PDP’s was compared with the results from the contemporary PDP.

3. Study 3 was performed during the same PDP as Study 2. This study was aimed at mapping the work processes, the organizational design and communication patterns during the verification process.

4.3 Research methodology used in the studies

A case study approach was used in all of the studied cases but the detailed design differed some between the studies (see descriptions below).

The studies performed have included verification processes of two different products. These processes were separated in time and were performed after each other. The research procedures have differed due to the fact that the process focused during Study 1 had already been performed when the studies begun, while during Study 2 and 3 the verification process was studied in real time. Therefore, the data collected during Study 1 consists mainly of historical data. Supplementary interviews were performed and informal discussions were held in order to receive a better understanding of the work method and organization used during Process 1 (The verification process studied in Study 1 is called Process 1. The same logic applies for Studies 2 and 3.)

During Study 1, own observations were used in combination with supplementary interviews with skilled workers, pre-production engineers and project leaders to receive as accurate information as possible. Due to the informal nature of the
supplementary interviews, notes were taken during the interviews and transcribed afterwards. In total, ten interviews regarding the verification process were performed during Study 1. The average length of each interview was approximately 60 minutes. The interviewees were asked about the verification method and organizational structure used. An interview template with open-ended questions developed for this particular study was used.

During Study 2 and 3, information was collected using observations (participation during four different verification series), interviews (to gather information regarding process descriptions and work methodology between the verification series) and collection of company internal performance data. The interviewees were selected depending on their degree of participation and on their previous experiences from earlier verification processes. Interviewees were also selected so that at least one representative from all organizational parts involved in the verification process cover was formally interviewed. In total 14 people were formally interviewed. An interview template with open-ended questions was used. The procedure performed during and after the interviews as well as the extent of each interview was similar to Study 1. In addition to the interviews, informal discussions were held with other people directly involved in the verification series. Participating observations were made both by attending meetings where different aspects on verification were discussed, and by attending four verification series. During the observations, the other participants were notified of the presence of a researcher. In addition to the oral sources, company internal databases were used as an information source at the same time as the structure of the information stored was studied to be able to describe how the information was handled.

4.4 Validity and reliability

The initial question that needs to be addressed is whether the study has construct validity or not. The knowledge transfer processes were not initially in focus, but as time went by they became central. The changes in effect of the knowledge transfer efforts performed was impossible to measure objectively since it was not possible to perform measurements regarding the verification of physical prototypes. Instead, information regarding the knowledge transfer processes during the verification process was gathered in order to use a theoretical model to analytically get to the effects. The construct validity in that case is therefore depending on the validity of the theoretical model used.

The second question to be addressed the reliability issue. To create reliability several sources can be used and triangulation of the gathered information can be performed. In this case, interviews were supplemented by written descriptions of the processes and by participating in discussions regarding development of the methodology used. These complementary sources strengthen the reliability in the descriptions as well as they contribute to the overall understanding of the studied field.

5. Results

5.1 Incoming knowledge transfer

For both of the processes studied in this phase, the most prominent differences are included. The different team members express their opinions regarding the proposed design and assembly solutions. The basis for their contributions is their individual mental models (for example, the proper assembly sequence). One of the subsidiary purposes of the verification process is to develop shared mental models, since the assembly staff participating will pass on this knowledge to the rest of the assembly staff (approximately 5% of the total number of assembly staff participates during the verification series). To transfer the same knowledge, shared mental models have to be created.

During Process 1, shared mental models were created as follows: Initially the product preparation engineers presented their proposed assembly sequence. After that, all of the team members gathered around the new product and the assembly staff tried to assemble the product according to the proposed sequence. If they detected any problems, it was discussed and the product preparation engineer went back to his/her workplace and changed the sequence. Each verification series consisted of several prototypes so that the assembly staff could practice every assembly sequence and in some cases even introduce the new, improved assembly sequence at the end of a series. Consequently, during Process 1, the work method created opportunity to use all of the proposed activities (dialogue, observation, imitation and practice) to create shared mental models.

During Process 2, two of the proposed activities were not used. Imitation and practice was not performed because of the use of computer-created images. The assembly staff could not test the assembly sequence by actually assembling the products. Instead, they had to evaluate the proposed assembly sequence only by studying the images on the computer screen. A lot of the
assembly staff complained about the difficulties doing a satisfactory job when they could not use their other senses to evaluate the propositions. To make the task even more difficult, this was the first time the verification teams used this verification method. The participants had to learn to work in the computerized environment besides the work evaluating the new product.

This indicates that virtual verification alone is not the answer. Polanyi (1966) supports this conclusion through his statement that explicit integration cannot replace its tacit counterpart. In the studied case, the use of computer-created images does not create opportunities for the assembly staff to express their tacit knowledge by actually showing the other participants what they mean. Instead they have to verbalize their knowledge, which in many cases is difficult (and in some even impossible).

5.2 Creating concepts
During Process 1, the prerequisites for an effective externalization mode were met. The team members could draw analogies from their previous experiences from other verification series, since the verification environment was similar to what they were used to. During Process 2, the prerequisites were not met, since the assembly staff had clear difficulties expressing their individual tacit knowledge due to the inability to use physical objects. We have already mentioned the difficulties for the assembly staff to create metaphors or models during Process 2 to some extent. Since this mode holds the key to knowledge creation, the following knowledge transfer activities (for example knowledge transfer to the other assembly workers) during Process 2 were influenced by the lowered efficiency in this mode.

5.3 Justifying concepts
One major challenge when making changes in crucial parts of a process is to convince the participants that the new method leads to improved results (whether the results aimed for are internal or external to the participant).

One important observation is that during the initial virtual series a lot of the participants expressed their uncertainty, and thereby their lack of acceptance, regarding the new work method. This uncertainty and non-acceptance of the method can be concluded to have an influence on the outcome from the process.

5.4 Building archetypes
The differences between the two processes studied are not substantial regarding the building of archetypes. The only major difference was the increased use of databases to store the information created in the verification series so that every interested party was able to have access to all of the information during Process 2. During Process 1, the normal procedure was to produce paper documents that were distributed to the team members. This meant that everybody did not have access to all of the information, but at the same time there were not as many documents circulating in the organization. If the structure of documents in a database is easy to follow, this tool can be a powerful enabler in the third mode. In the case studied, the structure was not satisfactory according to the users, which affected the final outcome.

5.5 Outgoing knowledge transfer
After each series, the discovered problems regarding the manufacturing process were brought back to the engineering teams, while the manufacturing representatives returned to their normal work at the assembly line. This resulted in a hampered learning process and that some of the knowledge assimilated by the manufacturing representatives was forgotten.

Outgoing knowledge transfer includes both internalization of the required knowledge by the participants and transfer to other individuals or groups within the organization and to external interested parties. The internalization activities are, in the cases studied, identified as activities such as writing verification series reports, writing assembly manuals and tutoring perform by the assembly workers during the latter parts of the verification process. The use of computer-created images does not influence the efficiency in this mode directly. The efficiency in the internalization mode during Process 2 decreased according to the assembly workers. It is probably because of the decreased efficiency in the preceding modes.

For organizational knowledge creation to take place the knowledge conversion process must go beyond the individuals that perform the interaction between tacit and explicit knowledge (Nonaka and Takeuchi, 1995). The process should “spiral” through the organization, that is, the knowledge must be shared with others in groups or within divisions.

There were methods in both Process 1 and 2 that supported the spiralling of knowledge. But, there is one interesting observation that must be illuminated here. The use of computer-created
images creates interesting possibilities for the tutors to show their “students” how to perform the assemblies, for example by introducing Virtual Reality (VR) in the tutoring situation.

In Table 1 below, the main disadvantages for each phase are summarised.

Table 1: The main disadvantages in each phase of the KTVP due to the use of virtual prototypes.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Disadvantages with virtual prototypes</th>
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<tr>
<td>Incoming knowledge</td>
<td>Imitation and practice was not performed.</td>
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<tr>
<td>transfer</td>
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</tr>
<tr>
<td>Sharing knowledge</td>
<td>No opportunity to express tacit knowledge by showing the other participants.</td>
</tr>
<tr>
<td>Creating concepts</td>
<td>Difficulties in expressing individual tacit knowledge due to the inability to use physical objects.</td>
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<tr>
<td>Justifying concepts</td>
<td>Lack of acceptance regarding the results due to the unexperienced participants</td>
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<tr>
<td>Building an archetype</td>
<td>No substantial differences were found.</td>
</tr>
<tr>
<td>Outgoing knowledge</td>
<td>No substantial differences were found.</td>
</tr>
<tr>
<td>transfer</td>
<td></td>
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6. Conclusions

The following conclusions can be drawn:

- In the studied cases, the introduction of virtual prototypes in the verification process resulted in clearly changed prerequisites for knowledge transfer and creation.
- These changes arose mainly regarding incoming knowledge transfer, creating concepts and the justification phases, but the efficiency in the other modes were also affected by this introduction.
- The use of computer-created images obstructed the creation of shared mental models during incoming knowledge transfer since the participants had difficulties utilizing imitation and practice to strengthen the tacit knowledge.
- The participants’ lack of experience regarding working in a virtual environment affected their efficiency. However, the team members’ inability to externalize their individual tacit knowledge must be regarded as the primary reason for the difficulties experienced during the verification process.
- The new method is not accepted by all of the participants. There is a need for a greater focus on justification activities. The possibility for the assembly staff to learn the new assembly sequences has decreased since the skilled workers participating in the verification process did not have the same possibility to practice the assemblies as the were used to.

7. Future research

An area where the final results have not been available to study yet, are the effects this new work method has on the learning activities when other influencing parameters come into play. The effects due to language and/or cultural barriers within verification teams or between verification teams (the knowledge creators) and the receivers of the knowledge (for example, suppliers or own employees abroad) are two important examples. Naturally, it is of great interest to study the effects on verification performance when the method has been adapted and accepted. What is the outcome of the verification process when the participants have got used to the virtual environment?

Another area of interest is, to study how the continuous technology development influences virtual verification in the future. Here, several alternative directions of interest can be identified. The effects when using VR as an outgoing knowledge tool and/or the effects when using databases and/or virtual communication (such as e-mail) in the knowledge transfer has been identified two areas influencing knowledge transfer. Another direction is the effects of improved computer capacity on the outcome of the verification process. How will the outcome be affected by more lifelike visualizations or by more rapid changeovers from engineering drawings to verification simulation?

References


MaKE First Steps: a Collaborative Approach to Defining Knowledge in Organisations

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Abstract: At a time when there is a lot of debate as to what 'knowledge' means in organisations MaKE First Steps provides a practical way of addressing the issue in organisations. It is a practical approach for collaboratively defining knowledge in organisations in such a way that the definition that is created fits an organisation's needs, context and preferences. This paper describes and explains how the process works, how it was tested in a commercial environment and the results of that research. This work is highly relevant to both academics and practitioners, and the author argues that this is an excellent way for employees in organisations to commence knowledge management (KM) practically.

Keywords: Knowledge definition, collaborative process

1. Introduction

At a time when KM is presenting academics and practitioners with as many questions as answers, it is extremely valuable to have a logical way by which organisations can go about defining knowledge. This paper presents MaKE First Steps that is a process designed to do this. It does this by making use of a body of work in the domain of defining knowledge in organisations.

The paper is structured as follows: Section 2 provides theoretical foundations that underpin MaKE First Steps. Section 3 outlines the method used to devise and test MaKE First Steps and Section 4 describes and explains the process. Section 5 describes and explains how the procedure was applied in practice in a major UK Fast Moving Consumer Goods (FMCG) manufacturer and Section 6 gives a description and analysis of the feedback obtained from participants before the conclusion is provided in Section 7.

2. Theoretical foundations and assumptions

MaKE First Steps is a procedure for defining knowledge collaboratively in organisations. The approach taken in this procedure rests on various epistemological assumptions. This section outlines these assumptions and the theoretical background before its design and application is explained.

First, the authors take the view that 'knowledge' is defined, discerned and created by humans, and because humans do not always have the same view, definitions of knowledge differ. The definition of knowledge is also something that is multifaceted, changes over time, varies according to the context in which the concept is being considered, and once it is articulated it can be something that is shared and reflected upon. In all these respects the author of MaKE First Steps agrees with Sveiby (1997) and Hirschheim, Klein and Lyytinen (1995).

These assumptions are also very practical in nature. It is clear from research into definitions of knowledge that there is very little consensus on the subject. A practical approach is one that accepts this as a reality and asks - "how can this be used to an organisation's advantage?" Because there is little consensus it is sensible to incorporate in the process a high degree of human input that is channelled into achieving a consensus. Participants can also help to validate and refine the outcome. In light of this, this research was applied in a workshop.

The scope to which MaKE First Steps can be applied in organisations is determined by the human-determined boundary that is deemed appropriate (e.g. the whole of a company, a department, a project, or in an information system development project). This is because the only vital ingredients for MaKE First Steps are willing participants in the organisation with an appropriate understanding of the context to which it is to be applied.

The emphasis in this research was upon defining knowledge in the context of organisations where people work and the literature survey of definitions and related concepts reflected this. However the process itself sits above the content of definitions and categories of knowledge.

Three broad perspectives were identified as to how the concept of knowledge can be 'defined' in the context of organisations and within each approach further sub categories exist: -

1. Textual Definitions
2. Categories of Knowledge for organisations
3. Knowledge as a Comparative Concept (i.e. differentiated from and compared with other entities)

MaKE First Steps incorporates the concept of knowledge from these three perspectives (in Stages 5, 6 and 7 - explained in Section 4) whilst accepting that there is overlap between them. Section 3 outlines how MaKE First Steps was devised, tested and refined.

3. Method Used to Devise and Test MaKE First Steps

The method that was used had several strands: literature search; creative design; testing, reflection and refinement.

First, a literature search was conducted into the concept of knowledge, in particular in the context of KM in organisations and intellectual capital. This literature search led to the view that three perspectives of knowledge as a concept have been taken (see Section 2) and within these three perspectives further classifications were created. Certain conclusions were reached on conducting the literature search about suitable design premises for MaKE First Steps (see Section 4).

Second, creative design work was conducted. A logical procedure was created for defining knowledge collaboratively based on the design premises. Then, the process and its component parts were tried and tested 'internally' using hypothetical situations and it was modified and honed.

Third, MaKE First Steps was tested, reflected upon and refined. Before taking it to the commercial environment, a large UK FMCG manufacturer, a questionnaire was prepared for participants to complete in writing after taking part. The questionnaire that was devised was short, simple and designed to elicit responses that would help gauge the usefulness of the approach and how, if at all, it could be improved.

MaKE First Steps was conducted with a team of employees at the organisation, in a workshop. The author of MaKE and his supervisors were present to facilitate the application of MaKE First Steps. Two employees present at the workshop were central to the context for the definition of knowledge in the company and were the people who created the definition of knowledge and provided feedback on MaKE First Steps.

4. Description and explanation of MaKE first steps

The design of MaKE First Steps was based on certain premises, most of which, map from the theoretical foundations and assumptions:
1. The process is to facilitate the production of a definition by the employees;
2. The employees should refine and shape it and ultimately be happy with it;
3. Information of experts on the concept of knowledge would be joined with 'where the employees are coming from' after the participants have expressed their own view;
4. The procedure is allied with establishing a context for KM in the organisation;
5. An acceptance that the definition may only be relevant for a certain period of time;
6. That a comprehensive approach would be taken in the first trial of the procedure. This would provide plenty of scope for the creation of a definition as long or short as the participants chose;
7. An acceptance that there maybe disagreements that may need to be addressed in the process;
8. Adopt a practical view accepting that users time is limited and;
9. That the process would seek to help users navigate and 'tap into' a body of work about the concept of knowledge in a relatively simple way using visual tools to do so.
4.1 Context of Definition
This stage is the one where the context for which the definition is determined. The boundary of the context is people-dependent. Once the context has been determined, suitable employees can be chosen to participate in MaKE First Steps. A suitable participant is a person who has an overview of the context that has been chosen. Two, three or four participants are required. Input from more than one person tends to help in drafting. A group that is no bigger than four in size is practicably easy to manage.

4.2 Time Period for Definition
This is the stage where the time for which the definition is designed to 'last' before it may be amended is determined (e.g. six months, a year, etc). If participants have no clear view on this then an indeterminate time can be stated.

4.3 Other Preliminary Issues
The first three of the other preliminary issues are practical ones. First, agree how much time the participants have for creating the definition. Second, if there are any views on an ideal length for the definition (e.g. not more than one page) then these should be stated at this stage. Third, the participants agree on a ‘Knowledge Arbitrator’. The Knowledge Arbitrator is appointed in case there is an undecided dispute later in the process that needs to be addressed before the time period for creating the definition expires.

The other thing the participants are asked to do is write down on a blank sheet of paper what they think should be in the definition of knowledge. This is done very quickly and can constitute any notes of things that participants think should be included. This is done at this early stage so participants bring 'to the table' what they 'have to offer' before they consider a wider body of knowledge to which their initial thoughts may be joined.

4.4 Embody Current Statements from Chosen Context?
Participants may also 'bring to the table' current statements the organisation may have for the context for which the definition is being created. Examples of these may include mission statements, department mottoes and past attempts at defining what is important for employees.

4.5 Systematic Definition Selection (Knowledge Definition Tower)
This stage is where participants systematically navigate through definitions of knowledge that have been devised by experts. Suitable definitions are selected and used as a starting point for creating a definition for their context.
To help do this, a visual tool called the Knowledge Definition Tower (see Figure 2) is used. The Knowledge Definition Tower has four layers that can help navigate to definitions of knowledge that could help the participants. The Tower itself represents definitions of knowledge that have been articulated and can be used in the application of MaKE First Steps. Outside the Tower are definitions that had not been articulated or are not accessible in the application of MaKE First Steps at the time when it was first applied. Moving towards the top of the Tower the levels become increasingly abstract, philosophical and tacit in nature, whereas as you move towards the 'ground' the categories become increasingly tangible, explicit, and related to the physical world.

The Tower maps to definitions of knowledge (predominantly made by experts in the fields of KM and intellectual capital) that are categorised and numbered according to the Tower levels. In a number of cases definitions have elements of more than one level, and are categorised accordingly. References for definitions of knowledge that were used in the initial application of MaKE First Steps are noted in Appendix B.

To navigate to definitions using the Knowledge Definitions Tower the participants go through the process outlined in Figure 3. This entails selecting level(s) from the Tower and using this as a starting point for selecting definitions with expert help. The selected definitions are copied, pasted and listed on a computer in a word processing package in the Knowledge Definition Template (see Appendix A). The participants can then highlight parts of the definitions that they wish to include in their final version. Once this is done the participants complete the other stages of MaKE First Steps.

4.6 Knowledge Categories Wheel

Experts in KM have devised categories to help organisations understand and analyse knowledge. Participants in MaKE First Steps may use these categories (or headings of categories) to define 'knowledge' and Stage 6 addresses the issue of whether they wish to do this. A tool called the Knowledge Categories Wheel is used to select any such categories or headings the participants may wish to include (see Figures 4, 5, and 6). The Wheel has an inner and outer ring and the category headings map to a table that contains greater detail in case participants wish to refer to it. Table 1 provides a summary of references for categories of knowledge that were used in the initial application of MaKE First Steps (see Appendix B).
Figure 3: Systematic Definition Selection

The overview of the Knowledge Categories Wheel (Figure 4) maps to the summary of inner and outer rings illustrated in Figure 5 and Figure 6. The numbers and letters in the segments shown in Figure 4 cross refer to the equivalent letters and numbers in Figure 5 and Figure 6, which in turn trace back to the original sources (see Appendix B). The Outer Ring refers to categories that are generally more broadly applicable (i.e. beyond organisations) whereas the Inner Ring refers to categories more specifically designed for organisations.

Figure 4: Knowledge Categories Wheel - Overview
Figure 5: Knowledge Categories Wheel – Summary of Outer Ring

Figure 6: Knowledge Categories Wheel – Summary of Inner Ring
4.7 Knowledge as Comparative Concept

Stage 7 of MaKE First Steps considers knowledge as a comparative concept; one that can be compared with information, data and other such closely related concepts. A number of comparative concepts have been devised and are summarised in the Comparative Concept Bar Chart (see Figure 7). The sets of comparative concepts are referred to in Appendix B.

The participants decide whether to include any element of this in their Knowledge Definition Template. However the bar chart is a summary device and cannot be simply applied, since behind each set of compared concepts there are different views as to how the compared concepts are differentiated. In some cases summarising this is extremely complex and deep conceptual thinking about knowledge may seem abstract to some employees. As with the other stages of MaKE First Steps, this stage is only explored to the extent that participants wish to pursue it.

4.8 Hone Definition to Taste

Once Stages 1 to 7 have been completed the accumulated material is put in to the Knowledge Definition Template and then the honing process begins. This stage is iterative and is illustrated in Figure 8.

Stage 8 is one of the most important stages of MaKE First Steps. This is because it is important for participants to tailor the definition to their satisfaction. In doing so, the participants become more obviously 'owners' of the definition and make it relevant to their context. It also brings closure to the MaKE First Steps process.

The key features to note about the honing process are below.
- The collation of highlighted statements is through a process that starts with highlighting hard copy definitions and then collating the definition into one coherent definition
- At first, this is done by inclusion of AND between the various parts of the definition (see Template Part 4 in Appendix A), but
during the honing process unnecessary words are removed
- The process of honing takes place using a computer and word processing package
- Changes are made only if there is consensus among the participants

- The honing process relies to some degree on the part-intuitive process of drafting
- If there is a disagreement during the honing process the Knowledge Arbitrator will resolve the disagreement and move the process towards its conclusion

5. **Summary of How MaKE First Steps was Applied in an FMCG**

The company in which the implementation phase of the research took place is a major UK FMCG manufacturer and distributor. It makes and distributes FMCG branded goods. It has several brands within the 20 top-selling grocery brands in the UK and holds major UK franchises.

MaKE can theoretically be applied to any company of any size. However, there are a number of reasons why this company provided a good context for the research. KM software project work had been conducted at the company, and it was likely they would be receptive to the application of the research. There is little, if any, reported KM work applied to a manufacturing company in the UK.
A workshop was the context in which MaKE First Steps was applied. There were seven people present at the workshop: four employees, the author and his two supervisors. The four employees held different positions within the company. One was a newly appointed IT Project Manager, who was introduced to the project. Another was an IT Development Programme Manager, who had been involved in the negotiations about the project over the previous eleven months. There was also an Insight Resource Manager and a Head of Category Insight, who had an overview of the domain to which the project would be applied.

The exact domain to which MaKE would be applied had not been articulated before MaKE First Steps was implemented. However, the IT-based KM project was being undertaken across the marketing and sales functions of the company, and two of the employees in the workshop were overseeing that project. It was decided that this project would relate to the area of the company over which they had an overview, and that they would be the participants involved in MaKE First Steps. Those who were not directly relevant to the domain for which the definition was being created, only helped with Stage 8.

An agenda was agreed for the workshop. It was agreed to allocate three and quarter hours in total for conducting MaKE First Steps. MaKE First Steps was only applied once. Only one definition of knowledge for the chosen domain is necessary to initiate the use of the other components of MaKE.

6. Description and Analysis of Feedback

There are a number of forms of feedback for MaKE First Steps that derived from application of MaKE First Steps in the company in which it was applied. These were formal direct (i.e. written responses in questionnaire), direct (i.e. oral communication of participants), indirect (i.e. from colleagues in the organisation), and reflections in and on practice at the workshop.

6.1 Formal direct

The two participants, who defined knowledge in the company using MaKE First Steps, completed the questionnaire in writing. One was appointed the 'Knowledge Arbitrator' (Employee A). The other participant is referred to as Employee B below.

The questions in the questionnaire were:

- 1. How useful is the Knowledge Definition procedure for arriving at a practical definition of knowledge?
- 2. Please specify whether you think it could be improved and, if so, precisely what feature(s) of it could be improved and how?

The written feedback on the questionnaire is discussed below in terms of the process overall and individual stages. All comments in square brackets are to help the reader understand quotations.

6.2 Process Overall

Generally the process was considered useful, comprehensive and works (though with qualification in the case of Employee B):

- "8 step process is useful in breaking down the task in to manageable chunks" (Employee A)
- "Appears fairly comprehensive. We arrived at a definition, but the procedure does not allow understanding what you may have missed. If you accept this then it works." (Employee B)
- "Ultimately, has the procedure moved thinking on, clarified it or started from a new point?" (Employee B)

6.3 Individual Stages:

6.3.1 Stage 1

Neither employee commented.

6.3.2 Stage 2

Employee A pointed out that what Box 2 refers to (see Figure 1) could be clarified:

- "Box 2: Time period could be confusing re difference between longevity of the definition vs. the time period over which the process [MaKE First Steps] takes place."

6.3.3 Stage 3

This stage was considered useful and Employee B suggested more formal structured incorporation of it in the process:

- "Again - v. useful." (Employee A)
- "The brainstorm [part of Stage 3] might be developed to 'knowledge definitions' 'outputs' as [Employee A] had done. It clarifies the thinking. Also, there should be greater readiness to bring the brainstorm in as an active, prompted step rather than the more ad hoc manner we used." (Employee B)

Employee B queried whether the definition produced by MaKE First Steps might conflict with cultural trends in the company:

- "Also, are there any definitions currently in use (we have had one) by the business.
Should this be discounted (i.e. will it cause a conflict with current cultural acceptance?) and should this therefore be built in?"

6.3.4 Stage 5
Employee A commented on Stage 5 as follows which corroborates to some extent with Employee B's comments on the overall process: -

- "Box 5: - Like the idea and thought behind it - but it is a v. difficult question to answer (i.e. pick a number [level of tower] without concrete examples of what goes at each level. Perhaps using some form of specific analogy would help."

6.3.5 Stage 6
Employee B queried the usefulness of Stage 6 (knowledge categories): -

- "Box 6: Didn't really understand how/what categories would add? Should this be something that is after the definition has been arrived at?"

6.3.6 Stage 7
Neither employee commented though a comparative concept internally devised in the company was incorporated in the template.

6.3.7 Stage 8
Employee A regarded this stage, the template and honing process as good:

- "Process of using the online 'AND' to then breakdown and synthesise was good."

No comment from Employee B on this stage.

6.4 Informal direct
Conversation with the participants during the process reflected a high degree of engagement in the process and 'buying in' to the collaborative nature of the process. It also suggested that engagement in MaKE First Steps had prompted interest in the whole concept of knowledge, which previously had not been considered as much, and questions about the business's culture and frameworks already produced within the company were raised.

6.4.1 Indirect feedback
The knowledge definition that was devised was used in presentations within the business that suggests the participants in MaKE First Steps endorsed the outcome of the process.

The definition was also used in the application of the remainder of MaKE and employees within the context rarely, if at all, suggested alterations to the definition of knowledge that resulted from the application of MaKE First Steps.

6.4.2 Reflection in and on practice
MaKE First Steps took approximately 2 hours and 30 minutes and the authors noted the difficulty of navigating through the Knowledge Tower, and also whether it is appropriate to include stages 6 and 7 in the process and, if so, how to do so practically.

The significance of the feedback for MaKE First Steps is summarised below.

- The concept of defining knowledge for business context is endorsed;
- The process works;
- Stage 3 may be improved by making the brainstorming session a more 'formal' aspect of the process;
- The concept of Knowledge Tower (Stage 5) is endorsed but some form of specific analogy would help;
- It is questionable whether knowledge categories and the comparative concept aspects (Stages 6 and 7) should be included as part of the process and;
- The process tends to generate thinking by participants as to what 'knowledge' constitutes for them and this tends to focus on what is valuable to them - hence the final product is a valuable starting point for MaKE (Sharp, 2006).

There is scope for future testing of MaKE First Steps that adopts these changes and applies the process to a wide range of different contexts.

7. Conclusion
There is a lack of consensus as to what knowledge is and what constitutes KM in organisations. However, MaKE First Steps is a process that seeks to facilitate the production of definitions of knowledge that are relevant to organisations. The process facilitates the reaching of a consensus in practice. The process inevitably helps focus thinking on what is valuable to the organisation (Stewart, 1997). The collaborative involvement of participants in the process engenders a sense of shared ownership of the final product that adds value to it. Furthermore, this provides a good starting point for management of 'knowledge' in the organisational context. In doing this, MaKE First Steps bridges the gap between theory and practice in the world of KM.
Note about MaKE and MaKE first steps

MaKE stands for 'Manage Knowledge Effectively' (Sharp, 2003). The author wishes to acknowledge that this is not to be confused with an acronym similar, but different to this one, which is described in Winfield, M. J., Basden, A., and Cresswell, I. (1996), Knowledge Elicitation Using a Multi-Modal Approach, World Futures, Vol. 47, pp.93-101. MaKE is a trademark owned by its author, Peter Sharp who also designed and created MaKE First Steps. Michael Simm helped ‘test’ it prior to taking it to into a commercial environment. Alan Eardley and Hanifa Shah were Peter’s supervisors.

References

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**Appendix A**

**KNOWLEDGE DEFINITION TEMPLATE**

Date: 
Knowledge Arbiter: 
Position of Knowledge Arbiter:
1. CONTEXT FOR KNOWLEDGE DEFINITION

2. TIME PERIOD FOR KNOWLEDGE DEFINITION

3. EMBODY CURRENT STATEMENTS RELEVANT TO CONTEXT (E.g. Company (Mission Statement), Department (Statement of Ethos of Department, rules), Project (E.g. Aims and Objectives of Project) and Computer System (e.g. Specification)

4. SYSTEMATIC KNOWLEDGE DEFINITION SELECTION

Knowledge in the above context for the period specified (if any) is:

AND
AND
AND the following categories can be used to categorise it:
AND these EXTRA NOTES were deemed relevant

It can be compared or differentiated from other related concepts as follows:

AND it was also thought the following should be stated about the Knowledge Definition we devised

Appendix B  Cross References for Stages 4, 5 and 6 of MaKE First Steps

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<th>Comparative Concept</th>
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Balancing the Flows: Managing the Intellectual Capital Flows in Inter-Organisational Projects

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Abstract: The aim of this paper is to analyze different strategies for protecting knowledge in interorganisational collaborative relationships, based on intellectual capital (IC) theory. Previous research has stressed the need for the flows between structural, human and relational capital to work properly, i.e. that the firm has a broad bandwidth of communication. Firms involved in interorganisational collaborative relationships need to be able to manage the IC flows in order to make the communication run smoothly, while limiting involuntary leakage of strategically important knowledge. The paper examines the strategies aimed at keeping the balance between sharing and protecting knowledge identified in a multinational firm with extensive experience of close collaboration with partners that are partly also competitors.

Keywords: Intellectual capital, protection of knowledge, interorganisational collaboration

1. Introduction

In the fast moving information society firms need to be able to adjust to market changes and other external factors quickly. However, firms often face the reality that in-house development and new adaptations of knowledge become too costly both in terms of time and finances. New comprehensions of collaboration and competition emerge as firms increasingly form alliances and enter joint projects or networks (Gibbons et al. 1994) in order to develop new knowledge for innovations or technologies, or to enhance the quality of existing products or processes (Dyer & Nobeoka 2000; Doz et al 2000).

The aim of this paper is to analyse, through the lens of intellectual capital (IC) theory, different strategies for managing the flows of IC in interorganisational collaborative relationships. The research question the paper aims to explore is: How can IC theory advance the understanding of how organizations try to manage the flows of intellectual capital in interorganisational relationships in order to protect their knowledge? IC theory is chosen in this paper as a novel approach for analysing strategies for protecting knowledge. New research (Salojärvi 2005) indicates that there is a relation between managing the sharing and protecting of knowledge on the one hand, and organizational success in terms of growth on the other hand. Salojärvi’s study indicates that many companies are using knowledge management to implement either a sharing or a protection strategy, but that it is the companies implementing both of these strategies to manage the balance that develop into organizations with high competitive strengths and high performance. They are often innovative high growth companies. Consequently, there is a need for further studies in the area. Following the work of among others Sveiby (1989, 1997), (1998a), Stewart (1991, 1994, 1997) and Saint-Onge (1996), the intellectual capital resources that can be employed by an organization are in this paper considered an entity containing three different dimensions. These are: 1) human capital; 2) structural capital; and 3) relational capital. Human capital is seen as the skills and knowledge residing in the minds of the employees, structural capital as knowledge leveraged in processes and structures that support the staff in their intellectual work, whereas relational capital is seen to involve the relationship the firm has with external parties. Previous research has stressed the need for the flows between these dimensions of IC to run smoothly, expressed as an appropriate bandwidth of communication built on trust (Sveiby in Stadler 1998). Collaboration between two parties may be built exclusively on trust, and lacking contracts (Davenport et al 1999, Fraser et al 2001). However, it is highly unlikely that a firm would enter a contractual arrangement with another party without the existence of trust (Hägg 1994), as trust is a “necessary condition for economic exchange” (Neu 1991 p 243). The definition of trust used here is an “actor’s expectation of the other party’s capability, goodwill and self-reference in future situations involving risk and vulnerability” Blomqvist 2002: 269).

Firms involved in interorganisational collaborative relationships, however, need to be able to manage the IC flows in order to make the communication run smoothly, while limiting involuntary leakage of strategically important knowledge. The most appropriate bandwidth of communication is not necessarily the broadest, but rather a balanced outcome of sharing and protection considerations. The focus of this paper is on the flows between the relational capital, manifested by relationships with external partners,
and human and structural capital. The flows as constructed in this paper and protection strategies are illustrated in figure 1. The large arrows indicate the bandwidth between the different kinds of intellectual capital, whereas the small arrows demonstrate where protective mechanisms might have to be put in place. The large straight arrow between structural and human capital indicates flows that are important for the function of the organization as a whole, but that do not need to be restricted in any way as they are internal to the firm and do not involve any external parties.

![Figure 1: Types of organizational intellectual capital and the flows between them](image)

Although this paper discusses strategies for protecting knowledge, the intention is not to advocate a total closure of the channels connecting (external) relationship capital to the internal dimensions of organizational capital. Such excluding strategies entail performing selected tasks within the firm, on behalf of an alliance by building a “Chinese wall” or “Black Box” (Lewis 1990, Lorange & Roos 1992) around competences and hence locking in firm-specific knowledge. There are also other selective strategies that aim to limit the scope of collaboration to certain technologies, products, processes or markets (Hamel 1991, Baughn et al. 1997, Oxley & Sampson 2004) are not discussed in this paper. Neither is it possible to take all the factors facilitating knowledge transfer and claim they can be turned around and regarded as protective strategies. Rather, the underlying assumption is to reach a suitable bandwidth. This by adjusting the channel so that knowledge can flow in and out of the organization during different kinds of collaboration, but still do so in a controlled manner. Naturally, for interorganisational collaboration to occur, knowledge needs to flow in and out of the organization as employees from the two organizations interact and engage in joint problem solving. Protection is here defined as “the process by which firms sustain the uniqueness and value of their competences” (McEvily, Eisenhardt and Prescott 2004:114)

This paper is structured as follows: The different dimensions of the classification of organizational intellectual capital – human, structural and relational capital - are discussed in the following section, followed by a review of the methodology used for the empirical study. After this, the empirical results and the protective strategies used for managing the flows in the case company are examined. The results are in the discussion section validated and compared to earlier research within the strategic management field, after which the conclusion together with the suggestions for further research and the limitations are presented in the last section.

2. Intellectual capital

Tom Stewart (1991) in his article “Brain Power - How Intellectual Capital Is Becoming America’s Most Valuable Asset” was among the first to use the term intellectual capital. The term had been used before, but what differentiated Stewart’s discussion of the intellectual capital of the firm was that he advanced it to an organizational level. (Sveiby 1998) Since then, knowledge as an intangible asset is often seen as a possession or property of an organization, i.e. the stock of knowledge that resides within an organization at a certain point in time. (Bontis, 1996, 1998, 1999, 2002; Bontis et al., 1999; Choo and Bontis, 2002; Edvinsson and Malone, 1997; Stewart, 1997;
Sveiby, 1997). This stock of knowledge can be further divided into different subdivisions: individual, group, and organizational level (Bontis, Crossan, & Hollan, 2002) or, as opted for in this paper; human, structural, and relational capital (Sveiby, 1989, 1997; Stewart, 1991, 1994, 1997; Saint-Onge, 1996). As illustrated in Figure 1, the interaction between these subdimensions of intellectual capital is identified as flows of knowledge. In the following section the different dimensions of the classification of organizational intellectual capital – human, structural and relational capital – are presented.

2.1 Human capital

Human capital is the sometimes tacit knowledge that resides in the heads of the employees, ranging from the professional staff, the R&D experts, to factory workers and marketing people (Sveiby, 1997). It is especially important to professional service firms as it constitutes the core competency of the organization, but remains difficult to codify. The flows between human and structural capital represent internal flows of the organization, where at least some of the knowledge that resides in the minds of the staff can be captured and leveraged, and turned into organizational knowledge. As Ordoñez de Pablos (2004) points out, this is a vital process for the survival of the organization, as individuals only use human capital in their work on a voluntary basis. Hence measures need to be in place for making sure that the knowledge can be captured and made available for others in the organization should they need it.

2.2 Structural capital

Structural capital is the knowledge embodied in the organization, in the structures built to support the staff in their intellectual work. It helps the organization in turning individual human intelligence into knowledge that can be measured and developed on an organizational level. Without good and reliable structures for leveraging human capital it will only remain in the minds of the employees. In other words, by leveraging human capital and making it useful for the whole organization, the employees create structural capital. (Ordoñez de Pablos, 2004, Bontis, 1998)

Structural capital contains the patents of the firm, models, templates and computer systems and other administrative processes, as well as the culture or the atmosphere of a firm that makes people want to share and collaborate, and that tolerates failures and encourages staff to try new things without risks of penalizations (Sveiby, 1997). Bontis (1998) differentiates between two kinds of structural capital: its technological component and architectural competencies. The technological component is employed in the day-to-day problem solving activities, and includes the local abilities and knowledge, including tacit knowledge, proprietary design rules and unique collaborative processes. The architectural competencies are more overlapping and concern communication channels and information filters between different groups of the organization, idiosyncratic search routines and control systems.

2.3 Relational capital

Relational capital consists of a wide variety of external relationships between the organization and its customers, suppliers, competitors, and partners. The value of the relationship may sometimes be trademarked or otherwise converted into intellectual property of the company. The relationships determine the image the market get of the organization (Sveiby, 1997), and represent the potential value an organization can achieve based on intangibles external to the organization itself. This also includes an understanding of the impact of industry associations and customer needs, and access to the knowledge embedded in customers and partners (Bontis, 1998). Suggested measurements of relational capital include seeing it as a function of the longevity of the relationship, based on the assumption that the value of relational capital increases with time (Bontis, 1998). There is, however, no simple way of conducting such a measurement.

3. Methodology

The study was conducted in a professional service firm, Company A, a multinational with approximately 6000 employees worldwide. Company A is wholly owned by the employees, and specialized on consultancy and engineering. Its UK-division was used for this study, and the interviewed project managers were chosen to represent different collaborative relationships that the firm had with the same external partner. The study hence focuses on the relationship between the engineering consultancy firm and its partner, a construction service firm, from the point of view of the engineering consultancy. Whereas the employees of the consultancy firm that are interviewed are seen as representatives of the relationship between the two firms they all naturally have their own personal relationship to different people in the partner firm. The projects in this industry usually are carried out as consortia consisting of several organizations, some of which competitors and also the client is usually very involved. Hence why other firms are sometimes mentioned in the quotes from the interviews.
The empirical study consists of 8 interviews with project managers from the engineering consultancy firm with prior experience of interorganisational collaborative projects. The taped, semi-structured interviews lasted for 1-1.5 hours. After the interview, the researcher transcribed the tapes with the assistance of N-Vivo software. In addition to the interviews, general industry information and material, as well as informal discussion with the employees were used as supplementary sources of information.

4. Strategies for managing risk

The risks involved in interorganisational collaboration may vary from project to project. Oxley and Sampson (2004) identify five issues that may be internalized by the partner when collaborating (the study focused on R&D collaboration, although the identified risks are generalizable to other kinds of collaboration). These are: 1) the loss of strategic and R&D knowledge, which includes hints the partner can pick up about the firm’s strategies or directions of technological development, 2) the loss of competitive benchmarking data, 3) identification and poaching of employees that the company might be interested in hiring, 4) the loss of explicit, codified knowledge such as drawings, designs, procedures and finally 5) the exposure of tacit knowledge involved in work routines and embedded skills. These five risks will be the base for the following analysis of the strategies employed by the case company to protect knowledge, from the theoretical lens of IC.

The following sections focus on the flows between relational capital and the other two forms of capital. The strategies for protecting knowledge present in the case company are introduced in each of these flows and discussed in relation to the risks. The flow between human and structural capital is included in the discussion, as it is an internal flow and does not imply any risks in terms of disclosure. However, the issue of knowledge protection is certainly also present on an individual level within the firm. Employees have to be motivated to share their knowledge with others within the organization, making the flow between human and structural capital very important for the company. This acknowledgement notwithstanding it is a discussion that falls outside the scope of this paper.

4.1 The flows between human and relational capital

As human capital is inherent in the minds of the employees, the strategies for protection of knowledge important for managing this flow are mostly relating to the staff. The strategies found in the empirical case study concerning human capital are presented in relation to the previously-mentioned risks. The core capabilities of the case firm were by the informants identified as depending largely on human capital, as they were residing in the minds of a handful of people, who were claimed to be responsible for giving the company its innovative and competitive edge. Furthermore, the structural capital i.e. processes and structures around them that enabled innovation and developed well-functioning business solutions were also mentioned as part of the concept. When co-locating in the same office with partners these innovators would not be sitting close to the incoming staff from the partner firm, due to their high competitive value. Hence, the strategy chosen by the case firm was to “lock in” certain key staff or at least to separate them from the collaborative relationships, i.e. cutting off the flows between human and relational capital in terms of certain individuals. This is not, however, generally a strategy that can be used in this kind of collaboration.

Six different strategies were identified in the case material that can prevent risks of the partner identifying and poaching key staff involved in collaboration. These are: retaining staff; creating loyalty and ensuring professional behaviour; gate keeping; utilization of reputation; and guarding customer relationships.

4.1.1 Retaining staff

Retaining staff is an important yet simple strategy for the protection of knowledge. Company A had a particular problem with co-located staff, as the rate of people staying on at the partner company was rather high, according to interviewee’s estimation as much as half of the people sent on secondment quit their job for staying with the partner firm. Hence their problem was rather a lack of strategy to retain staff.

“They have actually poached [some] of our staff, our key staff and others. And have those people to implement similar systems for themselves, which is difficult to restrict that sort of thing.” (Project Manager A)

Poaching often happens in situations where the people feel that their work is more valued in the partner firm, and start to develop loyalty towards the partner firm instead of the parent firm (Pitsis,
4.1.2 Ensuring Loyalty

Developing a sense of loyalty amongst the staff is an important strategy not only in the case of secondment. In collaborative projects it is equally important that employees feel a sense of loyalty towards their parent company, as this will influence their behaviour when interacting with staff from other firms. There is a clear need for strategies and awareness concerning these issues, as the expectations of the team members from the different organization often vary. Determining where the boundaries are is not always an easy task, as confirmed by the following quotation:

“The representatives of the partner firm in team thinks that we should be freely giving [knowledge to them] because it is in the interest of the team. And it might be in the interest of the team to do it, but it might be in the interest of one of the organizations [to] misuse that sort of trusted equipment and reengineer it...And we’d lose our competitive edge within the business, within the industry.” (Project Manager C)

Other important measures for creating loyalty include team branding so that people feel part of the team and the yearly conference was mentioned as an eye-opener regarding building loyalty to Company A. Here the project managers changed their view that they are doing in their team “for Company X is much more important than anything that could be happening anywhere else in Company A”. However, being brought in contact with the worldwide organisation made them feel part of the entity of the global organization of Company A, and also increased the understanding of the power of Company A’s knowledge as a whole. Hence the yearly conference is a very important factor creating loyalty to the organization.

4.1.3 Conventions of professionalism

The strategy of creating conventions of professionalism that emerged from the empirical material is closely related to loyalty. When asked about how an employee learns to manage the balance between sharing and protecting knowledge in collaboration, the informants identified experience and mentoring. Employees are not given certain responsibilities unless they already have a history within the firm and have gained some experience, and during this development period senior staff supports them. Through the development of conventions of professionalism the employees are expected to explicitly consider the need to for professional behaviour at all times as they often are located in the partner’s premises. In other words, they need to be aware of the fact that a behaviour that is displayed internally in the organization might not be acceptable in close collaboration.

4.1.4 Gate keeping

For some forms of interaction there is a gatekeeper, who is in charge that set procedures are followed before signing out documents to the partner. An occurrence of this is illustrated in the following statement:

“You have reached a particular grade or status in the company of seniority, that allows you to sign a letter, sign a drawing, sign a particular bit of information [ ] But it does still come down to the discretion and understanding of the project manager, say [ ] the only person that would legitimately sign information out is the project manager”. (Project Manager F)

No document may leave the organization without the correct signature on it, and only certain people are allowed to sign. Other processes are followed when developing new solutions, as they have to go through a control panel where it is decided if the solution can be offered to partners or if it makes the core competences too visible, and has to be kept within the firm, or developed and released at a later stage.

4.1.5 Utilization of reputation

Reputation is an integral part of relational capital and can also function as a protection strategy. This was also confirmed by the case study as one of the best ways of making sure that a partner would not behave opportunistically.

“You know, we could put bad press out about them, if we wanted to, around the clients. Reputation is by far the biggest weapon you have in you armoury. And the biggest threat to make.” (Alliance Manager D)

If a firm has got a reputation of trying to maximize the profit from a collaborative relationship in terms of learning from the partner, this information is likely to be spread to potential new partners. The reputation of a firm is taken into account when choosing between potential partners. Consequently, untrustworthy behaviour on behalf of a firm will have a negative impact on the negotiation strength of that firm when
discussing terms for future alliances (Baughn et al. 1997), as the trust and perceived risk will influence the structure of a collaborative relationship (Ring and Van de Ven 1992).

4.1.6 Guarding customer relationships

The case company is a professional service firm, where knowledge exchange and protection is very important in the day-to-day collaboration with external partners. It is very dependent on its relational capital, both for maintaining partners and finding new suitable partners and customers as illustrated in the previous section. However, the other dimensions of intellectual capital are also needed in order for the firm to have something to offer partners and customers. Hence, the managers of the firm face significant challenges and risks when managing the firm in collaboration and maintaining its competitive edge.

“The biggest concern we have is our client relationships […] that they would miss us out of client relationships. You know, we’ve made the introductions, and they then go into the client and do the deal.” (Alliance Manager D)

4.1.7 Risks

All the strategies identified in the previous section help to protect a firm form several different risks. The first three, retaining staff, creating loyalty and ensuring professional behaviour, are clearly aimed at avoiding the risk of the partner poaching employees. It is also through these strategies that the firm avoids losing the tacit and explicit knowledge that the employees have acquired from their work experience. In addition, some employees possess extensive knowledge about strategic plans and R&D development. However, it could be argued that even though an employee would start working for the partner firm, he/she would not necessarily share all the knowledge and experience he/she possesses from the former employer. Still, there is a risk that will happen, and this risk can be avoided by making sure that poaching does not occur in the first place.

The strategy of gate-keeping will mainly protect the firm against the loss of explicit knowledge. The gatekeeper is the person responsible for signing out drawing and similar material.

The strategy of utilizing reputation could work two ways. On the one hand, a firm with high reputation will easier attract and maintain key employees. On the other hand, a firm can use the threat of spreading bad reputation about a partner’s opportunistic behaviour as a protective strategy.

The final strategy, guarding of customer relationships, can be seen as protection from the loss of explicit knowledge. Usually in a relationship there is also a lot of tacit knowledge involved, such as a personal relation between employees at the supplier and customer firm, which would not be acquired even though the partner would happen to get access to customer records. In the collaborative projects of the case firm there was sometimes an issue about which firm was going to be the one with direct contact to the customers. In these cases, the experience of trust between the two collaborating firms was a critical factor.

4.2 The flows between structural and relational capital

Whereas the previous section presented the flows between the human and the (external) relational capital, this section focuses on the interaction between relational capital and structural capital. The attention hence turns from the employees’ contacts with the partner, to the possibility of the partner acquiring knowledge through, for example, systems, processes or products. Some of the structural capital is tacit in, for example, the problem solving processes and work procedures, and thus not easily imitated. However, when working closely together the partner may also gain insight into such processes. The set of strategies used to control the flows between structural and relational capital differ from each other to a large degree. In the case company six strategies for managing this flow were identified. These are: process for approving new tools, developing classification, time advantage, restricted access to knowledge base, release of only safe documents and packaging knowledge into systems.

4.2.1 Process for approving new tools

Innovations cannot always be immediately released on the market as they might reveal too much about the company’s technical development. Informal processes for avoiding the risk of exposure can even result in the innovations/tools not being released at all, or alternatively with a slight delay so that it no longer reveals the latest technological development.

“There has been situation where we’ve […] put together a business case of a tool and then we’ve found that it actually would be giving away too much competitive edge and we weren’t going to release it … [This is] not really a formal process … So because they go through this process a lot they know really what are the signs to look for within small packages and they can give
you a sort of spine or they might guide you through the appropriate channels to develop" (Project Manager C)

It is interesting to observe that this process, which could prove very important to preserving company core competences, only is informally acknowledged. One would expect such an important part of product development to be mandatory and formally instituted.

4.2.2 Developing classifications

The industry of the case company is still in a developing phase, and there are few established classifications or standards to follow. There is an ongoing competition about who can develop the best classifications, mainly because this will give the company good publicity among the clients.

“We are certainly leading in the number of the actual classifications that are now being written ... We are actually quite careful about how we release the information to the rest [of the partner team]. We’ve become quite conscious as we’ve seen examples where we’ve given away something and they have passed in on [] and we have essentially given it to them for free. Then they have the ability to reuse that somewhere else within their organization. you need to be very careful about those, the intangible property.” (Project Manager A)

Still, developing classification in this context may also give the company substantial competitive advantages if they are accepted on an industry level.

4.2.3 Time advantage

The strategy of time advantage is closely related to the process for approving new tools as this also seems to be an informal process. However, in this case it is all about making sure that the company’s own progress is so far ahead of the partners’, so that releasing an invention will not endanger the company’s competitive edge.

“We need to be quite careful about what we consider to be the crown jewels. We’re not going to release this, and if we are going to release this we need to do it in a very controlled manner. And what we perceive to be less sort of a great innovation or, it’s still, we’ve this far ahead and we’re prepared to release actual innovations that were, say, nine months old or a year old, so that they still are playing catch up but we still look good.” (Project Manager C)

4.2.4 Restricted access to intranet and knowledge base

The case company considered themselves to be a rather transparent and knowledge sharing firm. Still, a clear limit to the transparency was drawn in regards of intranet access and the special knowledge (database where all the knowledge used worldwide was stored. Access to the intranet was guarded, and within some collaborative projects separate intranet systems were provided only for the specific project.

“Company A has [an intranet], which includes a number of forums. If [Partner] has a problem, Company A will post it on their behalf onto the [intranet] and give them the answers that come back. However, they will not give them direct access to the system.” (Alliance manager G)

4.2.5 Release of only safe documents

A quite simple way of making sure that important knowledge stays within the company is by sending out only what is referred to as “dead” knowledge. This manifests itself in simple measures such as converting a CAD drawing to a “flat” PDF file before sending it outside the company, or by using software tools but without giving away the code. Project manager F illustrates this by stating that “we were always happy to share information, [] if it was in hard copy or in a secure document. We got the job done, but we didn’t give away the tools.”

4.2.6 Packaging knowledge into systems

Where knowledge close to the core competences of the firm has to be exposed, the knowledge can be embedded in a product or system so that each component is not easily separated from the rest of the system.

“We are rather protective of particular technological initiatives or advances so, for example, as part of our role of business we have developed some quite clever software packages and business systems as well. And so we tend to protect those rather carefully in terms of the rights of access to them and the rights of use. there are some things as the actual software that we won’t release to them, because we want to retain ownership of a particular software code, but that’s a relatively modest part of it.” (Project Manager A)

This strategy is related to “Causal Ambiguity”. Lippman and Rumelt (1982) used causal ambiguity to describe “the phenomenon surrounding business actions and outcomes that
makes it difficult for competitors to emulate strategies” (Reed & DeFilippi 1990). Reed and DeFilippi (1990) posit that the ambiguity can be a barrier to imitation, due to the tacitness, specificity and complexity of the competences, a view that is shared in this paper. The competences of the firm specific knowledge of a firm are not transparent in the result or processes produced by the combination of these competences.

4.2.7 Risks

The process of approving new tools is interesting, as it works throughout the company, but without being formalized or having to follow any specific processes. The informal approval process is extremely important, as this is where the company’s core competences are protected against the risk for partners getting insights into them. They protect both from the loss of tacit and explicit knowledge, as well as strategic and R&D knowledge.

The strategy of developing classifications is complex, as it actually lies in the company’s interest to eventually release the classifications and get others to use them, otherwise they will not turn into industry wide standards. However, just like the time advantage strategy, it comes down to choosing the right moment to release them. Both strategies are temporal, and hence serve the purpose of protecting strategic and R&D knowledge while it is developing and releasing it at a certain point in time.

The two following strategies concerning restricted access to knowledge base are more formal. The intranet and the knowledge bases are built around the core competences of the company, and not granting partners access to these is a way of protecting the company against loss of both explicit and tacit knowledge. The final strategy, packaging knowledge into systems is a strategy for protecting tacit knowledge.

5. Discussion and conclusions

This paper has analysed the strategies for protection of knowledge within the flows between human, structural and relational capital. Several different strategies have been identified and classified according to the different flows of intellectual capital. Previous research in strategic management has approached the issue, predominantly researchers have commented on the necessity for firms to also protect their knowledge, but without further exploring how. One notable exception is Norman’s (2001) work on protective strategies within a high-technology company, where she finds several of the strategies also discussed in this paper. This paper has further explored the issues highlighted in Norman’s work.

The strategies identified in the empirical material indicate that a single strategy might in fact protect the firm against several risks. The identified strategies are summarized in Table 1 below. Each strategy is considered in relation to the particular risk it is aimed at preventing. Hence the strategy “Ensuring loyalty” can protect the firm not only from the risk of the partner poaching key employees, but may also reduce the other risks discussed introduced in this paper.

As indicated in the, the two strategies that protect the company from most risk and helps balancing the IC flow between structural and relational capital, are the process for 1) approving new tools, and 2) maintaining time advantage. The by far most efficient strategy on the human-relational capital side is, as expected, the strategies aimed at retaining staff and creating loyalty. The balance between loyalties towards the parent company versus to the alliance, joint venture (JV) or acquiring company is an issue that has been discussed in international business (Johnson 1999, Stahl & Sitkin 2004), and no final conclusions have been reached. On one hand it is important that the employees working within the JV develop a sense of shared identity and belonging, but on the other had it is also vital to maintain the ties to the parent company and ensure knowledge transfer back from the JV. As demonstrated in the empirical material, the duality is especially sensitive when expectations of sharing are not the same within the two firms collaborating.
Table 1: Strategies and risks identified in the case company

<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>RISK IN HUMAN – RELATIONAL CAPITAL</th>
<th>RISK IN STRUCTURAL – RELATIONAL CAPITAL</th>
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<tbody>
<tr>
<td>Process for approving new tools</td>
<td>Loss of Explicit, codified knowledge</td>
<td>Loss of Strategic &amp; R&amp;D knowledge</td>
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<td></td>
<td>Identification and poaching of key staff</td>
<td>Exposure of tacit knowledge</td>
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<td></td>
<td>Loss of Strategic &amp; R&amp;D knowledge</td>
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<td>Exposure of tacit knowledge</td>
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<tr>
<td>Gate keeping</td>
<td>Loss of Explicit, codified knowledge</td>
<td>Strategic &amp; R&amp;D knowledge</td>
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<td>Exposure of tacit knowledge</td>
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<td>Loss of Explicit, codified knowledge</td>
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<td>Time advantage</td>
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<td>Ensuring loyalty</td>
<td>Loss of Explicit, codified knowledge</td>
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<td></td>
<td>Identification and poaching of key staff</td>
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<td>Loss of Strategic &amp; R&amp;D knowledge</td>
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<td>Exposure of tacit knowledge</td>
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<td>Conventions of professionalism</td>
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<td>Packaging knowledge into systems</td>
<td>Exposure of tacit knowledge</td>
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<td>Loss of Explicit, codified knowledge</td>
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<td>Restricted access to intranet/ Knowledge base</td>
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<td>Release of safe documents</td>
<td>Loss of Explicit, codified knowledge</td>
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<td>Utilization of reputation</td>
<td>Loss of Explicit, codified knowledge</td>
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<td></td>
<td>Loss of Strategic &amp; R&amp;D knowledge</td>
<td>Identification and poaching of key staff</td>
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<td></td>
<td>Exposure of tacit knowledge</td>
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<td>Guarding customer relationships</td>
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<td>Exposure of tacit knowledge</td>
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<td>Retaining staff</td>
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<td>Loss of Strategic &amp; R&amp;D knowledge</td>
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<td>Exposure of tacit knowledge</td>
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<td>Developing classifications</td>
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<td>Loss of Explicit, codified knowledge</td>
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The strategies for controlling the flows between human capital and relational capital involves the formal conventions according to which the employees interact with and relate to people external to the organization. The employees need to be given some freedom and responsibility, but also to be aware of the risks involved. The situation facing collaborating firms that share knowledge is similar to the situation when staff create/develop new knowledge inside a firm. For knowledge creation to occur within e.g. an R&D department, there has to be space and interaction between employees for the knowledge to flow and ideas to spark. This notwithstanding there is still a need for structures, in order to capture and leverage the created ideas and avoid them from reaching the competitors (Brown and Duguid 2000). Likewise, in inter-organizational collaboration there is a need for structures supporting the knowledge sharing in order to get the collaboration running. Yet strategies that prevent unintended sharing of firm specific knowledge are required to make sure there are no involuntary knowledge leaks.

An interesting observation is that no strategies were identified that could eliminate or decrease the risk of losing competitive benchmarking data. Such information can often readily be obtained externally, and hence a company can do little to prevent partners from acquiring it. Although this kind of information is important, it does to a lesser extent relate directly to the core competences and its loss does seldom have severe consequences for the company.

The limitations to this study are first and foremost that it is a single case study, and based on a limited number of interviews. Still, it gives some very interesting tentative conclusions. In addition, this paper only reports the tentative conclusions of the first stage of a research project. The next step includes research focused on individuals and on their behaviour in a collaborative setting when having to make decisions about sharing or protecting the knowledge of their organization. The area of research is certainly one that deserves more attention, both from an academic and managerial standpoint.
References


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